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Soil Survey
of
Texas County, Oklahoma

By

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and
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Bureau of Chemistry and Soils
In cooperation with the
Oklahoma Agricultural Experiment Station

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SOIL SURVEY OF TEXAS COUNTY, OKLAHOMA

By E. G. FITZPATRICK, United States Department of Agriculture, in Charge, and W. C. BOATRIGHT, Oklahoma Agricultural Experiment Station

COUNTY SURVEYED

Texas County is in the central part of the panhandle of Oklahoma (fig. 1). Its northern boundary is the Kansas-Oklahoma State line, and its southern boundary the Texas-Oklahoma State line. It lies between 36°30′ and 37° north latitude, and between approximately 101° and 102° west longitude. The county is practically rectangular in outline, extending 60 miles from east to west, and 34½ miles from north to south. It includes an area of 2,065 square miles, or 1,321,600 acres.

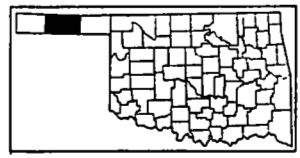

FIGURE 1.—Sketch map showing location of Texas County, Okla

Texas County lies within the subhumid region of the Great Plains. Physiographically it consists of a flat plain, of which approximately 25 percent has been dissected and eroded by North Canadian River (locally called Beaver Creek) and its tributaries. This flat plain is a part of the High Plains, or north plains, which are very extensive in western Texas, Oklahoma, Kansas, and Nebraska. Geologically these plains consist of an apron of debris extending eastward from the Rocky Mountains. It is generally believed that this material was deposited by rivers during and immediately following the uplift of the Rockies. The plains have an elevation of approximately 3,700 feet above sea level along the western boundary of the county and slope very uniformly to the eastern boundary where the elevation is approximately 2,700 feet. This gives the plain a fall of approximately 16½ feet a mile. Elevations [1] of the more important towns on the plains are as follows: Texhoma, 3,483 feet; Guymon, 3,119 feet; Hooker, 2,985 feet; and Tyrone, 2,916 feet.

Topographically the High Plains are in a stage of extreme youth, and drainage channels have not developed. Most of the rainfall is absorbed in the soil or flows a short distance into one of the numerous depressions, where it is either evaporated or percolates downward, joining the underground water. Only a small part of the run-off finds its way into the drainage channels of the "breaks" by surface flow, as much of the land slopes away from the breaks rather than toward them. The depressions range in diameter from 2 feet to nearly a mile, and most of them are circular or oval. They lie from 3 inches to 40 feet below the general level of the surrounding plain. The smaller depressions are locally

[1] GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U.S. Geol. Survey Bull. 274, ed. 4, 1072 pp. 1906.

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called "buffalo wallows" and the larger ones "lakes" or "sinks." They are all covered with water following heavy rains.

Dunelike or rolling relief prevails on those parts of the plains covered by the lighter textured soils, the greater parts of which are in the northeastern quarter of the county.

The breaks, or strongly rolling and eroded lands, occur along the stream valleys, mainly in the southern part of the county. The boundary between the High Plains and the breaks in most places is marked by a sharp slope or low cliff of caliche. Although much of this escarpment is low and inconspicuous, in some places it reaches a height ranging from 75 to 100 feet. The caliche, or cap rock, consists of white or grayish-white limerock, locally called gypsum, but is composed largely of calcium carbonate rather than calcium sulphate. The breaks are very strongly dissected by drainage channels, and their relief and distribution are determined by the drainage of the county.

The drainage of Texas County is controlled by North Canadian River which flows northeastward from a point near the southwestern corner nearly to the center of the county, thence eastward to a point about 11 miles north of the southeastern corner. This stream has two important tributaries, Coldwater and Palo Duro Creeks, joining it from the south, and four less important tributaries, Pony, Goff, Tepee, and Beaver Creeks, from the north, all of which follow a general eastward course. North Canadian River and its two southern tributaries are the only perennial streams. They are fed by springs which occur in places where the channels of the streams have been cut down to the bottom of the Tertiary geological formation. North Canadian River has carved out a trough to a depth of approximately 120 feet, and the total width of its dissected belt ranges from 2 to 7 miles. The valleys of the tributaries are somewhat more shallow and narrow. The rough land in these valleys is thoroughly and deeply dissected by short drainage channels running at right angles to the main valleys. A few remnants of the High Plains occur in these breaks, as small buttes or remnants, which reach a height ranging from 40 to 70 feet[2] above the surrounding eroded land. Most of them are protected by a cap of caliche. Practically all the land in the breaks is well or excessively drained, the only exceptions being small areas of bottom land, or alluvial soils, along the flood plains of streams, which are poorly drained in a few places. Most of the stream channels are shallow and wide, and they have a sandy bed ranging in width from 20 to 75 feet and in depth from 2 to 6 feet below the general level of the stream flood plain.

The native vegetation consists mainly of grasses, the types depending on the character of the soil. Heavy soils on the uneroded plains support a smooth heavy sod of short grasses, together with a few clumps of pricklypear. Most of the short-grass vegetation consists of about 50 percent buffalo grass and 50 percent blue grama, but where the heavy soils are more shallow an admixture of other plants occurs, the more important of which are wire grass, side-oats grama, bluestem, prairie clover, *Psoralea tenuiflora*, partridge-pea, blazing-star, prairie zinnia, niggerhead, dayflower, prairie cone-

[2] Data on elevations and depth of dissection were obtained from the Oklahoma State Highway Department.

flower, *Melampodium leucanthum*, bush morning-glory, and gumweed. In the small buffalo wallows, where more water is available, the grasses are replaced by smartweed, ironweed, erect doorweed, gumweed, and snow-on-the-mountain. In the larger depressions or lakes these plants give way to blueweed and water grass. Lighter textured soils support a more varied vegetation. In addition to the plants growing on the shallow heavy soils, a considerable amount of little bluestem, tall sage grass, yucca, and sand sage grow. The sands and loamy sands support a vegetation of sand sage, tall sage grass, yucca, Indian grass, and sand plum. Bottom soils are covered by a mixture of buffalo grass, blue grama, Johnson grass, and several bottom grasses, with a scattered growth of cottonwood and here and there willow or hackberry along a few of the stream courses.

Plants occurring as weeds in cultivated fields are Russian-thistle, perennial ragweed, bindweed, marestail, tumbling pigweed, grassbur, sandbur, horsenettle, sunflower, cocklebur, lambsquarters, and common thistle. Bindweed appears to be causing the most concern among the farmers because of its perennial growth and ability to choke out all other plants. Definite attempts are being made to exterminate this plant by use of poison sprays. Blueweed is a noxious weed in the vicinity of intermittent lakes. Sandbur and grassbur are troublesome on the lighter textured soils.

The Oklahoma panhandle was claimed successively by Spain, Mexico, and Texas before it became a part of the United States. After the northern boundary of Texas, the southern boundary of Kansas, and the eastern boundary of New Mexico were established this land was left outside the jurisdiction of any State, and its situation earned it the name of "No-Man's Land." Settlement was started about 1880, and a provisional territorial government was established. It was at that time called Cimarron Territory. After the establishment of Oklahoma Territory, this provisional government was lost, and the panhandle was called Beaver County. The first settlements were made along North Canadian River, Palo Duro Creek, and Coldwater Creek, where large cattle ranches were established. Aside from these few cattle ranches very little settlement took place in that part of the panhandle included in Texas County, until 1900. The panhandle was divided into three counties in 1907, Cimarron, Texas, and Beaver. Guymon, near the center of Texas County, was selected as the county seat of that county.

Settlement was encouraged by the building (in 1900) of a main line of the Chicago, Rock Island & Pacific Railway across the area now included in Texas County. A great many settlers came from Texas, Kansas, and eastern Oklahoma, and many from Illinois, Indiana, and Arkansas. Practically all these pioneers were white people whose ancestors came largely from northern Europe. Practically no Negroes and very few Mexicans have settled in Texas County. Settlement was well under way by 1905, and by 1910 the population was practically as large as it is now. Towns were established along the railroad and developed rapidly. From the southwestern corner northeastward along the railway are the towns of Texhoma, Goodwell, Guymon, Optima, Hooker, and Tyrone. Just outside the northeastern corner of the county is the town of Liberal, Kans.,

and a few miles east of the northwestern corner is Elkhart, Kans. Two other towns of importance in the county are Hitchland and Hardesty, located along a more recently built branch of the Rock Island Railway which runs from Amarillo, Tex., to Liberal, Kans.

Although Texas County lies at a considerable distance from the large centers of distribution, it is well supplied with railroads leading to such centers. In addition to the two railroad lines mentioned, it is crossed by the Beaver, Meade & Englewood Railroad and by a branch of the Atchison, Topeka & Santa Fe Railway. Elevators, to facilitate the handling of wheat, are being constructed at practically all the stations on these lines.

There are no hard-surfaced roads outside of the larger towns, but a number of good graded dirt roads make travel very easy during dry weather. A few of these roads are surfaced in places with the calcareous clay or caliche which outcrops around the edge of the breaks. United States Highway No. 54 crosses the county, paralleling the Chicago, Rock Island & Pacific Railway, and United States Highway No. 64 crosses from east to west. The plains parts of Texas County are in general crossed by roads at intervals of 1 mile along each section line, and the more important of these roads are usually kept in good condition during dry weather. Other section-line roads serve as outlets to the better graded roads. Within the breaks, roads are fewer and in many places do not follow section lines.

Rural free delivery of mail is available to the greater part of the county. Telephone communication is provided between the towns and in the rural districts along the lines connecting the towns.

Good graded schools and high schools are located in the towns, and in many places school busses are used to transport pupils from the rural sections. One- or two-room schools are placed at intervals ranging from 4 to 6 miles in the country districts. The Panhandle Agricultural and Mechanic Arts College, which provides excellent opportunities for higher education to the people in this section of the country, is located at Goodwell.

The towns of Texas County are well supplied with churches. Very few church buildings are in the rural sections, but many of the rural schools are used as churches on Sunday.

Throughout most of the High Plains section excellent well water is obtained at a depth ranging from 130 to 200 feet, but within the breaks water is reached at less depth. Water lies at comparatively slight depths in the bottom land, but it is of poorer quality because of the presence of dissolved organic matter. Water obtained from wells drilled into the "Red Beds" in the southeastern part of the county is of poor quality for drinking purposes because of the presence of dissolved gypsum.

The production of natural gas is about the only industry of importance in Texas County, aside from industries directly related to agriculture. The flow of three gas wells is used to supply the towns of Texhoma, Goodwell, Guymon, Optima, and Hooker. One of these wells is north of Texhoma and the other two are north of Guymon. Several other producing gas wells are in the county, but the flow is not being extensively utilized at present. Most of the rural homes located along the gas mains are supplied with natural gas from these lines.

Gravel and sand deposits occur in many places and are utilized to some extent in the production of concrete for local use.

CLIMATE

The climate of Texas County is continental and is subject to sudden changes in temperature. The average annual relative humidity is 61.3 percent, and the average annual precipitation is 18.63 inches. During the summer months temperatures ranging from 100° to 105° F. are often experienced, but because of the low humidity this temperature is not excessively oppressive, and the nights are usually cool. The average daily range in temperature is 31°. The number of clear days a year ranges from 200 to 250. The average wind velocity is 8.79 miles an hour.[8] The climate is generally considered exceedingly healthful throughout the year because of the low relative humidity and the preponderance of dry sunny days. Occasionally winter temperatures drop as low as 20° below zero during "northers", or blizzards. These cold spells rarely last more than 3 days before south winds raise the temperature. The average date of the last killing frost is April 20 and of the first is October 20, giving a frost-free season of 183 days. However, frost has occurred as late as May 22 and as early as September 22.

A very slight increase in the average annual rainfall occurs from northwest to southeast across the county. Approximately 66 percent of the rainfall occurs from May to September, inclusive, although about one-third of the annual rainfall occurs as light rains which add little if any moisture to the subsoil. Approximately one-fourth of the rainfall occurs as heavy dashing rains of 1 inch or more. The winters are uniformly dry.

The amount and distribution of precipitation has a very direct bearing on the agriculture. The low annual rainfall makes the conservation and proper utilization of moisture an important factor in crop production. Fall-sown wheat and late spring-sown sorghum and broomcorn are the principal crops fitting into the climatic conditions of Texas County. Wheat is sown near the end of the rainy season in the fall, and it makes use of the moisture stored in the soil from late summer rains. Wheat passes through the comparatively dry winter in a semidormant stage and is matured in summer by the late spring and early summer rains. The wheat produced is generally of high grade. It has won first place in the International Wheat Exposition because of its high quality. Grain sorghums and broomcorn are very drought resistant and are generally able to utilize the summer moisture and mature a crop in spite of periods of drought and hot dry winds. These crops have the ability to roll up their leaves and remain dormant during dry weather.

With the exception of a few days following rain or snow, it is possible to do some farm work at almost any time during the year, although on the wheat farms little work is performed during winter. On farms where livestock is raised and a more diversified type of agriculture is carried on, more winter work is done.

[8] FINNELL, H. H. THE UTILIZATION OF MOISTURE ON HEAVY SOILS OF THE SOUTHERN GREAT PLAINS. Okla. Agr. Expt. Sta. Bull. 190, 24 pp. 1929

Destructive hailstorms occur practically every summer. These are in general very local, and the probability of a particular farm being damaged by hail is not very great.

Hot dry winds of summer are the most dreaded climatic features. Moisture is evaporated from leaves faster than it can be supplied by the roots, and occasionally the wind parches the leaves to such an extent that they are unable to recover. Crop yields are more often curtailed by hot winds than through lack of rainfall.

Table 1, compiled from records of the Weather Bureau station at Hooker, in the northeastern part of Texas County, gives the more important climatic data which are believed to be representative of the county as a whole.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Hooker, Texas County, Okla.*

[Elevation, 3,038 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1910)	Total amount for the wettest year (1915)	Snow, average depth
	°F.	°F	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	33.5	78	−15	0.56	0.03	0.42	4.0
January	32.8	83	−20	.23	.26	.44	1.8
February	36.2	90	−10	.81	.25	1.87	4.0
Winter	34.2	90	−20	1.60	.54	2.73	9.8
March	45.4	102	−18	.65	(1)	.18	1.0
April	54.7	97	14	1.54	1.11	4.75	1.1
May	63.1	100	19	2.79	.99	6.64	.3
Spring	54.4	102	−18	4.98	2.10	11.57	2.4
June	74.2	112	35	2.47	1.03	5.45	.0
July	78.6	108	50	2.76	3.22	2.09	.0
August	77.6	110	39	2.18	2.39	2.54	.0
Summer	76.8	112	35	7.41	6.64	10.08	.0
September	70.3	106	30	2.12	.06	3.76	.0
October	56.7	98	11	1.74	.02	1.40	.5
November	44.5	88	−5	.78	.03	.05	1.4
Fall	57.2	106	−5	4.64	.11	5.21	1.9
Year	55.7	112	−20	18.63	9.39	29.59	14.1

[1] Trace.

AGRICULTURAL HISTORY AND STATISTICS

As has been stated, settlement of Texas County started along North Canadian River and Palo Duro and Coldwater Creeks, where a supply of water was available. The agriculture at that time consisted almost exclusively of cattle raising. The breaks along these streams were used for pasture and were divided into several large cattle ranches. The plains were used for grazing cattle when the intermittent lakes contained water. It was later discovered that a plentiful supply of good water could be reached at a depth ranging from 150 to 200 feet on the plains, and wells were drilled and wind-

mills installed to provide water for livestock, so that it was possible to utilize more of the land for grazing. Grass in the breaks was then saved for winter pasture because of the shelter provided by the broken land and because of the presence of taller grasses in these localities. These taller grasses were rarely entirely covered with snow, but a few severe winters taught the ranchmen the advisability of having feed to supplement the native pastures. In order to supply this feed the farmers cut and stacked native hay which grew along the stream bottoms.

As settlement of the county progressed, a few of the homesteaders began to break the native sod and grow crops. This resulted in considerable friction between the cattlemen and the farmers, because the cattle from the range often trespassed on cultivated land. The range lands were then fenced to keep the cattle out of cultivated fields. The area of cultivated land continued to expand until it included a very large proportion of the plains, and it is now encroaching on the more rolling land within the breaks. Breaking of the native sod was the only work necessary to put the land in cultivation, as practically no brush or shrubs of any kind grew to interfere with cultural operations.

The new settlers had to learn by experience which crops were adapted to these subhumid or semiarid conditions. Most of them kept a few cattle and left part of their holdings in native pasture. Kafir, milo, sorghum, wheat, and broomcorn were the most important crops, and a small quantity of corn, alfalfa, oats, and barley was grown. The principal changes occurring since that time have been a large increase in acreage devoted to forage crops and a comparatively small increase in wheat growing. Along with this change, the average size of farms has shown a marked increase, which has resulted principally from the introduction of power machinery, as combine harvesters and tractor-drawn cultural implements have made it possible for the farmers to adopt a large-scale type of agriculture. The farms were originally homesteaded in units of 160 acres, but the size has increased gradually until now the most common size is 320 acres. Many farms range from 480 to 640 acres, and some of the wheat farms have a maximum size of 4 or 5 sections. According to census data the average size of farms increased from 247.3 acres in 1910 to 570 acres in 1930. These figures are somewhat misleading because the entire acreage of a farm is tabulated with the county in which the farm homestead is located, although part of the farm may be in an adjoining county.

Table 2 gives the acreage and yields of the principal crops in Texas County, as reported by the census for the years 1909, 1919, and 1929.

The principal varieties of wheat grown in Texas County are Turkey and Blackhull. These are both hard winter wheats. In most years spring-sown grains do not receive enough moisture to mature a satisfactory crop.

The grain sorghums are the second crop in importance. Milo is the principal grain sorghum grown. Beaver milo, Yellow Straight Neck milo, darso, Pink kafir, Dawn kafir, hegari, and feterita are the common grain sorghums. Milo yields more grain than the others, but it produces forage of lower value than the kafirs.

TABLE 2.—*Acreage and yield of principal crops in Texas County, Okla., in stated years*

Crop	1909		1919		1929	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	6,557	33,360	4,435	61,076	9,259	147,131
Wheat	48,732	214,774	151,380	1,727,255	476,678	6,812,782
Oats	4,676	34,668	8,806	173,583	1,985	35,247
Barley	719	4,971	11,637	185,221	13,692	173,899
Potatoes	96	3,095	31	1,182	11	688
Sorghums for grain	68,380	367,658	129,807	2,048,370	58,038	871,571
		Tons		*Tons*		*Tons*
Hay	14,136	12,856	12,311	13,509	5,809	7,191
Clover	50	80	22	11	23	15
Alfalfa	2,350	3,311	1,823	2,024	835	1,171
Tame grasses	4,513	4,640	2,618	3,059	1,225	1,483
Wild grasses	9,126	7,882	7,969	8,592	4,426	5,587
Small grains for hay	497	334	1,530	1,564	145	104
Legumes for hay			194	294	13	17
Sorghums for hay or fodder	37,275	19,915	51,075	71,731	22,490	29,856
		Pounds		*Pounds*		*Pounds*
Broomcorn	23,901	2,655,915	7,737	2,424,988	15,677	4,796,975

Commercial fertilizers are not used. On a few farms barnyard manure has been applied to the more shallow soils and to the irrigated bottom lands used in the production of truck crops.

Ordinarily labor is hired only at harvest time. Such labor is usually itinerant and is paid from $2 to $3 a day. During the last few years the labor supply has been much in excess of the demand, resulting from the adoption of labor-saving machinery for handling crops.

The 1930 census reports 62.3 percent of the farms operated by owners, 37.1 percent by tenants, and 0.6 percent by managers. The marked increase in tenancy has taken place because the farm owner with a small acreage has found it profitable to rent additional land and expand his acreage to make better use of his power machinery. A large number of the tenants are, therefore, also farm owners. In the southeastern corner of the county, however, a larger percentage of the farms are operated by strictly "renting" farmers. Almost all the cultivated rented land is leased on a share basis, as leasing on a cash basis has not found favor because of the uncertainty of crops in this section. The most common form of rental is for the tenant to furnish all equipment and crop expense and to deliver one-third of the crop to the elevator as the landowner's share, but in places where the distance to elevators is great the landlord receives only one-fourth of the crop. Cash rent differs with the type of land and the distance from towns. Leases on wheat farms terminate August 1, and those on row-crop farms terminate in the fall.

The farm buildings commonly consist of a one-story frame house, a garage, and a chicken house. On a few farms a barn and, even more rarely, an implement shed are included in the farmstead buildings. Pioneer houses in this part of the country were dug-outs or half dug-outs, and many of these are still in use in Texas County. Several of the wheat farms have no buildings except a sheet-iron frame building for storing gasoline, oil, and seed. The operators of these farms live in town or on some other farm. In the sections where more diversified farming is engaged in, most of the farms are equipped with barns, implement sheds, and feed racks. Prac-

tically all farms and ranches have one or more windmills for pumping water.

The mechanical equipment of wheat farms of approximately 640 acres extent consists of a 15- to 30-horsepower tractor, an 8-foot one-way disk, three 12-foot or two 16-foot drills, a 12- to 16-foot combine harvester, and a 2-ton truck. On farms where agriculture is more diversified, a 2- or 3-bottom lister, a 2-row cultivator, a 10- to 20-horsepower tractor, of a type suitable for cultivating, and a corn binder are added to the equipment named. Some horses and mules are used on farms in those sections where more diversified crops are grown.

Some poultry is raised on almost all farms to provide a supply of eggs and poultry for local markets, and a few eggs are shipped. Several commercial hatcheries are operated, which supply young chicks to a wide territory in the Southwest. Leghorn, Rhode Island Red, and Plymouth Rock are the principal breeds of chickens raised. Some hogs are raised in the sections of diversified farming. The plentiful supply of cheap grain suitable for hog feed may encourage the expansion of this industry.

Dairying is carried on to some extent on a number of farms to supply the local demand for milk and butter, but it is more extensive in those sections where the agriculture is more diversified. Some of the cream is sold to local creameries. Holstein-Friesian, Jersey, and Guernsey are the principal breeds of dairy cattle.

Most farms on which diversified crop growing is practiced are fenced, in order to make use of all available pasture, and a few beef cattle are raised on these farms to utilize the pasture. Several large cattle ranches are located in the breaks of the principal stream valleys. The large cattle ranches are well fenced, and most of them have large barns and corrals for storing feed and taking care of the livestock. Practically all the cattle on these ranches are grade Herefords. The ranges are stocked at the rate of approximately 30 or 40 cattle a section, but, where supplemental feeding is practiced, as many as 60 or 70 head are pastured on a section. The cattle are generally raised on native pasture with some supplemental feeding of coarse forage and cottonseed meal during the winter. Very little of the livestock is fattened, or finished, in this section, as most of the cattle are shipped farther east for fattening. A few sheep are raised on the ranges in the southeastern part of the county, and a few saddle horses are raised on the cattle ranches.

SOILS AND CROPS

The soils of Texas County are, as a rule, naturally fertile, because they have developed under a grass cover and a comparatively low rainfall. The grass cover has added considerable nitrogen and organic matter to the soil, and very little leaching of plant-food elements from the soil has taken place, owing to the low annual rainfall. This low rainfall has also hindered rapid removal of plant food from the soil by crops and has, therefore, helped to maintain the natural fertility.

Moisture supply is the limiting factor in crop production on the smooth lands of the county, and the low rainfall makes it necessary to conserve and utilize the precipitation as efficiently as possible.

This is accomplished by growing crops best adapted to the prevailing subhumid conditions and by preventing unnecessary losses of moisture.

Winter wheat, milo, kafir, sorghum, broomcorn, and Sudan grass are the principal crops which have proved well adapted to the natural conditions existing in this section. Winter wheat is well adapted because it passes through the comparatively dry winter season in a semidormant stage and is matured by the early summer rains. Most of the winters are not severe enough to cause any great amount of winter-killing of wheat, and wheat yields in normal years range from 10 to 15 bushels an acre. Partial failure of the wheat crop occurs about 1 year in every 4. The grain sorghums and related crops are drought resistant because of their ability to roll up their leaves and become semidormant during periods of drought and to resume growth when conditions become more favorable. Another factor contributing to the adaptability of the sorghum crops is the fact that their comparatively short growing season occurs during the rainy season. Yields of milo during normal seasons range from 15 to 20 bushels an acre, and total failure of this crop is comparatively rare. Grain yields of the kafirs and hegari are usually from 70 to 80 percent of milo yields, but they produce a more valuable type of forage. Yields of broomcorn during normal seasons range from 100 to 150 pounds an acre.

Approximately 61 percent of the land of Texas County is in cultivation, and the relative acreages of the adapted crops are determined largely by economic factors. On account of the economic advantages of wheat production over grain-sorghum production, it is carried on almost exclusively on large areas of the smooth plains. Approximately 48 percent of the land in the county was devoted to the production of wheat in 1930. On the lighter textured and more rolling land the grain sorghums and related crops are of more importance. Approximately 13 percent of the land was devoted to milo in 1930. The predominance of wheat on the smooth land results from the fact that this crop yields a greater net profit than the grain sorghums during normal seasons. This greater net profit is because wheat is produced at a lower acre cost. This crop requires no attention between seedtime and harvest, and it can be harvested with a combine harvester; whereas the grain sorghums require cultivation and are generally harvested by hand or with a header. The growing of straight-necked milo hybrids, which may be more easily harvested with the header or with the combine harvester, may contribute to a greater popularity of this crop in the future. Closer spacing of milo to reduce tillage and use of livestock in harvesting may also influence the comparative importance of this crop in Texas County.

The greatest expansion of wheat growing has occurred during the last 7 years. During this time droughts have been infrequent compared to previous years. Farmers state that as many as 3 or 4 successive years of wheat failure have occurred in parts of Texas County in previous years. During the years of wheat failure, grain sorghums produced to some extent. In the event of a recurrence of such conditions, the grain sorghums may possibly become more popular.

Broomcorn is grown on a large acreage in a few sections. The demand for this crop is very limited and operates against the expansion of the acreage devoted to it.

Cowpeas, tepary beans, and sweetclover are grown only in an experimental way. Alfalfa is successfully grown on the bottom lands where an underground supply of moisture is available. At different times attempts have been made to grow cotton but with very little success. Yields of the varieties grown at present are too low to warrant the production of cotton in competition with the other crops now grown in this section.

Fruits and vegetables are grown only for home use, as a rule, because climatic conditions are not favorable for these crops.

Within the breaks, the raising of livestock is the most important industry. On the livestock farms or ranches, milo, hegari, kafir, and the sweet sorghums are grown for grain and forage to supplement the native pasture. Wheat is not extensively grown on this land because the relief is so rough that power machinery cannot be used in most places.

As most of the soils contain sufficient plant food, the choice of crops to be grown is determined largely by surface relief and texture of the soil. The texture of the surface soil is of considerable importance because of the tendency of the lighter textured soils to blow during the dry, windy, spring months. Land, which is being cropped to sorghum or some other row crop, can be left unplowed during the winter and spring, and the protection afforded by stubble will prevent blowing in most places. Land cropped to wheat must necessarily be stirred in the fall and is, therefore, in condition to blow if the soil is of light texture; and the blowing of the lighter textured soils cuts the young wheat plants off at the surface of the ground. The lighter textured soils are generally preferred for row crops because they absorb moisture rapidly and give it up to plants readily. Heavier textured soils are preferable for wheat production because of their ability to retain moisture during the dry winter months.

Although the importance of soil texture is recognized by the farmers, they usually give more consideration to the surface relief of their lands in their choice of a cropping system. Land with smooth or flat surface relief is generally cropped to wheat because it allows the use of tractor-drawn cultural implements and the use of the combine in harvesting. The greater part of the more rolling land is used for the production of row crops or for grazing land.

The soils of Texas County are placed in four agricultural groups, based on their adaptability to different crops and cropping systems as follows: (1) Wheatland, (2) diversified crop land, (3) pasture and row-crop land, and (4) grazing land.

Although their adaptability to the various uses is largely determined by soil character and surface relief, economic factors may at some later date change the method of utilizing these soils.

The soils classed as wheatland are heavy, deep, excellent agricultural soils occurring on smooth surface relief. Richfield silt loam is the only representative of this group. Diversified crop land consists of good agricultural soils of medium or light texture, occurring on smooth or gently rolling surface relief. This group includes Pratt fine sandy loam, Pratt loamy fine sand, Potter silt loam,

smooth phase, Potter fine sandy loam, smooth phase, Lincoln fine sandy loam, Lincoln loamy fine sand, and Lincoln fine sandy loam, high phase. Pasture and row-crop land consists of strongly rolling or steep land of different textures. This group includes Potter silt loam, Potter fine sandy loam, Potter loamy fine sand, Pratt loamy fine sand, dune phase, Vernon very fine sandy loam, and Randall clay. Grazing land consists of land unsuited to crop production because of rough broken surface relief. This group includes Potter

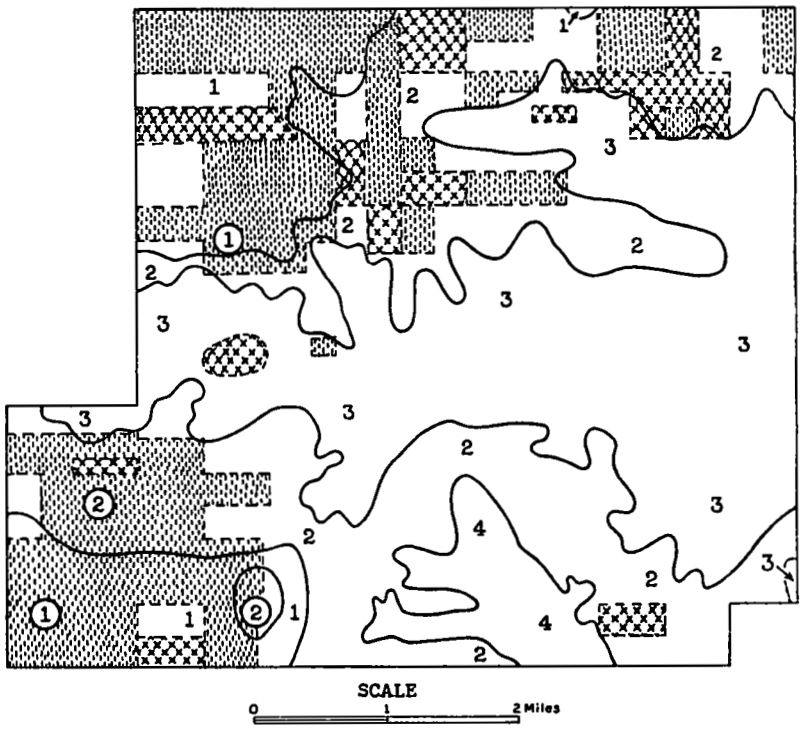


FIGURE 2.—Representative area of land in Texas County, Okla., showing the crop utilization of the soils of the four agricultural groups in 1930.

loamy fine sand, broken phase, dune sand, Vernon soils (undifferentiated) eroded phase, and rough broken land.

Figure 2 is a crop map of a representative area in Texas County, which illustrates the use of the soils of the different agricultural groups during the season of 1930.

The different soils in each county covered by a soil survey are classified according to their characteristics and are given names in order to facilitate their description. In the following pages of

this report the soils in Texas County are described, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 3.

TABLE 3.—*Acreage and proportionate extent of soils mapped in Texas County, Okla.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Richfield silt loam	450,816	34.1	Pratt loamy fine sand, dune phase	9,728	0.7
Pratt fine sandy loam	237,696	18.0	Vernon very fine sandy loam	5,376	.4
Pratt loamy fine sand	51,968	3.9	Randall clay	2,816	.2
Potter silt loam, smooth phase	126,976	9.6	Potter loamy fine sand, broken phase	52,736	4.0
Potter fine sandy loam, smooth phase	78,080	5.9	Vernon soils (undifferentiated), eroded phase	3,328	.3
Lincoln fine sandy loam	19,200	1.5	Rough broken land (Potter material)	41,216	3.1
Lincoln loamy fine sand	21,760	1.6	Dune sand	13,056	1.0
Lincoln fine sandy loam, high phase	5,888	.4			
Potter silt loam	31,232	2.4	Total	1,321,600	
Potter fine sandy loam	104,192	7.9			
Potter loamy fine sand	65,536	5.0			

WHEATLAND

Richfield silt loam.—Richfield silt loam is the important wheat soil in Texas County, covering 704.4 square miles, or 34.1 percent of the total area. It is typical "tight land" of the High Plains, has a comparatively heavy texture, and occurs in broad, smooth, almost flat areas on the uneroded parts of the High Plains. It is the most productive soil in the county, as it is well supplied with organic matter and the mineral elements necessary for plant growth. Its flat surface relief renders it free from erosion and excessive loss of moisture by run-off and allows the use of power machinery. Even though the surface relief is flat, the land is well drained because of the comparatively low rainfall.

The surface soil in most areas is well granulated, giving this material a good physical character, notwithstanding its rather heavy texture which protects it from destructive wind erosion. This is a very important factor in wheat growing, because soil blowing frequently cuts wheat plants off level with the ground in late winter and early spring on the lighter soils. The heavy compact subsoil absorbs moisture slowly and retains it remarkably well. This condition makes Richfield silt loam particularly adapted to the growth of wheat, because this crop needs a good supply of moisture during the comparatively dry winter and spring.

The average annual yield of grain sorghums on this soil is approximately 30 percent greater than the wheat yield, but notwithstanding this fact, about 78 percent of its total area is used for the production of wheat and only 8 percent for the production of row crops. This tendency toward a one-crop system is because of the economic advantage of using power machinery in cultural operations and in harvesting the wheat crop (pl. 1, *A*).

The 4-inch surface layer of Richfield silt loam is loose dark-brown or very dark brown silt loam containing no white caliche gravel. The subsoil is dark-brown silty clay loam that breaks into hard block-shaped clods when dry. At a depth ranging from 12 to 18

inches, the material is grayish brown because of the presence of numerous white spots and specks of lime. The grayish-brown layer extends to a depth ranging from 40 to 50 inches and is underlain by yellowish-brown or faintly reddish brown loose clay containing a few white lime spots. In some places the surface soil approaches silty clay loam in texture, and in others it is very fine sandy loam. In a few gently rolling areas, this soil appears slightly red. The red spots are comparatively scarce and nowhere cover large areas. Small bodies of this soil are underlain by beds of hard caliche which resembles limestone, but such areas are of no particular agricultural significance.

Although the surface relief of areas of this soil is comparatively flat, the land in most places has a fall of approximately 16½ feet a mile. Under virgin conditions the soil suffers very little from erosion and run-off, although, after the land is put in cultivation, considerable loss of water takes place from run-off, and some loss of the surface soil through erosion. The construction of a system of level terraces has proved valuable in conserving the precipitation.[4]

High natural fertility and comparative resistance to losses through erosion are factors which contribute to the present fertility of this soil and help in maintaining the fertility for a considerable length of time. A cropping system which adds no organic matter to the soil may eventually reduce the fertility to a noticeable degree and necessitate a change in the farming system.

Richfield silt loam is the most extensive soil in Texas County. Many large areas on the flat eroded parts of the plains range from 20 to 100 square miles in extent. Several small areas range from one-eighth to 1 square mile in extent, but their aggregate area is not large. The principal areas of Richfield silt loam occur immediately north of the breaks of North Canadian River and Goff Creek. This large plain, extending northward into Kansas, is predominantly Richfield silt loam, with the exception of the northwestern corner of Texas County and along the State line north of Hooker and Tyrone. Several comparatively large areas of lighter textured soils occur within this belt, particularly in the eastern part of the county. Another section in which Richfield silt loam predominates is between the breaks of Goff Creek and Beaver Creek, and another area is south of the North Canadian River breaks and north of Frisco and Coldwater Creek breaks. Two small areas occurring near Range are the only areas of this soil within the breaks in Texas County.

At present (1930) approximately 78 percent of this soil is cropped to wheat, 8 percent is in row crops consisting of milo, kafir, sorgo, and broomcorn, and 14 percent is in native sod. Yields of crops on all soils in the county differ so widely from one season to another that statements of yields are sometimes misleading. Crops of wheat on Richfield silt loam range from total failure to 50 bushels an acre, but in normal seasons the average yield is between 10 and 15 bushels. Acre yields of milo range from 5 to 30 bushels with an average of about 18 bushels. Kafir, feterita, and hegari are grown on a very small acreage and produce about 70 or 80 percent as much as milo.

[4] FINNELL, H. H. HEAVY PLAINS SOIL MOISTURE PROBLEMS. Okla. Agr. Expt. Sta. Bull. 193, 8 pp. 1929.

Sorgo yields from one-half ton to 3½ tons of forage. Broomcorn is seldom grown on this soil, but when grown it yields from 100 to 300 pounds an acre. Alfalfa and corn have been tried but generally have not proved successful.

Apples, pears, sour cherries, and grapes are grown in small home orchards, and vegetables, generally irrigated with water from windmill pumps, are grown in small home gardens.

Prices of land are so variable, because of changing economic conditions, that definite figures are apt to be misleading, and in this report the values of all other soils in the county are given on a percentage basis, using Richfield silt loam as a standard of value.

Grazing afforded by native pasture on this soil is considered the best in the county, and although the land is generally considered too valuable for crop production to be left in native pasture, on many farms a small plot is kept in grass for pasture. Before breaking, this soil is covered by a heavy, smooth sod of buffalo grass and blue grama.

DIVERSIFIED CROP LAND

Nearly half the area covered by the diversified crop land group of soils is classified as Pratt fine sandy loam. Other important soils in the group are Potter silt loam, smooth phase, Pratt loamy fine sand, and Potter fine sandy loam, smooth phase. Less important soils are Lincoln fine sandy loam, Lincoln fine sandy loam, high phase, and Lincoln loamy fine sand.

These soils are medium or light textured, and they occur on gently rolling surface relief. They are used to a large extent for the production of wheat because the smooth surface relief makes possible the use of power machinery in harvesting the crop. These soils are, however, not so well adapted to wheat growing as the soils of the wheatland group because of their greater tendency to blow and their lower capacity to retain moisture during dry winters. A large acreage is planted to row crops, to which the soils are particularly adapted because of their ability to absorb moisture readily and to release it rapidly when demanded by the crops. All these soils are sufficiently well supplied with the nutrient elements necessary for the production of crops, but they are lower in content of both organic matter and mineral plant nutrients than Richfield silt loam and will probably show decreased crop yields at an earlier date, although a factor operating in the maintenance of their fertility is the more diversified system of cropping followed on these soils.

This group of soils covers an area of 846.2 square miles, or 40.9 percent of the county. The individual soil areas of members of the group are in general smaller than those of Richfield silt loam. Most of them occur as a belt or fringe along each side of the rolling and eroded lands of the breaks of the larger stream courses. A belt of these soils extends across the plains in the northwestern corner of the county, and another belt is in the northeastern quarter. The latter belt extends in an almost unbroken area along the Kansas-Oklahoma State line for a distance of 36 miles. Southward from this belt the soils of this group are intermingled with the wheatland soils.

Pratt fine sandy loam.—Pratt fine sandy loam is similar to Richfield silt loam, the principal difference being that Pratt fine sandy

loam occurs in slightly more rolling or undulating areas, is lighter textured in both surface soil and subsoil, is slightly lighter in color in the surface soil, and the subsoil is brown or faintly reddish brown. This soil is locally called "sandy mixed loam." The 4-inch surface layer is very loose and friable dark-brown fine sandy loam. The subsoil in most places is dark-brown sandy clay that breaks into firm block-shaped clods when dry. A gray lime layer occurs at a depth ranging from 18 to 30 inches. The organic matter and mineral plant-food supply of the soil is somewhat less than that of the tight land, but it is sufficient for crop production at present. Long-continued crop production under a system in which no provision is made for maintenance of fertility will probably cause this soil to decline in productivity more rapidly than the tight land. Crop failures are said to be more rare on this than on any unirrigated soil in the county.

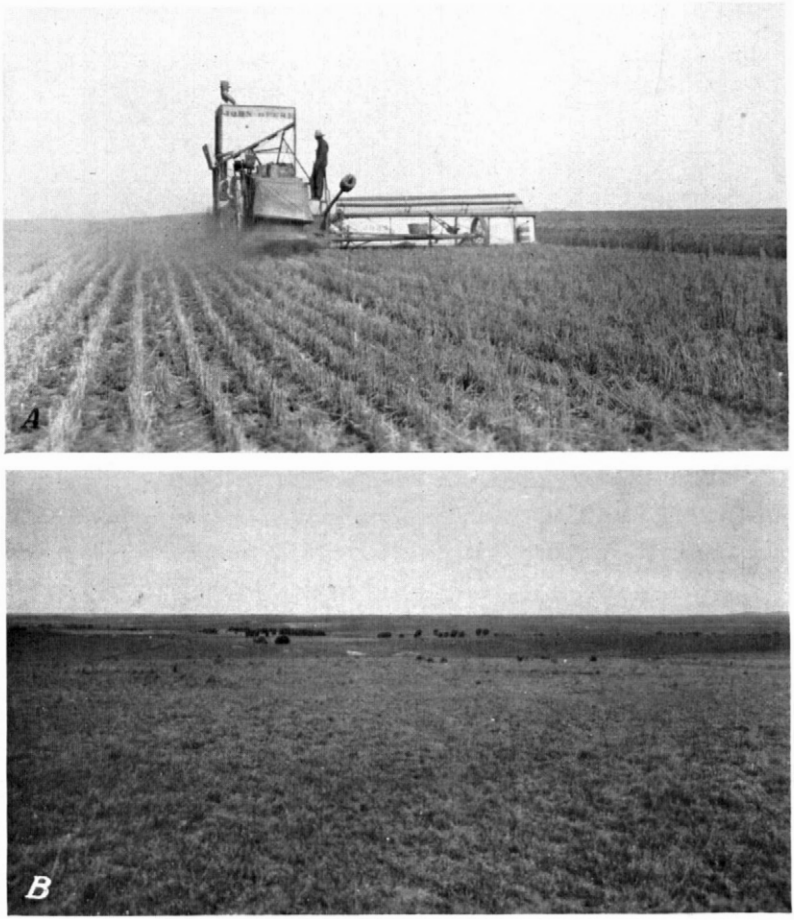
Pratt fine sandy loam ranks second in total area and in agricultural importance. It covers an area of 371.4 square miles, or 18 percent of the land in the county. With the exception of two areas east of Range, this soil occurs only on the uneroded High Plains. It occurs in comparatively large areas, associated with Richfield silt loam, in the northeastern quarter of the county where it covers approximately one-third of the land surface; narrow and almost continuous belts lie along both sides of the breaks of Goff Creek; an extension from the belt north of this creek follows approximately along the line of the Santa Fe Railroad to the Kansas-Oklahoma State line in the northwestern corner of the county; and a few small areas are in the southwestern corner and around the head of Tepee Creek.

Approximately 72 percent of the land is used for the production of wheat; 16 percent for the production of row crops, principally milo, with a small acreage of kafir, sorgo, and broomcorn; and 12 percent is in native pasture.

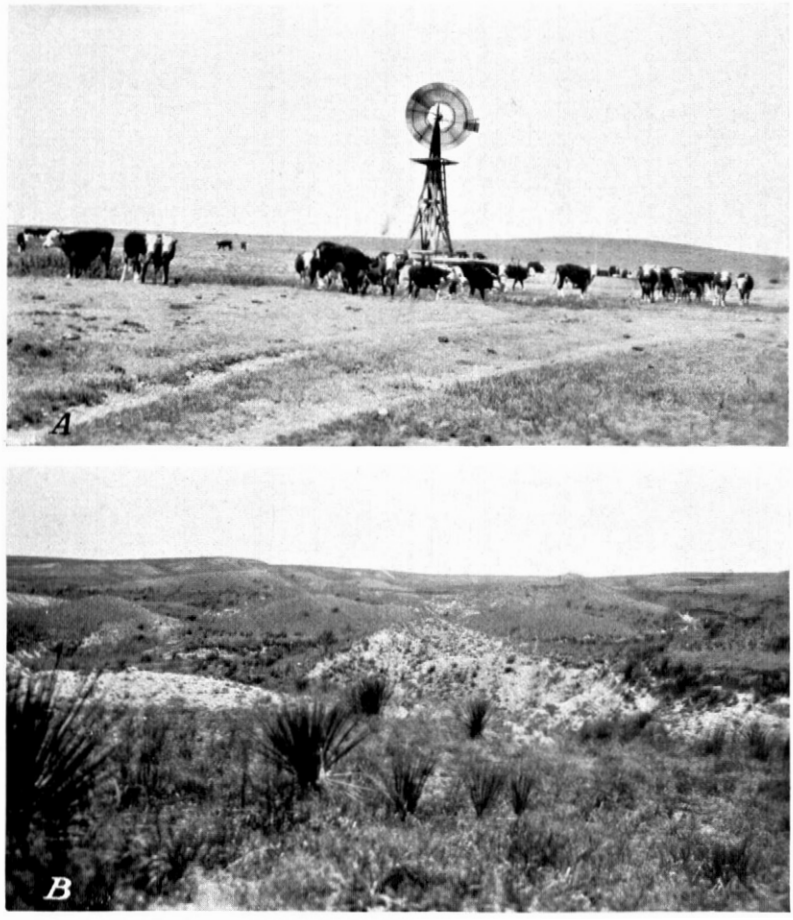
Pratt fine sandy loam, together with Potter silt loam, smooth phase, are better adapted to wheat production than the other members of this group, because they are heavier textured and less subject to blowing. Acre yields of wheat in normal years on Pratt fine sandy loam are only slightly less than those on the tight land, ranging from total failure to about 40 bushels, with an average of 9 bushels. This would seem to indicate that this soil is almost as good for wheat production as is the tight land, but the blowing incident to wheat production sometimes causes failures. Acre yields of milo range from 8 to 30 bushels, with an average of 20 bushels. Sorgo grown for forage produces from one-half to 4 tons an acre, with an average of 1 ton. Small quantities of broomcorn, Hungarian millet, and corn are grown.

Fruit and vegetable crops are produced in small home orchards and gardens and usually are more productive on this soil than on the tight land. Apples, peaches, and sour cherries are the principal fruits, and vegetables grown in small home gardens include watermelons, cantaloups, cucumbers, onions, peas, potatoes, carrots, turnips, beets, lettuce, cabbage, and tomatoes.

Native pasture on Pratt fine sandy loam is not so good as that on Richfield silt loam. The Pratt soil supports a fairly luxuriant



A, Wheat harvest on Richfield silt loam *B*, Smoother areas of pasture and row-crop land within the "breaks"



A, Range cattle on Potter fine sandy loam *B*, Grazing land, showing rough relief and natural vegetation

growth of buffalo grass and grama, with a small amount of wire grass and bluestem.

Pratt fine sandy loam currently sells at approximately 85 to 90 percent of the selling price of Richfield silt loam.

Pratt loamy fine sand.—Pratt loamy fine sand is very similar to Pratt fine sandy loam. It is locally called "sandy mixed land", or merely "sandy land." This soil differs from Pratt fine sandy loam in being lighter textured and lighter colored in both surface soil and subsoil, in being somewhat deeper to the lime layer, and in its occurrence in slightly more strongly rolling areas. The 4-inch surface soil is brown or faintly reddish brown loamy fine sand. The subsoil is brown or reddish-brown fine sandy loam or sandy clay. It is underlain by a gray lime layer at a depth ranging from 3 to 5 feet. This soil is easily penetrable by plant roots to a greater depth than the other upland agricultural soils in Texas County, crop roots in many places extending to a depth of 5 or 6 feet. Although the organic-matter and mineral plant-food content of this soil are sufficient for crop needs at present, they may not continue so indefinitely unless some provision is made for returning these constituents to the soil.

Pratt loamy fine sand covers an area of 81.2 square miles, or 3.9 percent of Texas County. Practically all of it occurs on the plains north of the North Canadian River breaks, the most extensive areas lying just south of the Kansas-Oklahoma State line north of Mouser and Hooker. A narrow belt lies between the heavier plains soils and the breaks of Goff Creek, an area is in the extreme northwestern corner of the county, and an area lies southeast of Adams. Most bodies of this soil are fairly large, ranging in size from one-half to 4 square miles. In most places this soil is associated with Pratt fine sandy loam.

Approximately 36 percent of the land is used for the production of wheat; 52 percent for row crops, including milo, kafir, sorgo, broomcorn, and corn; 1 percent for miscellaneous crops; and 11 percent for native pasture.

The light texture of both surface soil and subsoil renders this soil much better adapted to the production of row crops than of wheat, although the figures given indicate that a great deal of wheat is grown. This is a result of economic conditions rather than soil adaptation. Yields of wheat average about 8 bushels an acre. Many areas of this soil occur on sufficiently smooth surface relief to allow the use of power machinery. The tendency of the soil to blow is much more marked than of Pratt fine sandy loam.

This soil is well adapted to the production of grain sorghums and sorgo. Acre yields of milo range from 8 to 30 bushels, with an average of 20 bushels, and yields of broomcorn are only slightly less than on Pratt fine sandy loam. Pratt loamy fine sand is probably better adapted to the production of kafir and corn than any other unirrigated soil in the county, because of its greater depth and its ability to absorb moisture and give this up readily to the growing plants. These two crops are somewhat more sensitive to a deficiency of moisture than the other row crops grown in the county. Acre yields of corn range from 10 to 30 bushels, with an average of 15 bushels.

Pratt loamy fine sand is probably one of the best fruit soils, and home orchards are usually planted on this soil where possible. Apples, compass cherries, peaches, sour cherries, and grapes produce fairly well during favorable seasons, but apricots apparently have but little possibility except as ornamental trees. Vegetable crops are grown to some extent for home use, and, as these crops generally need more water than is supplied by the natural precipitation, water from windmill pumps is used for irrigating the gardens.

Native pasture is in general of low value because of the sparse and coarse grass vegetation. Sand sage is the predominant vegetal cover, and Indian grass, tall sage grass, and bluestem are the principal grasses.

The current selling price of this soil is about 80 or 85 percent of the price of Richfield silt loam.

Potter silt loam, smooth phase.—Potter silt loam, smooth phase, is a soil of somewhat different character from the members of the Richfield and Pratt series, which have been discussed. This soil, instead of being dark brown, is brown when moist and has a distinctly ash-gray appearance when dry. It has a small content of white lime or caliche gravel in both surface soil and subsoil. These gravel are nowhere present in the typical surface soil of the Richfield and Pratt soils.

The 8-inch surface layer of Potter silt loam, smooth phase, is granular silt loam, and below this is slightly lighter colored material. No hard blocklike clods occur in the subsoil, such as occur in the subsoil of Richfield silt loam, but, in many places, beds of hard white caliche lie at a depth ranging from 2 to 4 feet. This soil is locally called "ashy land", and it is recognized as being less valuable than Richfield silt loam. It is more shallow and lower in content of organic matter and mineral plant nutrients than Richfield silt loam, although the supply is adequate for plant needs at present. This soil occurs in smoothly sloping areas and, because of the loose granular structure of the surface soil, is subject to some erosion during the heavy summer rains and also to wind erosion. The small granules are about the size of sand grains and are easily moved by either water or wind, which results in a gradual decline in the productivity of the soil when the covering of native grass is removed. This factor should be taken into consideration in planning cropping systems, and terraces should be installed to minimize loss by erosion.

The smooth phase of Potter silt loam covers an area of 198.4 square miles, or 9.6 percent of the county. Most of it occurs on the slightly sloping areas extending from the edge of the breaks back to the flat uneroded soils of the plains. An extensive body forms a belt, ranging from one-fourth to 2 miles in width, around the edges of the flat plain between Coldwater and Hackberry Creeks in the southeastern part of the county. A nearly continuous body extends northward and eastward from the head of Frisco Creek along the south rim of the North Canadian River breaks to the junction of Coldwater Creek. Large areas of this soil in the western part of the county occur along the breaks on both sides of Tepee Creek. A few smaller bodies are in other parts of the plains, and a few small areas lie within the breaks near Range.

Approximately 44 percent of the land is used for the production of wheat; 16 percent for row crops, which are largely milo but

include some kafir and sorgo; and 40 percent is in native pasture. This soil is adapted to the production of both wheat and the drought-resistant row crops, but it is more commonly used for wheat because of its comparatively heavy texture and occurrence on smoothly rolling surface relief. Because this soil has a more loose and friable subsoil than the tight land, it is not so efficient in holding moisture during the long dry periods of winter and early spring. This factor operates against high yields of wheat during dry years.

Several types of plants are affected with chlorosis when grown on this soil, which condition is recognized by the green leaves becoming pale or almost white, and badly affected plants are stunted. This condition affects sorghums, legumes, fruit trees, flowers, and ornamental shrubbery. It is not serious among field crops, because usually only a small proportion of the plants are affected, but when it occurs on ornamental plants around homes it causes much more concern. The occurrence of chlorosis seems to be explained by the excessive amount of lime in the soil. The application of copperas or some other iron compound to the soil often causes plants to resume their natural green color.

Yields of all crops on this soil are practically the same as on Richfield silt loam during favorable seasons, but they fall slightly below those on the tight land during unfavorable seasons. The native pasture is excellent but not so good as on Richfield silt loam. This land is covered by a smooth heavy stand of buffalo grass and blue grama, with considerable wire grass, side-oats grama, and a few flowering plants (largely legumes and compositae).

Potter silt loam, smooth phase, currently sells for 85 or 90 percent of the selling price of Richfield silt loam.

Potter fine sandy loam, smooth phase.—Potter fine sandy loam, smooth phase, differs from Potter silt loam, smooth phase, in being lighter textured and having a lower content of organic matter and mineral plant food. In places it contains a somewhat greater quantity of white "gravel" or caliche fragments than is present in Potter silt loam, smooth phase. It has the ability to absorb moisture rapidly but, as it occupies sloping or rolling areas, a great deal of the precipitation is lost by run-off following heavy rains. This soil is locally called "ashy land" or "ashy sandy land." It covers 122 square miles, or 5.9 percent of the county. It occurs in fairly continuous narrow belts on the edges of the plains bordering the breaks, similar to the occurrence of Potter silt loam, smooth phase. Most of this soil is in the southern and southwestern parts of the county. A narrow irregular strip borders the breaks of North Canadian River and Beaver Creek northwest of Texhoma, an area lies north of the Frisco Creek breaks, and a body is south of these breaks in the vicinity of Prairie View School. An important area is near Pleasant Valley School south of the breaks of Goff Creek, and a few smaller areas occur along the Goff Creek breaks and in other parts of the plains.

Approximately 41 percent of Potter fine sandy loam, smooth phase, is used for the production of grain sorghums and broomcorn, 15 percent for wheat, and 44 percent is left in native pasture. Although this soil is less valuable for crop production than the soils previously discussed, it is fairly productive when the moisture supply is adequate. It is subject to both wind and water erosion, and the

productivity decreases after the native sod is removed, hence it is advisable to either leave the land in native grass or to install a system of terraces to check the loss from erosion.

Acre yields of wheat range from crop failure to approximately 25 bushels, with an average of 6 bushels, and yields of milo range from 5 to 25 bushels, with an average of 15 bushels.

This soil is apparently too shallow for the successful production of corn or fruit. Chlorosis, similar to that occurring on Potter silt loam, smooth phase, affects plants grown on this soil.

The native pasture is much inferior to that on the heavier soils, this land being covered with a more sparse growth of buffalo grass and blue grama, a large proportion of bluestem, several small legumes, and a small amount of sand sage. This land is used more largely for pasture because of its lower comparative value for the production of crops.

The current selling price of Potter fine sandy loam, smooth phase, ranges from 70 to 80 percent of that of Richfield silt loam.

Lincoln fine sandy loam and Lincoln loamy fine sand.—Lincoln fine sandy loam and Lincoln loamy fine sand are bottom-land soils occurring in long narrow strips along the more important streams. They have grayish-brown or brown surface soils which extend to a depth of about 12 inches. The subsoils are light-brown or yellowish-brown very fine sand. In most places water is reached in the subsoils at a depth ranging from 2 to 8 feet.

The surface relief of these soils is generally flat, and the land is cut to a slight extent by stream courses. The land lies at an elevation ranging from 4 to 8 feet above the stream channel and is subject to overflow when the streams are at flood stage. These soils, like most bottom soils, are well supplied with the nutrient elements, and their supply is periodically replenished by floods. They are productive when crops are not damaged by overflow.

These soils cover an area of 64 square miles, or 3.1 percent of the county. A few small areas are poorly drained and not suited to the production of crops, the more extensive of such areas being indicated on the map by marsh symbols. Some of the poorly drained spots are affected by alkali or an excess of soluble salts, but this condition occurs on a small total area and is not troublesome on the better drained parts of these soils.

Approximately 8 percent of the land occupied by these soils is in cultivation, and the rest is used for the production of native hay and pasture. Of the land in cultivation, approximately 50 percent is in alfalfa, 30 percent in sorghums and corn, and 20 percent in vegetable crops and fruits. These are the only soils on which alfalfa is an important crop, and they are adapted to alfalfa production principally because of the underground supply of soil moisture. The profitable production of this crop usually requires more water than is supplied by natural precipitation in the uplands of this county. On these soils alfalfa usually produces four cuttings of hay with a total yield of 3 or 4 tons an acre. Wheat yields from 25 to 40 bushels, and sorghum crops do well when not damaged by floods. Fruit trees and vegetables succeed fairly well without additional water.

Several areas of these soils are irrigated by water diverted from the streams. The principal private irrigation projects are along

Palo Duro and Coldwater Creeks. These are the only irrigated soils in the county, aside from small gardens which are irrigated from windmills. Practically all the commercial production of vegetables is on these two soils, the greater part on Lincoln fine sandy loam. Where vegetables are grown it is common practice to manure the land occasionally. Weeds are difficult to control on the irrigated land, because they make a very vigorous growth.

The greater parts of these soils are utilized for the production of hay and pasture. The natural vegetation consists of a heavy stand of water grasses, little bluestem, buffalo grass, needlegrass, blue grama, side-oats grama, tall bluestem, and a few legumes and other flowering plants.

These soils are valued higher than the other land in the breaks, but they are generally sold with some of the adjoining range land. Their current value ranges from 25 to 50 percent of the value of Richfield silt loam, although the irrigated land is considered more valuable than these figures indicate.

Lincoln fine sandy loam, high phase.—Lincoln fine sandy loam, high phase, is similar to typical Lincoln fine sandy loam, but it lies on benches bordering the bottom land at a slightly higher elevation. In agricultural adaptation and production it is practically the same as Potter fine sandy loam, smooth phase. The water table lies at a much greater depth than in typical Lincoln fine sandy loam.

This soil covers an area of 9.2 square miles. A few small bodies occur along the edge of the bottoms of North Canadian River near Guymon and along Coldwater Creek. Approximately 10 percent of the land is cropped to grain sorghums, and the rest is in native pasture.

PASTURE AND ROW-CROP LAND

The principal soils included in the group of pasture and row-crop land are Potter silt loam, Potter fine sandy loam, and Potter loamy fine sand, and the less important members are Pratt loamy fine sand, dune phase, Vernon very fine sandy loam, and Randall clay. The soils of this group are largely used for grazing because of their occurrence on strongly rolling relief, although approximately 10 percent of their area is cultivated to row crops. These are the principal soils occurring in the physiographic division known as the "breaks" (pl. 1, *B*), or low rolling plains.

This group of soils covers an area of 342 square miles, or 16.6 percent of the county. The principal areas occur in a belt ranging from 1 to 6 miles in width along the course of North Canadian River, and narrow branches of this belt extend up the courses of different tributaries of this stream. A few small areas are associated with sand dunes north of Hooker. These soils are generally separated from the plains soils by a short steep slope or escarpment which in many places is rather stony. The pasture and row-crop soils are generally recognized as being of lower fertility than the plains soils, and most of them show a marked decrease in productivity after a few years' cultivation. They are in general lighter colored and lower in content of organic matter and mineral plant nutrients than the plains soils. The steeply rolling surface relief makes them very subject to erosion as soon as the grass cover is removed, which probably explains their decreasing productivity. Ter-

racing on many areas would be expensive, because the terraces would have to be rather close together. Another disadvantage of the steeply rolling relief is that it hinders the use of larger types of power machinery.

It is generally recognized that these soils are probably more valuable for their native pasture than for cultivated crops, and, although the grazing afforded by them is not so good as that of the heavier upland soils, they are used for grazing because of their lower value for crop production. Some crops are grown to provide winter feed to supplement the native pasture. A large part of this land is included in large cattle ranches, although several small farms are located on the smoother areas.

Potter silt loam.—Potter silt loam differs from Potter silt loam, smooth phase, which is placed in the group of diversified crop land, in that it occurs on more strongly rolling relief and has only a very few spots where hard caliche rock is present in the subsoil, although it does have caliche gravel on the surface as a rule.

The surface soil is grayish-brown granular silt loam extending to a depth of about 8 inches, and the subsoil is lighter colored, loose, and granular. This soil is probably the most valuable soil in the group. It is the heaviest land of the breaks, and most of it is covered by a thick stand of buffalo grass and blue grama, with a small percentage of other grasses and leguminous plants. Blue grama and buffalo grass are both short grasses and seem to be the most palatable and nutritious.

Potter silt loam covers a total area of 48.8 square miles. The principal areas occur in the breaks of North Canadian River north of Goodwell, near the junction of North Canadian River and Tepee Creek, and along Tepee Creek north of James School. An area occurs in the southwestern quarter of the county around the head of Frisco Creek between Texhoma and Goodwell, and several bodies lie along the north sides of Hackberry Creek and Coldwater Creek.

Most of this soil is included in large cattle ranches and is not in cultivation, but approximately 7 percent of the land is cultivated. Milo and sorgo are about the only crops grown, except a small quantity of wheat on the smooth areas. Crop yields differ little from those obtained on Potter silt loam, smooth phase, when the land is first plowed, but the yields decrease much more rapidly because of the greater tendency of the land to erode. This soil needs the protection provided by the native sod.

Most of the farm or ranch land in the breaks is handled in large units that generally include several different kinds of soil, and for this reason it is difficult to give values of any particular soil. This soil is currently valued at prices ranging from 20 to 25 percent of the selling price of Richfield silt loam.

Potter fine sandy loam.—Potter fine sandy loam is similar to Potter fine sandy loam, smooth phase, but it occurs in more rolling and rough areas. It differs from Potter silt loam in that it is lighter textured in both surface soil and subsoil. It comprises a large percentage of the grazing land (pl. 2, *A*), although part of it is used for the production of row crops. It is locally called "white rock land", because of the presence of white caliche gravel in the surface soil, although caliche stones, or hardpan, are in most places lacking in the subsoil.

Potter fine sandy loam covers an area of 162.8 square miles. It is the predominant soil of the breaks and occurs along all the stream valleys. However, it covers only a small part of the breaks of Goff Creek. Most areas of this soil are very irregular in size and shape, as they are rather intimately mixed with the more broken areas of soil.

Approximately 12 percent of the land is cultivated to milo and sorgo, and the rest is in native pasture. Crop yields are practically the same as on Potter fine sandy loam, smooth phase, when the land is first plowed, but, as with Potter silt loam, a fairly rapid decrease in productivity results after the native sod is removed and erosion has set in. Terracing may be practical on some of the smoother areas.

Grazing is probably the best use for this soil. The native vegetation consists largely of little bluestem, with some buffalo grass, blue grama, side-oats grama, and a few legumes. The current value of this land ranges from 18 to 20 percent of the selling price of Richfield silt loam.

Potter loamy fine sand.—Potter loamy fine sand differs from Potter fine sandy loam in having a lighter texture in both surface soil and subsoil. Most of the land is strongly rolling and is covered with a growth of sand sage, together with a sparse growth of coarse grasses. It is farmed to a very small extent, most of it being utilized for the scant pasture it affords.

This soil covers an area of 102.4 square miles. Most of it occurs in the northern part of the county, the principal areas lying along Goff Creek. Other important areas are south and southeast of Adams.

Approximately 4 percent of the land is cultivated to milo and sorgo. This is not considered a good agricultural soil, and it is very subject to blowing and erosion. It is currently valued at about 15 to 18 percent of the selling price of Richfield silt loam. Part of its value is on account of the oil and gas probabilities, and the selling price is somewhat higher than would be justified by its value for agricultural purposes alone. Oil and gas lease possibilities enter into the valuation of most of the land in Texas County and constitute a large proportion of the valuation of the poorer land.

Pratt loamy fine sand, dune phase.—Among the less important soils of this group is Pratt loamy fine sand, dune phase. This soil differs from Potter loamy fine sand in that it is slightly darker colored and does not contain white lime gravel in the surface soil. It is an inextensive soil. The principal areas are on the plains north of Hooker and southeast of Adams.

A small acreage is used for the production of grain sorghums, but most of the land is left in native pasture because of its light texture and rough dunelike surface relief. It is of low value for pasture because of the predominance of sand sage and the scarcity of grass. The land is currently valued at prices ranging from 15 to 20 percent of the selling price of Richfield silt loam.

Vernon very fine sandy loam.—Vernon very fine sandy loam differs markedly from the soils previously discussed, and it is locally called "red land". It has a reddish-yellow or yellowish-red surface soil which extends to a depth of 7 inches, where it is underlain by red compact clay.

Most of this soil is used for grazing livestock. It is not considered a good soil because it is very shallow and subject to erosion. The native vegetation consists largely of little bluestem, with a small amount of buffalo grass and blue grama.

The principal areas of this soil occur in the breaks of Palo Duro and Chiquita Creeks near Range and Grand Valley. Land of this kind is currently valued at about 15 to 20 percent of the selling price of Richfield silt loam.

Randall clay.—Randall clay, on the basis of surface relief, does not belong to this group of soils, but its agricultural value is somewhat similar to that of the other soils of the group. This soil occupies the beds of the many small intermittent lakes that occur over the High Plains. Most of the areas are circular or oval in shape and range from 10 to 500 acres in size. This soil is probably better supplied with organic matter and plant nutrients than any other soil in the county, but it is not very productive because of its heavy texture and because it is often covered with water.

The surface soil of Randall clay is very dark gray or black, and it is comparatively loose and friable when dry. It is underlain by heavy black clay, and a white lime zone occurs at a depth ranging from 2 to 3 feet. On some farms this soil is used for the production of wheat, because exclusion of these areas would break the continuity of the cultivated fields and leave them irregular in shape. The production of crops on this soil is very precarious, because of the ever-present possibility of rains filling the lakes before harvest. The soil is droughty during dry seasons, because the heavy clay soil does not give up moisture to plants very readily.

The native vegetation is blueweed, ironweed, smartweed, and water grass. The land has a fairly low value for grazing, because of the sparse grass growth in most places.

GRAZING LAND

Included in the group of strictly grazing lands are Potter loamy fine sand, broken phase; dune sand; Vernon soils (undifferentiated), eroded phase; and rough broken land (Potter material). These soils are used only for grazing because their relief is so rough and broken that it is considered impractical to attempt the production of cultivated crops on them (pl. 2, *B*). They occur within the breaks, with the exception of dune sand which occurs both in the breaks and on the plains. Most of these soils occupy long narrow belts near the outer rim of the breaks and along the drainage lines leading to the main streams. The principal areas are in the breaks of North Canadian River and Coldwater Creek. Soils covering 172.4 square miles, or 8.4 percent of the county, are included in this group, and none of them is used for the production of crops. The grazing afforded by them is not of very high quality, but most of the areas provide good shelter for cattle during the cold windy weather of winter and early spring.

Potter loamy fine sand, broken phase.—Potter loamy fine sand, broken phase, differs from Potter fine sandy loam in that it is lighter textured and supports a native vegetation consisting largely of sand sage, with a sparse growth of bluestem, tall sage, and Indian grass. Within the areas of this soil, as shown on the soil map, some small

areas of Potter fine sandy loam occur, which were included here because the rough relief on which they lie makes crop growing impossible and places them with the grazing lands. These areas of fine sandy loam comprise somewhat better grazing land than most of the area mapped as Potter loamy fine sand, broken phase. The latter has comparatively low value for grazing because of the sparse growth of grass and the abundance of sand sage (*Artemisia*).

Vernon soils (undifferentiated), eroded phase.—The material classed as Vernon soils (undifferentiated), eroded phase, resembles the subsoil of Vernon very fine sandy loam. The soil material consists of red clay, and the land is very rough and is broken by drainage channels. This land has been badly eroded and is of very low agricultural value. It supports a thin growth of little bluestem, buffalo grass, and blue grama, and has a low value for grazing. It occurs near the streams in the breaks of Hackberry, Palo Duro, and Chiquita Creeks, in the vicinities of Range and Grand Valley.

Rough broken land (Potter material).—Rough broken land (Potter material) consists of escarpments, or cliffs, and steep slopes of caliche or caliche gravel. In some places sufficient soil is present to support a sparse growth of vegetation consisting of catclaw, yucca, buffalo grass, and blue grama. Included in areas of this soil are some areas of sandstones and some red shales and clays.

Rough broken land (Potter material) covers an area of 64.4 square miles. It has a very low value for grazing but is valuable as protection to cattle during cold stormy weather.

Dune sand.—Dune sand consists of grayish-brown fine sand underlain by yellowish-brown fine sand. It has a dunelike relief. Most of this land is covered by a growth of tall sage grass, Indian grass, sand sage, yucca, and sand plum. It has no value for crop production under present economic conditions.

Dune sand covers an area of 20.4 square miles, the principal area occurring just north of North Canadian River east of the Amarillo-Liberal branch of the Chicago, Rock Island & Pacific Railway. It is utilized for the inferior grazing which it provides. The preponderance of tall coarse grasses makes it valuable for winter pasture following heavy snow.

AGRICULTURAL METHODS AND MANAGEMENT

The principal aim of farm operations is to conserve and utilize to the best advantage the scant rainfall. This is accomplished by keeping the land in condition to absorb the precipitation, preventing all unnecessary losses of moisture, and growing crops best adapted to utilize this moisture and return the highest net profit. These conditions are in strong contrast to conditions in more humid sections where maintenance of soil fertility is of greatest importance.

Systematic rotation of crops is not generally considered practical here because of the seasonal and annual differences in rainfall, and higher average yields are obtained by adapting the cropping system of each year to the moisture conditions. It is generally considered not practical to sow wheat during a fall in which soil moisture is deficient, because the winter precipitation cannot be depended on to supply the deficiency. Summer fallow is usually

profitable only when the spring and early summer moisture supply is so limited that sorghum crops are not likely to make good yields. Most farmers occasionally change the crop grown on the land in response to these moisture variations, particularly in those sections where more diversified agriculture is practiced. However, on many farms wheat follows wheat year after year on the same land, and grain sorghums follow grain sorghums in like manner. The principal reason for this is that wheat will not ordinarily succeed following grain sorghums unless a period of summer fallow intervenes; also, wheat is harvested too late to allow the planting of grain sorghums until the following spring.

As a general rule, the soils are naturally in fairly good condition to absorb moisture, but continued cropping is tending toward a condition in which this may not hold true. Heavy soils which have been in cultivation for 25 years now contain but two-thirds as much organic matter as they contained when first put in cultivation.[5] It is a recognized fact that organic matter is of great importance in keeping soil in a condition to absorb moisture, and such a marked loss is of paramount importance in a country where every drop of available moisture is needed for crop production. This situation is disregarded by most farmers, because they have not noticed any great reduction in yields as yet, although it is generally admitted that the virgin land when first put under cultivation is superior in producing power to land which has been in cultivation for several years.

If the precipitation is not absorbed immediately after falling, it is often lost through run-off. It is estimated that approximately 13.5 percent of the total rainfall on heavy cultivated soils on average plains relief is lost through run-off, and on the more sloping land this loss is doubtless much greater. As conservation of moisture is of prime importance, this loss should not be disregarded. Experiments at the Panhandle Agricultural Experiment Station and at other experiment stations on the subhumid plains have shown that this loss can be largely prevented by the use of contour tillage and level terraces. Results of 4 years' experiments with level terraces on heavy soils at the Panhandle Agricultural and Mechanic Arts College have shown an average increase in yield of 25.4 percent of the staple crops of the section.

Linked with the process of getting moisture into the soil, is the problem of conserving this moisture for the use of crop plants, which is primarily a tillage problem. The relative humidity is very low, and for this reason the soil dries out to the depth reached by tillage operations. In other words, the deeper the soil is tilled the greater the loss of soil moisture; hence all tillage should be as shallow as possible consistent with its purpose.

The natural sod is generally broken to a depth of 5 inches, and thereafter the land is broken to a depth of only 4 inches. The principal purpose of plowing in this section is to cover the stubble growth and crop residues of the preceding crop and to kill weeds, and the purpose of all other tillage is to kill weeds and should be used only as often and as deep as is required to accomplish this.

[5] See footnote 8, p 5.

The moisture-saving efficiency of a surface mulch produced by tillage seems to lie entirely in the effect of the tillage on killing weeds.

The times of plowing and cultivation are in general regulated by the crop grown, the kind of soil, and the moisture condition of the soil. In wheat farming, it is common practice to plow immediately after harvest, and on many farms the plow follows only a few hours behind the combine. Where the land is very dry at the time of plowing, it is left very cloddy and a great deal of moisture is required to reduce the clods and establish a good seed bed for the following crop. For that reason, if the soil is very dry, it is often advisable to delay plowing until moisture conditions are more favorable or to dispense with it entirely if the soil is too dry for weed growth. Two or three additional shallow cultivations are given at intervals during late summer, in order to kill all volunteer wheat and weeds. The wheat crop is sown in the fall, generally between September 1 and November 1, the date of seeding being determined by the available supply of moisture in the soil. If the soil is very dry in the fall, the land is left fallow throughout the winter and planted to row crops the following spring.

Where row crops are grown, the land is generally plowed or listed in the fall, except the soils that are subject to blowing, which are generally left unplowed until late spring. The grain sorghums are ordinarily sown in May or June. Late planting lessens the amount of cultivation necessary and in general makes better use of the moisture.[6] Highest yields from grain sorghums are ordinarily obtained by varying the stand according to the amount of moisture in the soil at planting time. The common practice is to space the rows 3½ feet apart, although wider spacing is successful in many places. The row crops are generally cultivated with tractor cultivators, and much of the harvesting is done by hand, although the combine is used for some of the straight-necked varieties of grain sorghums.

Prevention of blowing is a very important problem on many of the soils. This is particularly true of the soils included in the diversified crop-land group and the pasture and row-crop group. It is in general much easier to prevent blowing than to check it after it has started. Soil blowing is prevented by keeping the land in a fairly rough or fine-cloddy condition during winter and spring or by leaving row-crop stubble on the land until late spring or early summer and by plowing furrows at right angles to the direction of the prevailing wind.

The addition of fertilizers or barnyard manure to the soil is practiced to only a very small extent, as an excessive amount of plant nutrients, particularly in the form of nitrates, sometimes reduces yields in this section. Excessive fertility may foster a very rapid growth of plants which use up an excessive amount of the soil moisture early in the season, and these rapidly growing plants later in the season will suffer more severely from drought than plants on less fertile soils. Eventually these soils may reach a condition in which the addition of fertilizers and organic matter will be neces-

[6] FINNELL, H. H. SORGHUM CROPS ON THE HIGH PLAINS OF OKLAHOMA. Okla. Agr. Expt. Sta. Bull. 191, 30 pp. 1929.

sary. The use of green-manure crops or barnyard manure in this locality is fraught with difficulties, because decomposition of such crops is very slow and may interfere with moisture movement the following season. The fertilizers and green-manure crops should be plowed under preceding a period of summer fallow, in order to give them a chance to decompose, or they should precede a forage crop in which an excess supply of nitrogen is not so objectionable.

The Panhandle Agricultural and Mechanic Arts College located at Goodwell is doing valuable work in the study of cultural methods, adaptation of new crops and varieties, and other problems of vital interest to the farmers of Texas County and the surrounding country. It is suggested that any one wishing more detailed information on crop production or other phases of agriculture in this section will find the results of experiments made at this station of great value.

SOILS AND THEIR INTERPRETATION

With very few exceptions the soils have developed from the Tertiary geological formation which consists of an apron of debris extending eastward from the Rocky Mountains. This slopes gently eastward where undisturbed by erosion, but approximately 25 percent of that part in Texas County has been reduced somewhat below the original level by erosion. Although this geological formation was deposited during Tertiary time, it is extremely variable in composition, consisting of beds of sands, clays, conglomerates, impure limestones, fine stratified sandstones, and gravel of various types, which were deposited by streams flowing from the Rocky Mountains.

The soils that have developed in this county are the result of climatic, topographic, and biological influences on the different geological materials. On the flat uneroded parts of the High Plains, most of the soils have developed the characteristics of mature soils of the region, and such variations as occur are the results of differences in the parent material. Eliminating any recent climatic changes, the soils have developed under an average annual rainfall of approximately 18 inches, an average annual relative humidity of 60 percent, and an average annual temperature of 55.7° F. The soils have developed under a grass cover, and the thickness and character of the grass stand varies with the texture of the surface soil. The flat or gently sloping areas, which comprise most of the plains section, have developed characteristics intermediate between those of the southern chernozem soils and the dark-brown soils. Briefly, the characteristics of the mature soil are a dark-brown loose faintly laminated noncalcareous surface soil, extending to a depth of 4 inches, and a heavier textured subsoil which on drying breaks into ill-defined rather large prisms, this layer in turn being underlain by a rather definite layer of lime accumulation. The soils having these characteristics have been classified as members of the Richfield series. These soils may have at one time covered the entire county but have since been eroded along the stream valleys. In the stream valleys, or breaks, the mature soils have been removed or modified by erosion, or the soils were not allowed to lie in place long enough for development to take place.

The mature soils are the most important, considered from both a pedological and an agricultural point of view. They range in texture from fine sand to clay, and these textural differences are apparently the results of differences in the content and fineness of the quartz in the parent material, and in some places the result of accumulations of finer material and organic matter by surface wash.

The predominant soil has been classified as Richfield silt loam.[7] Following is a description of a typical profile of this soil as observed in the center of the west half of sec. 36, T. 2 N., R. 13 E.:

0 to 4 inches, brown or dark-brown noncalcareous faintly laminated silt loam which is comparatively loose and friable and breaks easily into soft granules. This layer contains a heavy mat of grass roots.

4 to 12 inches, dark-brown or very dark brown noncalcareous clay loam or silty clay loam which breaks into rather hard compact prisms ranging from 2 to 6 inches in diameter. These prisms are irregular in shape and have bumpy shiny surfaces. They break down into irregular clods approximately one-half inch in diameter, which appear only slightly lighter when crushed. Horizontal cleavage planes are more irregular and less distinct than vertical cleavage planes. No insect casts are present.

12 to 20 inches, dark-brown calcareous clay loam or silty clay loam which is slightly lighter colored than the material in the layer above and breaks into hard prisms with a diameter ranging from 1½ to 3 inches These prisms break horizontally, making a blocklike or jointed structure. Both horizontal and vertical cleavage planes are very distinct and are coated with slightly darker material. The clods are very hard and compact when dry.

20 to 28 inches, brown calcareous clay loam or clay, containing scattered specks and spots of lime accumulation. The material is very hard when dry and breaks into cubical or slightly elongated clods from one-half to three-fourths inch in horizontal diameter and 1 inch long.

28 to 32 inches, light grayish-brown calcareous clay or clay loam, containing a large quantity of spots and specks of lime ($CaCO_3$). This is probably the layer of greatest lime accumulation. The material is slightly less compact than in the layer above, and the cleavage planes are less distinct, though still present and giving a block structure.

32 to 42 inches, brown calcareous clay loam containing fewer lime spots and specks than the layer above. The material has a blocky structure when very dry.

42 to 52 inches, brown calcareous clay loam very similar to the material in the layer above but lighter colored, with a tendency toward a slightly red cast. The root cavities are lined with lime, causing the accumulation to resemble mycelium. The material is less compact than that in the overlying layers, and the blocky structure has practically disappeared.

52 to 96 inches, light-brown or slightly reddish brown calcareous clay or clay loam, with lime coating in root holes. There are also some splotches or large spots of lime. The material in this layer is friable and shows no indication of cleavage planes. It rests on soft white caliche which is largely calcium carbonate.

The white caliche described in the substratum is very irregular in occurrence and cannot be considered typical of this soil. It may lie at a depth ranging from 4 to 20 feet and in many places is entirely absent to a depth of at least 150 feet. Associated with Richfield silt loam are Pratt fine sandy loam, Pratt loamy fine sand, and Pratt loamy fine sand, dune phase. These soils differ from Rich-

[7] According to recently adopted methods of mechanical analysis, by which more thorough dispersion is obtained than by the old method, this soil is a clay loam as shown by the table of mechanical composition on p 32 In the field, because of its good structure, it appears to be a silt loam

field silt loam only in those characteristics influenced by differences in texture. They are lighter colored, and their lime has been leached to a greater depth. Their structural characteristics are not so well developed as are those of Richfield silt loam.

Associated with Richfield silt loam are several small areas of Richfield clay loam, dark phase, but because the areas are small and unimportant they are not separately shown on the map.

Occurring at frequent intervals over the heavy soils of the plains are small intermittent lakes, in which the soil has been classified as Randall clay. These lakes lie in depressed areas and receive run-off from the surrounding country. The soil is poorly drained part of the time and well drained at other times, depending on the amount and character of the rainfall. It has been sufficiently well drained for a well-defined soil profile to develop. Following is a description of a typical profile of Randall clay as observed at the crossroads 12 miles due east of Hooker:

0 to 5 inches, dark-gray or black noncalcareous clay which is loose and granular.

5 to 9 inches, compact stiff noncalcareous clay having definite but very irregular jagged cleavage lines. The material is black or very dark gray when moist.

9 to 23 inches, mottled reddish-yellow or rust-brown and gray noncalcareous clay loam which is very compact and hard when dry. No cleavage lines are present.

23 to 38 inches, mottled light-brown and light-gray friable calcareous clay loam, the layer of lime accumulation. The material rests on light-brown friable calcareous clay containing only a few lime spots.

The common explanation of the occurrence of these depressions is that soluble material has been removed from the underlying geological material, causing the surface to settle somewhat below the general level of the plain. After the depressions have formed, the run-off from the surrounding land finds its way into these sinks, bringing organic matter and fine material which is deposited. This explains the heavier texture of this soil and partly explains the dark color. However, much of the dark color is no doubt brought about by periodic poor drainage.

The principal immature soils have been classified as members of the Potter series. These soils are called immature, partly because erosion has annually removed part of the surface material and partly because the greater run-off has left less water to percolate into the soil for the growth of plants responsible for soil development. They occur in the rolling eroded lands within the breaks of the streams. Following is a description of a typical profile of Potter silt loam as observed 4 miles north of Goodwell in the NW¼ sec. 11, T. 2 N., R. 13 E.:

0 to 13 inches, brown or grayish-brown calcareous silt loam which is distinctly gray when dry. It has a loose granular structure. The granules range from one-sixteenth to one thirty-second inch in diameter, are irregular in shape, and comparatively soft and easily broken. The material is very friable and has no indication of compaction. It contains numerous grass roots and a high percentage of insect casts, burrows, and pupae cases. A few white irregular angular caliche gravel are present, and a few small quartz gravel have a thin coating of lime on their undersides.

13 to 28 inches, brown or grayish-brown loam containing numerous white lime spots or concretions, which produce a spotted or speckled appearance. The material is light gray when dry. Some lime-coated

gravel of mixed origin (quartz, granite, basalt, limestone, and quartzite) are present. The material is slightly more compact than that in the layer above, but it readily breaks into soft irregular granules from one thirty-second to one-sixteenth inch in diameter. Insect casts are numerous, and they have a more gray appearance than the soil material. This is a layer in which some lime has apparently accumulated.

28 to 45 inches, brown or yellowish-brown clay loam having a slight red cast. The material is slightly compact but crumbles easily into soft clods one-half inch in diameter. It is highly calcareous and contains a few lime specks. No insect casts and very few roots are present. This is merely the slightly weathered Tertiary clay.

Fritch fine sandy loam, which was not separately mapped because of the very small areas in which it occurs, covers only a small total area. It occurs where erosion has apparently cut down to an original land surface which was heavy in texture and resistant to erosion, and later a calcareous fine sandy loam was deposited over the surface. This inference is drawn because it occupies comparatively flat areas within the breaks. This is a buried soil which apparently developed under a soil climate somewhat similar to that of Randall clay. A description of a typical profile of Fritch fine sandy loam, which is included with Potter fine sandy loam in mapping, follows:

0 to 7 inches, calcareous brown or grayish-brown heavy fine sandy loam which is loose and lacks any marked structure.

7 to 15 inches, very dark gray or black material containing brown streaks and root holes. The material is slightly more brown when crushed. Insect casts are scarce in the top part, but they become more numerous with depth. The texture of the material is clay loam, and the structure is cheesy. The material in this layer is not calcareous.

15 to 30 inches, brown or dark-brown calcareous cheesy clay loam containing a few specks and streaks of lime. Insect casts comprise from 40 to 50 percent of the volume of this layer which is the layer of lime accumulation.

30 to 42 inches, yellowish-brown loose friable calcareous clay loam containing a few lime concretions. This is the unconsolidated Tertiary material.

Other buried soils occur in many places on the plains, but no surface indication of their occurrence is evident. Most of these buried soils underlie typical areas of Richfield silt loam or Pratt fine sandy loam. The typical profile has a distinct layer of lime accumulation, below which lies the dark noncalcareous humus layer of the buried soil. This dark layer, in turn, is underlain by another very distinct layer of lime accumulation.

Members of the Vernon series occur in places where the Permian "Red Beds" underlying the Tertiary formation have been exposed by erosion. These soils are immature and are red in color.

Occurring in many parts of the county are areas of calcareous material which is locally called caliche. It consists of both soft unconsolidated calcareous clay and hard vitreous limestonelike material. It occurs in discontinuous belts along the breaks, forming an escarpment or steep rocky slope, which in many places marks the boundary line between the High Plains and the rolling eroded plains. This escarpment, together with a few other stony soils, has been classified as rough broken land (Potter material). The stony escarpment occurs in so many places that it gives the impression that the entire plain is underlain by this material, but well drillers

state that in most places it disappears a few hundred feet back from the breaks. However, a number of small isolated areas of this material occur in several parts of the plains south of Goff Creek and North Canadian River. The caliche beds lie at a depth ranging from 6 inches to 150 feet below the surface. They appear to be geological deposits rather than lime accumulations derived through the development of overlying soil. This statement is based on the fact that in many places the caliche beds range in thickness from 6 to 10 feet, and in a few places even to 40 feet, and they have a very high content of calcium carbonate.

The occurrence of caliche in a more or less continuous belt along the edge of the breaks was possibly brought about by carbonation of soil lime and transportation of this material by soil water to the edge of the breaks where the water was evaporated and the calcium carbonate precipitated. This calcium carbonate may have been consolidated by concentration and exposure to soil air after evaporation of water. The consolidated material resisted erosion and therefore exists at the present time as an escarpment. This explanation necessarily presupposes a greater amount of soil moisture than is now present in this material, but this is possible, as a very extensive supply of underground water is present under the plains at a depth of 150 feet. This water table may have been near the surface when the breaks were first being formed.

The occurrence of isolated spots of caliche in the plains cannot be explained in this manner. It is possible that these spots represent accumulations of calcareous material underlying intermittent lakes which were later covered by additional Tertiary material. The fact that buried soils, intermittent lakes, and areas of caliche occur in isolated roughly circular areas suggests a possible relationship.

Table 4 gives the results of mechanical analyses of samples of several of the principal soils, and table 5 gives their pH values as determined from the same soil samples.

TABLE 4.—*Mechanical analyses of several soils from Texas County, Okla.*

Soil type and sample no	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Richfield silt loam	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
451416	0–4	0 2	1.7	3 8	7 4	11 3	49 5	25 9
451417	4–12	.0	1.2	2.8	5 0	8 5	45 5	35 9
451418	12–20	1	.7	1.6	2.6	5.0	45 4	44.6
451419	20–28	.1	.4	.9	1 6	3 5	49 0	44.4
451420	28–32	.1	.6	1.4	1 9	3 6	46 0	46.5
451421	32–42	.1	.3	.8	1.2	2.9	48.4	46.2
451422	42–52	.1	3.8	8.4	11 5	9 8	23 6	42.9
451423	52–72	.1	.9	1 4	2.1	3 4	59.9	32.2
Pratt fine sandy loam								
451401	0–4	1	8 9	22.5	33.9	15 8	6 1	12.6
451402	4–18	.3	9.6	16 4	22.7	21 8	13 5	15.6
451403	18–26	1	4.5	12.4	23 5	22.2	21 5	15.7
451404	26–37	0	5 9	18.9	25 0	12.5	19 1	18 5
451405	37–55	.3	7 1	16.5	22.8	15 3	16 5	21.4
451406	55–60+	4	3 2	6.7	10 0	8 9	36 4	34.3
Potter silt loam								
451424	0–13	4 2	9 2	8.1	10 4	18 4	36.1	13.5
451425	18–28	4 1	6 6	4 3	5 3	12.2	33 0	34.4
451426	28–45+	2.6	4 3	3 2	4 2	9 3	36 7	39 7

TABLE 5.—*pH determinations of samples of several soils from Texas County, Okla.*

Soil type and sample no	Depth	pH	Soil type and sample no	Depth	pH
Richfield silt loam	*Inches*		Pratt fine sandy loam—Continued	*Inches*	
451416	0–4	7.23	451402	4–18	7 25
451417	4–12	7 69	451403	18–26	8 39
451418	12–20	8.47	451404	26–37	8. 22
451419	20–28	8. 47	451405	37–55	8 33
451420	28–32	8 53	451406	55–60+	8 41
451421	32–42	8 30	Potter silt loam		
451422	42–52	8. 53	451424	0–13	8. 42
451423	52–72	8. 49	451425	13–22	8 52
Pratt fine sandy loam.			451426	28–45+	8 67
451401	0–4	7 40			

SUMMARY

The soils of Texas County are in general brown or dark brown, and they have a layer of lime accumulation in the subsoil. They have developed under a grass cover, and approximately 75 percent of them occur on smooth or almost flat surface relief. The soils have been classified in 6 series, including 10 soil types and 6 phases of types, in addition to 2 classes of miscellaneous soil material. The most extensive soil and the most important agriculturally is Richfield silt loam.

The soils are largely good agricultural soils, and fertility is not an important soil problem. Productivity is governed largely by precipitation and the factors contributing to conservation and losses of moisture.

Approximately 36 percent of the county is covered by heavy soils which are particularly adapted to the production of wheat. Practically all the agricultural soils are well adapted to grain sorghums. Wheat is the principal crop grown on the smooth uplands because of its adaptability to the prevailing natural conditions and because of the low cost of production compared to that of other crops. Milo and other grain sorghums are of considerable importance because of their ability to resist drought.

A one-crop system of agriculture is commonly practiced on the heavy wheatland, but a more diversified system prevails on the lighter textured soils.

Conservation of moisture and avoidance of losses through run-off by use of level terraces will probably be of value on practically all the heavy soils, except those occurring in depressions.

Power farming and low cost of production incident to large-scale operations combine to make the plains farms of this county well adapted to compete to advantage with other parts of the United States in the production of wheat and grain sorghums.

○

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Areas surveyed in Oklahoma shown by shading.

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