TEXAS AGRICULTURAL EXPERIMENT STATION

BULLETIN NO. 192 JUNE, 1916

DIVISION OF CHEMISTRY

Soils of Grayson, Lee, McLennan, Titus, and Tyler Counties

POSTOFFICE:

COLLEGE STATION, BRAZOS COUNTY, TEXAS.

AUSTIN, TEXAS:
VON BOECKMANN-JONES CO., PRINTERS,
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BY

G. S. FRAPS, PH. D.
Chemist in Charge, State Chemist

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*As of June 1, 1916.
**In cooperation with United States Department of Agriculture.

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Soils of Grayson, Lee, McLennan, Titus and Tyler Counties

BY G. S. FRAPS, PH. D., CHEMIST IN CHARGE; STATE CHEMIST.

This bulletin is the fifth of a series dealing with the chemical composition of typical Texas soils. The preceding bulletins are Nos. 99, 125, 161, and 173. The samples were sent in by the soil survey agents of the Bureau of Soils of the United States Department of Agriculture, with the exception of those for Lee and McLennan counties, which were collected by this station.

Detailed reports of the surveys with maps showing the various soil types have been published by the Bureau of Soils, United States Department of Agriculture, from which the descriptions given in this bulletin are taken, as follows:

Soil Survey of Grayson County, by Frank Bennet et al.

Soil Survey of Lee County, by J. L. Burgess and W. S. Lyman.

Soil Survey of the Waco, Area, by A. W. Mangun and Mr. Earl Carr (part of McLennan county).

Soil Survey of Titus County, by Thomas B. Rice and E. B. Watson.

Soil Survey of the Woodville Area, by J. E. Lapham and party (part of Tyler county).

Requests for copies of these surveys should be addressed to the Bureau of Soils, United States Department of Agriculture, Washington, D. C.

MAINTENANCE OF FERTILITY.

The following are the chief essentials to the maintenance of soil fertility:

(1) Maintenance of vegetable matter and nitrogen by growing legumes and turning these under or grazing them off.

(2) Correction of deficiency in phosphoric acid, if needed, by use of phosphates.

(3) Correction for acidity, if present, by use of ground limestone or lime.

(4) Correction for deficiency of potash, if needed, by use of potash fertilizers.

1. *Vegetable Matter.*—The maintenance of the supply of vegetable matter in the soil is essential to the fertility of most soils, though some soils produce well for a long time without additions of vegetable matter, through liberal use of fertilizers. Vegetable matter may be supplied in farmyard manure, which is sufficient if the quantity available is enough, but barnyard manure is usually not at hand in large enough quantities. Legume crops, in such cases, should be grown in rotation

with other crops, and either turned under or grazed off. Turning under a heavy green crop may sour the land; if the crop is heavy, it is best to allow it to become nearly mature before turning it under. The plant tissues are then harder, decay less rapidly, and are less likely to cause sourness. We are still more in favor of grazing off the crop, as in this case, some of its feeding value is secured, while the droppings from the animal, together with the liquid excrement, contain the bulk of the plant food taken up by the crop. To make the crop into hay and save the manure from it is not such a good plan, as a large part of the fertility is lost in this way; and when the legume is made into hay, to be sold, the land gains practically nothing in fertility.

While other crops than legumes add vegetable matter to the soil when plowed under or grazed off, the legumes are the only plants that can utilize the free nitrogen of the air. On account of this fact legumes are chosen for the crop to be turned under or grazed off.

The maintenance of the nitrogen supply of the soil is more important than the maintenance of the vegetable matter. The only practical way to do this for farm crops is to secure the nitrogen from the air by growing legumes. Nitrogen costs too much for the planter to purchase enough of it to maintain the nitrogen content of the soil. The purchase of a small supplementary quantity may be profitable, but the main supply must come either from the soil, which then loses in fertility, or from the air by means of legumes.

It is not our intention to go into the matter of the kind of legumes to grow, except to say that corn grown in six-foot rows with cowpeas between, often produces as many bushels of corn the first year as corn grown in the usual way, and the second year, if the legumes are turned under or grazed off, it often produces eight to twelve bushels more. A cotton crop following the corn and cowpeas, likewise, is considerably larger.

2. *Phosphoric Acid.*—Soils are often deficient in phosphoric acid. The deficiencies of the soils discussed here will be shown later on. For discussion of the use of phosphates and other fertilizers, see Bulletin 167.

3. *Acidity.*—Some soils contain organic or inorganic acids, and are acid in character. Certain crops do not grow well in acid soils, especially clover, alfalfa, barley, rye, etc. There are other crops, such as cowpeas and watermelons, which do well on acid soils. Acidity may be corrected by adding lime, either as slaked lime, quicklime, or ground limestone rock. The last mentioned is usually the cheapest, and is preferable in other respects. The acidity or non-acidity of the soils is shown in connection with the analyses. Many of the soils of the area contain an abundance of lime, and do not need further additions.

4. *Potash.*—Soils as a rule contain an abundance of potash to produce good crops, though there is a variation in this respect. In general, potash is least often needed, and often needlessly used. The use of manure, the turning under of green crops, and the use of lime when needed, appear to assist the plants to secure potash from highly in-

soluble forms. The farmer should endeavor to secure the greatest benefit from his soil potash, before undertaking to purchase the fertilizer potash.

HOW TO USE THE ANALYSES.

Analyses of the soils are given in connection with the various types. The interpretation of the analyses and the pot experiments are also given.

If the soil is well supplied with plant food, but does not give good yields, its physical condition is poor, due to bad cultivation, poor drainage, inferior physical character, or other unfavorable physical conditions.

If the soil is well supplied with total plant food, but low in active plant food, attempts should be made to increase the activity of soil agencies which make plant food available, by means of addition of manure, of green crops, plowed under, or, if the soil is acid, by addition of lime or ground limestone.

If the crop yields are low and the plant food is deficient, the table shows the plant food that should be used first.

Suppose, for example, a farmer on Durant fine sand of Grayson county is securing a yield of one-fourth bale cotton per acre, what fertilizer should be used?

The table shows that this soil is deficient in nitrogen and in phosphoric acid. The farmer then should apply acid phosphate, for the purpose of furnishing phosphoric acid and cotton seed meal, for the purpose of furnishing nitrogen. These should increase the yields. But it would be still better for him to secure the nitrogen by growing legumes, and turning them under or grazing them off, and using acid phosphate to supply the phosphoric acid.

If truck crops were to be grown on this soil, some potash would probably be needed.

In the case of the Wilson clay loam, the analysis indicates the need of phosphoric acid first. With Wilson clay, also of Grayson county, nitrogen is needed first.

Other analyses should be examined in the same way.

For methods of interpretation of the analyses, see Bulletin 161.

In considering the pot experiments one should compare the soil containing the complete fertilizer (KPN) with the soil that has had the particular plant food, K (potash), P (phosphoric acid) or N, (nitrogen). Thus the effect of nitrogen is seen by comparing KP, which receives no nitrogen, with KPN, which had nitrogen, phosphoric acid and potash; the effect of phosphoric acid, by comparing KN, which receives no phosphoric acid, with KPN, which had nitrogen, phosphoric acid, and potash.

SOILS OF GRAYSON COUNTY.

Grayson county has an area of 1010 square miles. Its altitude varies from 520 to 900 feet above sea level. The greater portion of the county is gently rolling to rolling, but there are some rough, hilly areas in the northern and northeastern section, and also large areas of comparatively level country. A large portion of the soils of Grayson

county consists of black prairie lands of high fertility. Table 1 shows the areas of the various soils mapped in this county by the Bureau of Soils.

TABLE 1. SOIL SURVEY OF GRAYSON COUNTY.

Areas of Different Soils.

Soil.	Acres.	Per cent.
Houston black clay	137,088	21.2
Wilson clay	100,864	15.6
Susquehanna fine sandy loam	81,664	12.6
Durant fine sandy loam	46,848	7.2
Durant loam	45,440	7.0
Houston clay	44,096	6.8
Wilson clay loam	36,224	5.6
Trinity clay	34,176	5.3
Meadow	28,736	4.5
Miller fine sandy loam	26,688	4.1
Houston loam	13,120	2.0
Grayson clay loam	10,560	1.6
Crawford stony clay	9,664	1.5
Houston clay loam	7,168	1.1
Wilson loam	6,720	1.1
Rough stony land	6,528	1.0
Susquehanna clay	5,696	0.9
Crawford clay	3,520	0.6
Durant fine sand	1,600	0.3
Total	646,400	.....

The soils of this area are, as a rule, well supplied with total phosphoric acid, though the samples of Durant fine sand, Houston clay loam, and Wilson clay, are low in this respect. The analyses indicate that a number of these soils should, however, respond to fertilization with acid phosphate, as they appear to be somewhat low in active phosphoric acid. This is also shown in the pot experiments. The Durant fine sandy loam (2826) produces 16.5 grams corn without phosphoric acid (KN), 48.5 grams with phosphoric acid (KPN). The Houston clay loam (2944) produces good crops at first without phosphoric acid, but the second crops of corn (1912) without phosphoric acid (KN) is 17.6 grams, compared with 58.1 grams with phosphoric acid (PKN), and the following crops show large differences. The same is seen to occur in a number of the other pot experiments.

The soils are much better supplied with potash than either phosphoric acid or nitrogen.

The soils are, as a rule, better supplied with nitrogen than with active phosphoric acid, though this is not the case with all the soils. However, as is shown both by the analyses and the pot experiments, a number of these soils need nitrogen. Nitrogen is also rapidly lost under cultivation.

Not any of the soil samples were found to be acid.

We conclude that the great needs of this area for the maintenance of soil fertility are: first, legume rotation to maintain vegetable matter and nitrogen; second, use of acid phosphate to supply phosphoric acid.

DESCRIPTION OF GRAYSON COUNTY SOIL TYPES.

Houston Clay.—The soil of the Houston clay varies from a brownish gray to an almost white clay with an average depth of 8 inches. The darker colored areas occupy shallow depressions and the more level places, while the color of the soil on the slopes is usually of a lighter shade and from a distance sometimes appears to be almost pure white.

Partially decomposed limestone fragments are scattered over the surface and are generally most numerous on the knolls and slopes.

The subsoil of the Houston clay varies from a stiff brownish to a light gray clay, which becomes lighter as the depth increases, grading at from 20 to 30 inches into a white silty material composed of rather soft limestone. Below this, about 1 or 2 feet, is limestone hard enough to offer resistance to plant roots.

This type is a residual soil, and is rolling to rough and hilly in topography. The greater part of the type is found in the southeastern corner of the county along Cedar, Mill, Sister Grave, and other creeks. There are also areas in the southern and central parts of the county.

The surface of the soil is frequently badly eroded and broken by ledges of out-cropping limestone. Owing to these conditions, a very small percentage of the soil is cultivated.

When wet, the soil is very sticky, and bakes hard on drying. Where the topography is suitable, the soil gives good yields of corn, cotton, and oats. The productiveness of the soil varies widely in different areas, but on an average corn produces from 25 to 40 bushels, cotton from one-third to one-half bale, and oats from 35 to 50 bushels per acre.

These soils are high in lime, and well supplied with plant food. They will probably need crop rotation and nitrogen first of all.

Houston Black Clay.—The Houston black clay is composed of 10 to 15 inches of brownish black to jet black clay, resting on a subsoil very similar to the soil in texture and of dark gray color, frequently with a bluish tinge. The surface soil contains more organic matter than the subsoil and is less tenacious and impervious. Small lime concretions are mingled with both soil and subsoil, and a few fragments of limestone are occasionally found. This is one of the heaviest types in the county. It is sticky when wet and forms clods when plowed in this condition. These bake very hard and continued harrowing is necessary to put the fields in condition. However, when properly cultivated, the soil breaks up into small granules and has the appearance of black gravel and sand, a good seed bed being secured with comparatively little trouble.

Almost the entire area of the Houston black clay is adequately drained during years of normal rainfall. In topography the type varies from level to hill, the greater proportion being gently rolling. The hilly areas are found along the streams which flow in deep cut valleys, showing out-crops of the solid limestone.

The soil is a residual one and is derived from the Austin chalk and Taylor marl formations. It is naturally rich in humus. Practically all this type is found east of a north and south line passing through

Gunter and Southmayd, though there is one comparatively large area west of Gunter. Very little of it appears north of Sherman. It is found in large and uniform areas, the most conspicuous one extending south from Sherman through Howe and Van Alstyne and reaching the eastern limit of the county.

Practically all of the Houston black clay is under cultivation and is regarded as one of the most productive types in the area. General farm crops are suited to this type, and oats, cotton, corn and wheat are the principal crops. Cotton yields from one-fourth to three-fourths bale per acre, corn from 40 to 50 bushels, oats 40 to 60, and wheat 12 to 18 bushels. Many of the best farmers secure larger yields than those stated.

This soil is well supplied with lime and with plant food. Its need will probably be crop rotation.

Susquehanna Clay.—This soil consists of 4 inches or less of brown or reddish yellow fine sandy loam with a red to yellowish red sandy clay subsoil. This type is derived principally from the erosion of the Susquehanna fine sandy loam. The original timber growth was red oak, post oak, and blackjack oak. The land is difficult to handle where the clay lies near the surface. If plowed too wet it bakes very hard, and requires some time to get it back again into proper condition. The greater proportion of this type occurs in one large area about three miles southeast of Denison. It is found on land which is from hilly to rolling with occasional level areas on top of the hills. The land does not produce well at present.

It needs crop rotation, legumes, and probably phosphoric acid.

Susquehanna Fine Sandy Loam.—This soil consists of 5 to 15 inches of gray or reddish brown fine sandy loam, resting on a reddish yellow to red sandy clay, containing some iron concretions. The depth of the soil is variable, being shallower on knolls and slopes. It is found on rolling to rough and hilly land. The drainage is good. The land has been badly damaged by erosion. The largest body of this type occurs in the vicinity of Denison as a high broad ridge or broken ridges with a maximum width of five miles extending east and west. It also occurs in smaller spots in various portions of the county. Only a small portion of this soil is under cultivation. Where it is not too rolling or too badly eroded, it produces good yields of corn or cotton, but the average yields are 15 to 30 bushels of corn and about one-third bale cotton per acre. The soil responds well to fertilization. Orchards and small fruits and truck, such as cantaloupes, potatoes, and tomatoes, are grown to a certain extent on this land, and the soil also promises well as a peach soil.

This soil needs nitrogen, vegetable matter, crop rotation and phosphoric acid.

Wilson Clay Loam.—The surface soil consists of about 10 inches of a dark brown clay loam, underlaid to a depth of 30 inches with a stiff tenacious clay, varying from yellow to dark yellow in color. Lime

nodules are found in the subsoil and occasionally on the surface. This type is somewhat similar to the Houston black clay, but is not as dark as the Houston black clay and is less productive. The type is most largely found in the central western section of the county. The surface varies from rolling to almost level. Some of the more level areas are poorly drained during wet seasons. Corn yields 30 to 45 bushels, cotton one-third to one-half bale, and oats from 40 to 50 bushels per acre. The first need of this soil is legume rotation. Phosphates are also needed.

Wilson Clay.—The surface soil consists of 10 to 15 inches of very heavy clay, varying in color from a dull yellow to a dark brown or almost black. The subsoil is very similar to the soil in texture, but somewhat more tenacious. The soil is not uniform, as there are places where the fields appear to be striped alternately from yellow to dark, the stripes extending up and down the slope. This difference seems to be due to erosion and exposure of the yellow subsoil. Where the land has not been cultivated regularly the surface is frequently very uneven, owing to a succession of small depressions and knolls. Such land is known locally as hog wallow land. The darker colored phase of the soil is more fertile and more easily cultivated. The land is from rolling to level. The drainage under ordinary conditions is good, but in wet years crops are badly damaged by excess of moisture, especially on the leval areas. The impervious subsoil permits little movement down through the soil. The greater proportion of the Wilson clay is found in one large body in the western part of the county. The area begins a little west of Southmayd and extends across the county line between Tioga and Gunter. It is about eighteen miles long and five miles wide. Corn produces 30 to 40 bushels, cotton one-third to one-half bale, oats from 35 to 55 bushels, and wheat from 12 to 15 bushels. The sample analyzed needs phosphoric acid, nitrogen, and rotation.

Miller Fine Sandy Loam.—The surface soil consists of a loose fine sandy loam, 12 to 20 inches deep with an average depth of 15 inches. The color for the most part is gray to reddish brown. The subsoil is similar in texture and structure but is lighter colored, and at the depth of about 30 inches a yellow sand is reached. The Miller fine sandy loam is a river deposit, and is not uniform in character. There are sometimes three terraces of this type of soil. The major portion of the type has good drainage, but there are some depressions where the soil is too wet for cultivation. These areas could be easily reclaimed by open ditches or by tile drains. The water table is generally found at the depth or 2 to 3 feet even in dry weather. It is a result of deposits laid down by the Red River. The original timber growth consists principally of cottonwood, ash, pecan and elm. This is a very fertile soil, well adapted to corn but suited also to the other crops grown in this locality. Corn yields from 30 to 40 bushels per acre and cotton about one-half bale. This soil is also well adapted to truck crops, such as potatoes, tomatoes, cabbage, and cantaloupe. Alfalfa

produces 4 to 5 tons per acre. Peanuts do well. This soil is well supplied with plant food. It will need rotation, with legumes first of all.

Grayson Clay Loam.—The surface soil consists of 8 to 10 inches of dark gray or brown loam with a stiff yellow clay or silty clay subsoil, sometimes mottled in color. This type of soil is known locally as flat and covers an area resembling an old lake bed about nine miles long and one and one-half miles wide, extending north and south between Southmayd and Gunter. The soil is flat and poorly drained, and most of it is uncultivated. The soil could be drained. The soil is well supplied with plant food.

Durant Fine Sand.—The surface soil consists of 3 to 4 inches of light gray fine sand with a reddish gray or yellowish gray fine sandy subsoil to a depth of 30 to 36 inches. It is found principally around Collinsville. The soil is probably formed by wind action. It occurs in small spots in the Susquehanna sandy loam and the Durant fine sandy loam. The soil is drifted by the wind, does not hold water, and is for this reason unproductive. It is also low in phosphoric acid and nitrogen.

Crawford Clay.—This is brown or chocolate colored clay soil 10 inches deep with a lighter colored stiff clay subsoil. It is found on slightly rolling to almost level areas. The drainage is good. Only a small area of this type is found about six miles southeast of Sherman. It is easily cultivated and produces well. Corn yields from 35 to 50 bushels, cotton one-half to three-fourths bale, oats 40 to 50 bushels, and wheat from 12 to 20 bushels per acre. The soil is well supplied with plant food. It would perhaps respond to acid phosphate in a good season.

Durant Loam.—This soil consists of 10 to 15 inches of dark gray or grayish brown loam surface soil with a somewhat heavier subsoil passing by degrees into a stiff brown or yellowish brown silty clay. It is found on areas that vary from almost level to slightly rolling. The drainage is good during an average year, but during wet seasons crops suffer to some extent from an excess of moisture on the level areas. A large area is found around Red Branch; other large areas are found in the vicinity of Whitesboro and Steedman. It is a productive soil, well adapted to corn, cotton, and oats. Corn yields from 35 to 45 bushels per acre, cotton about one-half bale, and oats from 35 to 50 bushels. This soil is well supplied with plant food. It will need crop rotation with legumes first.

Durant Fine Sandy Loam.—The surface soil is a fine textured sandy loam of a dark gray color and about 8 to 15 inches deep. The surface soil varies from dull yellow to brown, and is a sticky clay containing some fine sand. Both the soil and subsoil vary in color. The surface ranges from level to gently rolling and the level areas are darker and have a deeper color than the rolling areas. The soil has a tendency to drift. Large areas are found in the western part of the county north

and south of Whitesboro. The soil is easily cultivated, and well adapted to corn, cotton, oats, and fruit. It is a fine peanut soil and also produces truck well, including sweet and Irish potatoes and cantaloupes. Corn yields from 25 to 35 bushels, cotton about one-fourth bale, and peanuts from 35 to 50 bushels per acre.

This soil is fairly well supplied with plant food. It will probably need nitrogen and legume rotation first of all.

DESCRIPTION OF SAMPLES.

2834. Crawford clay: Brown or chocolate colored clay; 0"-8"; no rocks; taken five miles north of Howe.

2835. Subsoil to 2834: Chocolate colored, stiff clay; 8"-36".

2826. Durant fine sandy loam: Gray, fine sandy loam; 0"-18" depth; taken one and one-half miles southeast Whitesboro, Whitesboro Fruit Farm.

2827. Subsoil to 2826: Yellowish, mottled clay soil; 18"-36".

3355. Durant fine sandy loam: 0"-10"; W. A. Boaz's farm, three miles west of Whitesboro. Produces one-third bale cotton and 25 bushels corn; moderate.

3356. Subsoil to 3355: 10"-22".

2842. Durant fine sand: 0"-4"; three miles southeast of Denison; light gray; fine sand.

2843. Subsoil to 2842: 4"-36"; light gray, fine sand, slightly reddish tinge.

2822. Durant loam: 0"-10"; one and one-half miles south of Whitesboro, Whitesboro Fruit Farm; gray loam, high per cent silt.

2823. Subsoil to 2832: 12"-36"; yellowish mottled silty clay.

2946. Houston black clay: 0"-10"; seven miles southeast of Sherman; R. E. Fowler's farm; heavy black clay.

2947. Subsoil to 2946: 10"-36"; heavy black clay.

2840. Houston clay: 0"-8"; gray friable clay; seven miles southeast of Sherman.

2841. Subsoil to 2840: 8"-36"; yellowish clay, containing white spots.

2948. Houston clay: 0"-12"; gray friable clay; ten miles southeast of Sherman; Passel Head farm.

2944. Houston clay loam: 0"-12"; brown clay loam; five miles southeast of Sherman; Wm. Leslie's farm.

2945. Subsoil to 2944: 12"-36"; brown clay loam.

2836. Miller fine sandy loam: 0"-18"; grayish yellow sandy loam; one mile east of Cedar Mills; Allen Gudyer's place.

2837. Subsoil to 2836: Light reddish sandy clay; types get heavier as depth increases.

2838. Susquehanna clay: 0"-5"; reddish brown, heavy sandy loam; three and one-half miles southeast of Denison.

2839. Subsoil to 2838: 5"-36"; red sandy clay.

2824. Susquehanna fine sandy loam: 0"-15"; brownish gray, fine sandy loam; one mile north of Whitesboro; Harper's estate.

2825. Subsoil to 2824: 15″-36″; red sandy clay.

9335. Susquehanna fine sandy loam: 0″-6″; fertility moderate and uniform; upland; five miles east of Denison; F. M. Glothlin's farm.

9336. Subsoil to 9335: 6″-18″.

2828. Wilson clay: 0″-6″; land used as meadow; one-half mile southwest of Pottsboro; J. T. Bryant's place.

2829. Subsoil to 2828: 5″-36″.

2830. Wilson clay loam: 0″-10″; one-half mile southeast of Pottsboro; J. T. Bryant's farm; land in corn.

2831. Subsoil to 2830: 10″-36″; 4 per cent. gravel.

TABLE 2. COMPOSITION OF SOILS—GRAYSON COUNTY.

	Crawford Clay.		Durant Fine Sandy Loam.		Durant Fine Sandy Loam (probably).		Durant Fine Sand.		Durant Loam.	
	Surface 2834	Subsoil 2835	Surface 2826	Subsoil 2827	Surface 3355	Subsoil 3356	Surface 2842	Subsoil 2843	Surface 2822	Subsoil 2823
Percent.										
Phosphoric Acid	.11	.11	.05	.03	.04	.04	.02	.02	.04	.02
Nitrogen	.18	.10	.08	.09	.08	.07	.02	.04	.18	.08
Potash	.72	.78	.15	.34	.29	.39	.18	.07	.34	.23
Total Potash	.58	1.08	.66	.82	.48	.56	.32	.22	.88	.90
Lime	.93	.85	.19	.25	.24	.42	.13	.12	.41	.35
Magnesia	.05	.33	.15	.49	.16	.45	.11	.08	.58	.09
Alumina and Oxide of Iron	15.84	20.45	2.80	8.41	6.22	11.69	.95	1.14	8.90	4.16
Insoluble and Soluble Silica	69.38	62.51	94.31	84.55	87.69	78.25	97.99	98.88	80.33	89.00
Loss on Ignition	11.61	10.00	2.08	3.27	3.47	4.87	.70	1.26	6.66	3.93
Moisture	3.97	4.93	.69	2.81	1.59	3.95	.07	.05	2.67	1.80
Parts Per Million.										
Active Phosphoric Acid	29	.....	46	4	9	15	28	39	27	14
Active Potash	290	.....	93	116	97.7	99	56	46	199	79
Acidity	0	0	0	0	0	0	0	0	0	0

TABLE 2—Continued. COMPOSITION OF SOILS—GRAYSON COUNTY.

	Grayson Clay Loam.		Houston Black Clay.		Houston Clay.		Houston Clay.	Houston Clay Loam.	
	Surface 2832	Subsoil 2833	Surface 2946	Subsoil 2947	Surface 2840	Subsoil 2841	Surface 2948	Surface 2944	Subsoil 2945
Percent.									
Phosphoric Acid	.07	.05	.12	.09	.21	.16	.10	.03	.02
Nitrogen	.14	.05	.26	.14	.07	.05	.12	.12	.10
Potash	.42	.12	.66	.60	.48	.33	.31	.24	.20
Total Potash	.88	.33	1.02	.56	.76	.84	.58	.58	.54
Lime	.65	.16	3.01	7.54	33.80	31.35	32.70	.59	.70
Magnesia	.41	.18	.62	.86	.70	.80	.31	.29	.40
Alumina and Oxide of Iron	7.25	6.25	15.60	15.82	7.63	8.99	5.5	8.62	11.25
Insoluble and Soluble Silica	83.21	90.26	58.80	55.88	24.07	27.30	15.54	81.17	78.56
Loss on Ignition	7.26	2.73	13.33	13.31	18.88	18.75	20.11	5.74	6.15
Moisture	2.29	.74	15.13	5.80	2.69	3.05	1.99	2.65	2.93
Parts Per Million.									
Active Phosphoric Acid	30	6	254	100	20	9	14	17.5	6.9
Active Potash	190	99	379	180	114	100	86	175	153
Acidity	0	200	0	0	0	0	0	0	0

TABLE 2—Continued. COMPOSITION OF SOILS—GRAYSON COUNTY.

	Miller Fine Sandy Loam.		Susquehanna Clay.		Susquehanna Fine Sandy Loam		Susquehanna Fine Sandy Loam.		Wilson Clay.		Wilson Clay Loam.	
	Surface 2836	Subsoil 2837	Surface 2838	Subsoil 2839	Surface 2824	Subsoil 2825	Surface 9335	Subsoil 9336	Surface 2828	Subsoil 2829	Surface 2830	Subsoil 2831
Percent.												
Phosphoric Acid	.06	.05	.05	.05	.04	.04	.05	.04	.02	.09	.04	.04
Nitrogen	.08	.05	.08	.06	.05	.07	.07	.05	.15	.07	.11	.13
Potash	.25	.43	.40	.60	.27	.33	.15	.22	.30	.44	.31	.29
Total Potash	1.24	1.06	.92	.64	.60	.72	.68	.....	1.44	1.36	.84	.84
Lime	.29	.16	.54	.28	.11	.26	.17	.02	.82	4.43	.31	.54
Magnesia	.16	.11	.24	.69	.35	.37	.14	.16	.38	1.27	.37	.31
Alumina and Oxide of Iron	3.34	7.10	10.05	15.63	3.55	10.15	4.45	8.93	18.17	17.68	6.63	8.78
Insoluble and Soluble Silica	93.53	89.00	80.11	70.62	93.43	83.06	91.15	84.41	62.10	56.29	83.98	81.62
Loss on Ignition	1.28	2.45	4.60	6.62	2.00	4.01	2.71	3.50	10.74	9.61	5.30	6.78
Moisture	1.49	1.40	2.91	3.23	.63	2.36	0.94	2.26	6.26	7.04	2.29	2.76
Parts Per Million.												
Active Phosphoric Acid	151	22	11	.....	19	7	16	8	18	154	19	13
Active Potash	291	.....	168	.....	105	118	161	81	308	233	151	169
Acidity	0	0	0	0	0	0	0	460	0	0	0	0

TABLE 3. INTERPRETATION OF SOIL ANALYSES OF GRAYSON COUNTY.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibility in bushels per acre for		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Grayson County.						
Crawford clay	good	good	good	18	120	48
Durant fine sandy loam	fair	low	fair	30	37	23
Durant fine sandy loam (probably)	good	good	good	6	37	23
Durant fine sand	low	good	good	12	37	8
Durant loam	good	good	good	18	80	48
Grayson clay loam	good	good	good	18	80	38
Houston black clay	good	good	high	50	157	48+
Houston clay	good	good	high	45	80	23
Houston clay	good	good	high	12	37	28
Houston clay loam	low	good	good	12	80	33
Miller fine sandy loam	good	good	good	45	120	23
Susquehanna clay	good	good	good	12	80	23
Susquehanna fine sandy loam	fair	fair	fair	12	51	18
Susquehanna fine sandy loam	fair	fair	fair	12	80	23
Wilson clay	low	good	good	12	157	8
Wilson clay loam	good	good	good	12	51	33

TABLE 4. GROWN WITH FERTILIZER IN GRAYSON COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
2826	Durant fine sandy loam.	Corn, 1910	48.5	30.0	16.5	6.5	36.7
		Corn, 1910	29.4	.....	.....	6.2	16.2
		Corn, 1911	50.1	49.5	.....	.....	25.2
		Corn, 1912	49.9	.....	.....	26.8	.....
		Sorghum, 1912	21.1	.....	.....	3.6	.....
		Corn, 1913	36.2	.....	.....	6.7	.....
2822	Durant loam.	Corn, 1910	41.0	42.0	20.2	37.5	36.5
		June corn, 1910	22.0	.....	.....	.....	18.3
		Mustard, 1910	.7	.....	.....	.....	.4
		Corn, 1910	57.3	.....	.....	.....	44.7
2823	Durant loam subsoil.	Corn, 1912	60.1	.....	.....	25.0	.....
		Sorghum, 1913	23.0	.....	.....	2.2	.....
		Corn, 1912	40.4	.....	.....	5.4	.....
2946	Houston black clay.	Corn, 1910	24.1	15.8	16.5	23.1	19.2
		Sorghum, 1910	45.2	.....	.....	.....	51.7
2947	Houston black clay subsoil.	Corn, 1910	34.5	.....	3.0	.....	21.0
		June corn, 1910	14.2	.....	3.8	.....	9.3
2948	Houston clay.	Corn, 1910	10.0	4.1	3.6	13.5	10.6
		Sorghum, 1910	47.4	.....	.....	.....	43.0
		Oats, 1910	2.7	.....	.....	.....	1.9
		Corn, 1911	33.0	.....	.....	.....	24.5
		Corn, 1912	22.6	.....	.....	.....	22.0
		Sorghum, 1912	15.2	.....	.....	.....	13.0
2944	Houston clay loam.	Corn, 1910	43.0	40.0	38.2	13.0	43.0
		Sorghum, 1910	44.7	.....	40.2	8.0	41.4
		Corn, 1912	58.1	.....	17.6	.....	.....
		Sorghum, 1912	24.7	.....	17.0	.....	.....
		Corn, 1913	45.2	.....	20.2	.....	.....
		Sorghum, 1913	25.2	.....	6.6	.....	.....
		Corn, 1914	37.5	.....	10.0	.....	.....
		Sorghum, 1914	30.7	.....	7.5	.....	.....
2945	Houston clay loam, subsoil.	Corn, 1910	43.0	37.0	4.0	.....	.....
		Oats, 1910	0.7	0.8	0.8	.....	.....
		Corn, 1911	49.0	45.5	6.9	.....	.....
2824	Susquehanna fine sandy loam.	Corn, 1910	38.5	2.80	7.7	4.1	26.3
		June corn, 1910	25.8	.....	.....	.....	18.7
		Corn, 1913	27.2	.....	.....	19.7	.....
		Sorghum, 1913	29.5	.....	.....	3.9	.....
		Corn, 1914	36.4	.....	.....	10.0	.....
		Sorghum, 1914	27.5	.....	.....	4.4	.....

TABLE 4. GROWN WITH FERTILIZER IN GRAYSON COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
2825	Susquehanna fine sandy loam. subsoil.	Corn, 1910....	34.0	.....	3.0	.....	27.5
		June corn, 1910	27.2	.....	.....	.....	21.2
		Corn, 1911....	37.3	.....	.....	.....	30.0
9336	Susquehanna fine sandy loam, subsoil.	Corn, 1915....	34.7	.....	.....	.....	31.0
2828	Wilson clay.	Corn, 1910....	25.5	23.0	7.0	28.7	28.5
		June corn, 1910	16.2	.....	5.7	7.3	19.0
		Corn, 1911....	37.0	.....	.....	.....	33.0
		Corn, 1914....	22.6	.....	11.9	.....	.....
		Sorghum, 1914.	.....	.....	21.5	.....	.....
		Corn, 1915....	54.3	.....	24.3	.....	.....
2829	Wilson clay, subsoil.	Corn, 1910....	16.5	.....	6.5	14.0	18.0
		June corn, 1910	11.7	.....	4.4	3.5	10.5
		Corn, 1911....	30.7	.....	.....	.....	29.5
		Sorghum, 1911.	9.5	.....	.....	.....	8.3
2830	Wilson clay loam.	Corn, 1910.....	45.5	11.0	13.0	20.0	37.7
		June corn, 1910	22.7	.....	.....	.....	15.9
		Corn, 1911....	39.9	.....	.....	.....	33.2
		Corn, 1912....	43.4	.....	44.6	.....	.....
		Sorghum, 1912.	19.3	.....	19.0	.....	.....
2831	Wilson clay loam, subsoil.	Corn, 1910....	42.0	.....	9.5	15.0	39.0
		June corn, 1910	15.3	.....	.....	.....	10.2
		Corn, 1913....	53.0	.....	.....	10.9	.....
		Sorghum, 1913.	25.7	.....	.....	2.5	.....
		Corn, 1914....	28.5	.....	.....	5.6	.....
		Sorghum, 1914.	32.0	.....	.....	2.9	.....
		Corn, 1915....	31.5	.....	.....	5.8	.....

SOILS OF LEE COUNTY.

Lee county is in the Gulf Coastal Plain and has an area of approximately 700 square miles. The mean altitude is 400 feet. It is inclined to the southeast and north and has a general slope of about four feet to the mile. Ten different types have been mapped by the Bureau of Soils. These are shown in Table 5.

TABLE 5. SOIL SURVEY OF LEE COUNTY.

Areas of Different Soils.

Soil.	Acres.	Per cent.
Lufkin fine sandy loam	113,152	26.6
Orangeburg fine sand	96,696	16.4
Orangeburg fine sandy loam	57,920	13.6
Lufkin gravelly loam	47,360	11.1
Norfolk fine sand	41,856	9.8
Houston black clay	38,208	8.9
Sharkey clay	28,096	6.6
Meadow	13,760	3.2
Orangeburg clay	10,688	2.5
Lufkin loam	5,376	1.3
Total	426,112	.....

With the exception of the Houston black clay, the soils of this area are low in active phosphoric acid, and seem to need fertilization with acid phosphate. They also need crop rotation, including legumes to secure nitrogen from the air. None of these samples tested for acidity

were found to be acid. Nitrogen, crop rotation, and acid phosphate, seem to be the chief needs of the soils of this area. This is also shown in the pot experiments.

DESCRIPTION OF THE SOIL TYPES OF LEE COUNTY.

Lufkin Fine Sandy Loam.—The Lufkin fine sandy loam is generally light in texture, and gray to dark gray in color. The type varies in depth from 3 inches on hillsides to 20 inches, but averages about 15 inches. The subsoil of this type is a stiff sandy clay, varying from 3 to 36 inches in depth and gray to dark gray in color. During the dry seasons the subsoil cracks deeply unless covered by a good depth of soil.

This soil has great water holding capacity, but capillarity works very rapidly and crops frequently suffer unless due care is exercised in the preservation of the moisture. The Lufkin fine sandy loam is the predominating type of the southeastern part of the county.

The drainage is generally good, although some of the land must be drained in order to produce good crops.

Only a small part of this type is cultivated, corn and cotton being the principal crops. From 15 to 20 bushels of corn and one-fourth to one-half bale of cotton are the average yields per acre. The soil needs phosphoric acid, nitrogen, and legume rotation.

Houston Black Clay.—The Houston black clay varies from a heavy loam to a clay loam or clay, and is known as "waxy clay land" by the farmers. The soil is from 3 to 12 inches deep, and it has great water holding capacity. It cracks badly in dry season. The soil is dark to dark brown in color.

The subsoil is a dark heavy clay varying in depth from 10 inches to 3 or 4 feet. The soil forms a belt running northeast and southwest across the county at the center. The drainage is generally good. This soil has been cultivated for a number of years to corn, cotton and oats. Under favorable conditions corn produces 50 bushels and cotton from one-half to one bale per acre. This soil is well supplied with plant food. It will need crop rotation with legumes first.

Orangeburg Fine Sandy Loam.—This soil is from 6 to 15 inches deep, and is covered by a forest growth of post and blackjack oaks. It is a medium to fine sand, reddish brown to gray in color and does not contain much organic matter. Most of the area occupied by this type is still virgin.

The subsoil is a red sandy clay, usually more than three feet deep. Most of this soil is found in the northern part of the county and some in the extreme western part. The drainage is everywhere very good.

Cotton and corn are the principal crops, 30 to 40 bushels of corn and one-half to three-fourths of a bale of cotton being produced per acre. The sample examined is low in phosphoric acid.

Lufkin Loam.—The Lufkin loam is from 3 to 10 inches deep, grading from a heavy loam to a fine sandy loam, is dark in color, and contains

a fair amount of organic matter. It is easily puddled. The subsoil is a stiff, compact, dark colored clay. This soil lies principally three miles east of Giddings on both sides of the Houston & Texas Central Railroad. The drainage is poor and during wet seasons crops suffer from standing water.

Corn and cotton are the principal crops, corn producing from 25 to 35 bushels per acre, and cotton from one-fourth to three-fourths bale per acre.

Norfolk Fine Sand.—The Norfolk fine sand is a fine loose coarse soil, always over three feet deep, with little or no difference between the soil and subsoil. Only a small percentage of the total area has been cleared. The largest continuous areas of this type are found in the extreme northern part of the county. The soil is everywhere rolling and the drainage is perfect. The soil is considered of little agricultural value and only a small area is planted to crops. When first cleared it yields fair crops of cotton, but corn makes only an indifferent growth. The sample examined is low in phosphoric acid and nitrogen. It needs a legume rotation.

Orangeburg Fine Sand.—This soil is a loose, incoherent, medium to fine sand, varying in depth from 18 to 36 inches, and gray to yellowish gray in color. The subsoil is nearly all a red sandy clay.

This type is located mostly in the northern and western part of the county, although narrow strips are found in the south. The surface of this soil is always rolling and the drainage is almost perfect. The crops grown are cotton and corn, the yields being one-third to one-half bale of cotton and 25 to 30 bushels of corn per acre, when the land is fresh. The humus is soon exhausted from this soil. The sample examined is low in active phosphoric acid.

Orangeburg Clay.—The Orangeburg clay is from 3 to 10 inches in depth, is a red heavy sandy loam to a loam, and usually contains much organic matter. The subsoil usually extends to a depth of more than 36 inches. Most of this soil lies in the northern part of the county. The surface is rolling and the drainage is good. Corn yields from 30 to 40 bushels per acre, and cotton from one-half to three-fourths of a bale per acre. Most of the soil is under cultivation, some of it is in meadow and good crops of Johnson grass hay are secured. The sample is low in phosphoric acid, but well supplied with nitrogen.

Sharkey Clay.—This soil is from 10 to 20 inches deep and is usually a heavy yellowish gray to dark gray clay. The subsoil grades from a dark stiff heavy clay to fine yellow sand. This type is found along the lower courses of the larger streams north of Giddings; it is generally level and subject to annual overflow. The soil would profit by both surface ditches and tile drains.

Only the lighter phases of this type are under cultivation. Cotton produces a bale per acre, and corn 50 bushels. Floods, however, are yearly expected and crops are frequently lost.

Meadows.—The meadow varies in depth and texture of soil, from 10 to 24 inches deep and contains a fair amount of organic matter. The surface soil is a gray to a dark gray fine loamy sand. The subsoil is similar to the surface but usually contains more clay than the latter. The meadow is found along almost all the smaller streams; it is nearly all level enough to plow. It is easily tilled and most of the land is under cultivation. The average yields are 20 bushels of corn and one-third bale of cotton per acre.

TABLE 6. COMPOSITION OF SOILS—LEE COUNTY.

	Houston Black Clay.		Lufkin Fine Sandy Loam.		Lufkin Fine Sandy Loam.		Norfolk Fine Sand.		Norfolk Fine Sand (probably).	
	Surface 3633	Subsoil 3634	Surface 3631	Subsoil 3632	Surface 3974	Subsoil 3975	Surface 3652	Subsoil 3653	Surface 4289	Subsoil 4290
Percent.										
Phosphoric Acid	.08	.07	.04	.05	.03	.02	.01	.03	.02	.02
Nitrogen	.06	.05	.06	.06	.05	.04	.02	.04	.04	.03
Potash	.99	1.05	.19	.39	.19	.13	.05	.....	.12	.25
Total Potash	.....	.....	.....	.....	.70	.59	.63	.62	.....	.....
Lime	.98	.80	.59	.53	.39	.14	.15	.....	.20	.19
Magnesia	.30	.32	.16	.43	.15	.14	.11	.....	.07	.09
Alumina and Oxide of Iron	18.80	18.65	3.09	11.64	1.72	3.61	1.23	.....	1.15	4.31
Insoluble and Soluble Silica	64.24	65.91	91.93	76.22	94.27	92.77	97.35	.....	96.53	91.91
Loss on Ignition	7.02	6.70	2.17	4.99	1.74	1.86	.95	.40	1.30	1.55
Moisture	6.10	7.23	1.26	5.69	.85	1.22	.23	.29	.36	1.07
Parts Per Million.										
Active Phosphoric Acid	66	56	95	9	18	6	5	11	21	11
Active Potash	259	243	299	310	135	81	74	52	106	93
Acidity	.....	.....	0	0	0	0	200	.....	0	.....

TABLE 6—Continued. COMPOSITION OF SOILS—LEE COUNTY.

	Orangeburg Clay.		Orangeburg Fine Sand.		Orangeburg Fine Sand (probably).		Orangeburg Fine Sandy Loam.	
	Surface 3662	Subsoil 3663	Surface 3654	Subsoil 3655	Surface 4326	Subsoil 4327	Surface 3656	Subsoil 3657
Percent.								
Phosphoric Acid	.13	.11	.02	.02	.04	.05	.02	.02
Nitrogen	.13	.11	.02	.02	.05	.06	.02	.03
Potash	.33	.30	.03	.07	.28	.42	.02	.19
Total Potash	.57	.67	.71	.73	.....	.....	.53	1.18
Lime	.26	.30	.20	.18	.15	.21	.07	.23
Magnesia	.30	.26	.17	.13	.17	.26	.15	.19
Alumina and Oxide of Iron	17.95	17.94	1.08	.99	6.20	14.12	.96	6.82
Insoluble and Soluble Silica	69.74	69.87	97.53	97.71	89.60	77.04	97.60	87.60
Loss on Ignition	7.56	6.92	.85	.58	1.55	3.63	.66	2.31
Moisture	3.46	3.43	.16	.26	1.52	4.26	.19	1.68
Parts Per Million.								
Active Phosphoric Acid	9	10	6	6	5	3	13	7
Active Potash	242	154	98	92	181	176	66	86
Acidity	0	0	0	0	0	0	0	0

DESCRIPTION OF SAMPLES.

3633. Houston black clay: 0″-12″; good soil, rolling; cracks on drying; washes; three miles west of Lexington; C. H. Taylor's farm; produces 30 bushels corn, one-third bale cotton.

3634. Subsoil to 3633: 12″-24″; black.

3631. Lufkin fine sandy loam: 0″-6″; moist in dry season; does not wash; crumbles; one and one-half miles southwest of Giddings; moderate, upland; 25 years in cultivation; 8 tons of barnyard manure to acre; produces 1200 pounds seed cotton, 45 bushels corn.

3632. Subsoil to 3631: 6″-12″.

3974. Lufkin fine sandy loam: 0″-12″; brown loam; moderate, rolling; one mile southwest of Giddings; O. D. Hurst's farm; 20 years in cultivation; 12 tons manure; good results; crops, cotton and peanuts.

3975. Subsoil to 3974: 12″-24″; brown to black clay loam.

3652. Norfolk fine sand: 0″-12″. Packs, does not wash; Louis Gest's farm, two miles west of Lexington; not in cultivation.

3653. Subsoil to 3652: 12″-24″.

4289. Norfolk fine sand: 0″-6″; light, sandy; moderate, upland, rolling; five miles northwest of Lexington; W. D. Plant's farm; holds moisture well in dry season; under drains well in wet season; does not pack, crack or wash; crumbles; two years in cultivation; crops, corn, cotton, cowpeas; 20 bushels corn, one-half bale of cotton.

4290. Subsoil to 4289. 6″-13″; light, sandy.

3662. Orangeburg clay: 0″-18″; red, little sticky when wet; does not wash; cracks some on drying; Jno. Mundin's farm, one-half mile east of Lexington; 30 years in cultivation; produces three-fourths bale cotton, 50 bushels corn.

3663. Subsoil to 3662: 18″-30″.

3654. Orangeburg fine sand: 0″-12″; good rolling soil; does not pack or run together; holds moisture; two miles west of Lexington; Louis Gest's farm; 25 years in cultivation; produces 20 bushels corn, one-half bale cotton, 100 bushels potatoes.

3655. Subsoil to 3654: 12″-24″; behaves well in wet weather; have used fertilizers with good results.

4226. Orangeburg fine sand: 0″-5″; red, sandy; L. L. Sealy's farm, two and one-half miles southwest of Tanglewood; moderate, upland; does not crack, pack, or wash; crumbles; 60 to 70 years in cultivation; produces 15 bushels corn.

4227. Subsoil to 4226: 5″-18″; red, sandy.

3656. Orangeburg fine sandy loam: 0″-12″; holds moisture well; does not crack on drying; no clods; two miles east of Lexington; Louis Gest's farm; cotton will not grow, probably root rot; produces 25 bushels corn, 2 tons cane, 100 bushels potatoes; have used barnyard manure with good results.

3657. Subsoil to 3656: 12″-24″; good soil.

TABLE 7. INTERPRETATION OF SOIL ANALYSES OF LEE COUNTY.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibility in bushels per acre for		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Houston black clay	good	good	good	35	120	18
Lufkin fine sandy loam	good	good	good	40	80	18
Lufkin fine sandy loam	low	good	good	12	51	18
Norfolk fine sand	low	low	good	6	37	8
Probably Norfolk fine sand	low	good	good	18	37	13
Orangeburg clay	good	good	fair	6	80	38
Probably Orangeburg fine sand	low	low	good	6	37	8
Orangeburg fine sand	fair	good	good	6	80	18
Orangeburg fine sandy loam	low	low	low	12	37	8

TABLE 8. GROWN WITH FERTILIZER IN LEE COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
3633	Houston black clay.	Sorghum, 1910.	18.1	30.9	2.0	3.5	22.5
		Mustard, 1910.	1.8	5.1	.....	.....	5.0
		Corn, 1911....	36.7	65.6	.....	.....	52.2
		Corn, 1913....	11.0	.....	.....	10.7	.....
		Sorghum, 1913.	34.8	.....	.....	3.3	.....
		Corn, 1914....	33.2	.....	.....	5.0	.....
		Sorghum, 1914.	25.2	.....	.....	2.2	.....
		Corn, 1915....	23.3	.....	.....	4.5	.....
3634	Houston black clay.	Sorghum, 1910.	10.2	11.7	1.4	3.0	.82
		Mustard, 1910.	4.1	.....	.....	3.3	.....
		Corn, 1911....	33.7	.....	.....	.....	29.2
3631	Lufkin fine sandy loam.	Sorghum, 1910.	50.9	53.7	41.5	15.2	47.9
		Mustard, 1910.	4.8	6.0	4.5	2.7	4.3
		Corn, 1911....	37.2	42.5	11.5	7.5	32.6
3632	Lufkin fine sandy loam.	Sorghum, 1910.	45.3	.....	7.7	17.9	42.9
		Mustard, 1910.	2.2	.....	1.6	0.7	4.5
		Corn, 1911....	43.3	.....	5.4	6.1	42.6
		Corn, 1913....	14.6	.....	.....	9.9	.....
		Sorghum, 1913.	35.9	.....	.....	.....	.....
		Corn, 1914....	35.5	.....	.....	4.8	.....
		Sorghum, 1914.	25.9	.....	.....	1.4	.....
		Corn, 1915....	29.0	.....	.....	3.9	.....
3974	Lufkin fine sandy loam.	Oats, 1910.....	12.5	17.8	6.3	6.3	16.2
		Corn, 1911....	40.5	34.0	5.9	6.6	27.0
3975	Lufkin fine sandy loam.	Oats, 1910.....	11.2	14.2	3.3	3.0	12.2
		Corn, 1912....	43.6	.....	48.6	.....	.....
		Sorghum, 1912.	28.3	.....	23.5	.....	.....
3662	Orangeburg clay.	Corn, 1910....	24.5	20.9	17.9	21.3	26.0
		Mustard, 1910.	5.1	2.8	2.0	1.7	0.2
		Corn, 1911....	49.3	51.3	35.8	12.8	49.2
3663	Orangeburg clay.	Corn, 1910....	20.2	16.8	4.4	15.4	22.2
		Mustard, 1910.	3.3	6.2	2.2	1.0	2.2
		Corn, 1911....	47.9	48.0	15.0	9.7	44.8
3654	Orangeburg fine sand.	Corn, 1910....	22.5	17.2	3.3	5.0	19.3
		Oats, 1910.....	10.8	.....	.....	.....	10.0
		Corn, 1911....	45.5	.....	.....	.....	31.1
3655	Orangeburg fine sand.	Corn, 1910....	29.5	30.0	3.5	2.2	25.0
		Oats, 1910.....	4.2	.....	.....	.....	2.7
		Corn, 1911....	47.8	.....	.....	.....	29.6
		Corn, 1913....	.....	6.9	7.4	.....	.....
		Sorghum, 1913.	.....	6.4	7.0	.....	.....
		Corn, 1914....	.....	3.5	4.0	.....	.....
		Corn, 1913....	.....	25.4	31.4	.....	.....
		Sorghum, 1913.	.....	23.0	25.3	.....	.....
		Corn, 1914....	.....	8.4	3.5	.....	.....
		Sorghum, 1914.	.....	4.4	2.2	.....	.....
		Corn, 1915....	.....	3.7	1.9	.....	.....
		Sorghum, 1914.	.....	16.9	17.0	.....	.....
		Corn, 1915....	.....	9.0	5.8	.....	.....

TABLE 8—Continued. GROWN WITH FERTILIZER IN LEE COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
3656	Orangebury fine sandy loam.	Corn, 1910....	20.4	19.7	5.7	6.2	19.7
		Oats, 1910....	6.7	.....	.....	.....	6.2
		Corn, 1911....	50.1	.....	.....	.....	32.3
		Corn, 1914....	39.5	.....	3.57	.....	.....
		Sorghum, 1914.	26.0	.....	6.9	.....	.....
		Corn, 1915....	39.4	.....	8.6	.....	.....
3657	Orangebury fine sandy loam.	Corn, 1910....	17.9	22.0	2.0	3.0	21.0
		Oats, 1910....	10.7	.....	.....	.....	9.5
		Corn, 1911....	41.0	.....	.....	.....	28.5
		Corn, 1913....	15.8	.....	.....	10.2	.....
		Sorghum, 1913.	27.9	.....	.....	1.5	.....
		Corn, 1914....	40.8	.....	.....	4.0	.....
		Sorghum, 1914.	33.3	.....	.....	1.3	.....
		Corn, 1915....	24.9	.....	.....	1.7	.....

SOILS OF McLENNAN COUNTY.

The area mapped in this survey occupies 490 square miles, of which about 440 miles are in McLennan county and 50 square miles in the northwest part of Bosque county. The greater part of the area on both sides of the Brazos River consists of rolling upland prairie, intersected by numerous small streams and rivers. The prairies have a gentle slope toward the Brazos River. The topography is rough and broken along the small streams and rivers which traverse the prairies of the western section of the area, and the soils here suffer from erosion, which causes them to be shallow, stony, and of low agricultural value. A considerable portion of this area consists of soil deposited by the Brazos River. Sixteen types of soil were mapped in the area. Table 9 shows the area embraced by each type in the locality.

TABLE 9. SOIL SURVEY OF WACO AREA.

Areas of Different Soils.

Soil.	Acres.	Per cent.
Crawford clay	112,320	35.5
Houston black clay	57,280	18.1
Crawford stony clay	27,264	8.6
Susquehanna fine sandy loam	24,512	7.7
Miller fine sandy loam	22,208	7.0
Yazoo heavy clay	13,248	4.2
Houston clay	12,864	4.0
Travis gravelly loam	12,416	3.9
Houston loam	8,640	2.7
Yazoo clay	7,488	2.4
Crawford loam	6,784	2.2
Miller heavy clay	4,608	1.5
Rock outcrop	2,880	0.9
Houston gravelly clay	1,984	0.6
Miller fine sand	1,408	0.4
Miller silt loam	960	0.3
Total	316,864	.....

The soils of this area are generally well supplied with phosphoric acid, although a few of the samples were somewhat low in this respect. They are also well supplied with nitrogen, although there are a larger

number of these soils which are low in nitrogen. They are well supplied with potash. The soils range from fair to good in lime. The principal need of this area appears to be a rotation of crops, which includes legumes to be turned under or grazed off for the purpose of maintaining the supply of nitrogen and adding vegetable matter to the soil. Such a rotation is essential to the proper maintenance of fertility. In connection with this rotation some phosphate would be of advantage on most of the soils, although, as stated, these soils are well supplied with available phosphoric acid as a rule.

DESCRIPTION OF SOIL TYPES OF MCLENNAN COUNTY, WACO AREA.

Houston Black Clay.—This soil is known locally as black waxy prairie land, and is very productive. It is a black sticky clay, sticky and tenacious when wet, but friable and loamy when in a well cultivated condition. The soil grades at about ten inches into a stiff dark drab to slate colored clay, becoming stiffer, heavier, and a little lighter in color as the depth increases.

The largest unbroken tract of this soil lies to the south and southwest of Waco, but it occurs in bodies of more or less extent throughout the county.

The topography is rolling, the soil has good natural drainage, and can be cultivated in a comparatively short time after a rain.

The greater part of this type is derived from the weathering of the Taylor marl formation, a compact, massive, calcareous clay.

The Houston black clay is well adapted to general farming and produces well, suffering very little from drouth. Oats, wheat, and corn are nearly always profitable. Cotton produces from one-half to three-fourths of a bale per acre, corn gives a yield of 30 to 35 bushels per acre, wheat 15 bushels, oats 35 to 50 bushels per acre. The soil is considered best adapted to cotton and grain.

Yazoo Clay.—This soil is a black or dark brown clay loam with an average depth of 8 to 10 inches. On drying it cracks and a lighter colored crust forms. The soil becomes darker, stiffer, and heavier as the depth increases. The type occurs along the valleys of the north and south forks of the Bosque River and reaches the greatest extent between the junction of these streams and the mouth of the Brazos River. The topography is generally level, with a general slope towards the stream. The greater proportion of the type is not subject to overflow and is usually well drained.

The Yazoo clay is an alluvial soil, and one of the strongest and most productive soils in the county. Cotton yields from one-third to one-half bale per acre, even when damaged by the boll weevil. Corn yields 35 to 40 bushels per acre, oats from 35 to 50 bushels, and wheat, which is grown very little, yields from 12 to 15 bushels per acre. Alfalfa does well, and millet, sorghum, onions, and potatoes are grown with excellent results. This soil is well supplied with plant food.

Yazoo Heavy Clay.—The Yazoo heavy clay is a dark drab to black clay, having an average depth of about 10 inches, and grading into a subsoil of slightly lighter color but stiffer and more tenacious. If this soil is plowed when in a wet condition the clods become very hard and baked, making it difficult to get the soil in a suitable condition for the cultivation of crops and lessening its productivity in no small degree.

The largest areas of the type occupy valleys of the Tehucan and Aquilla creeks. The topography is comparatively level, and the land is generally well drained. The Yazoo clay is of alluvial origin, is subject to overflow, and is very productive. With careful management it gives large yields of cotton, corn, oats, and forage crops. Corn and cotton are the principal crops. Before the advent of the boll weevil this soil yielded three-fourths to one bale per acre; at present the yield is one-half bale per acre. Corn gives an average of 35 to 40 bushels per acre. Wheat is seldom grown on account of the danger of overflow.

Miller Fine Sand.—This is a loose gray to white, fine to medium sand, which grades at 12 to 15 inches into a sand of about the same texture, but of a slightly brown or yellowish color and extending to a depth of 4 to more than 6 feet. The largest area of this soil occupies a ridge on the eastern side of the Brazos in the northern part of the county. The soil is of little agricultural value and is not cultivated to any extent. Cotton and corn sometimes give fair yields in wet seasons.

Susquehanna Fine Sandy Loam.—The Susquehanna fine sandy loam is a gray to very light brown fine sandy loam, averaging in depth from 10 to 12 inches. The subsoil is a heavy red to reddish brown sandy clay. The soil becomes stiffer as the depth increases.

The largest areas of this type are scattered over that section of the area surveyed which lies east of the Brazos River. The topography is rolling, the drainage good.

A comparatively small proportion of this type is under cultivation, the remainder being covered by a heavy growth of post oak. The Susquehanna fine sandy loam is locally known as "post oak land" and is not considered a strong soil. The crops usually suffer from lack of moisture in seasons of average rainfall, and are, as a rule, a failure during a dry season. Profitable yields are always obtained in wet seasons. The soil warms up quickly in the spring and is, therefore, well suited to crops which mature before the hot dry months of late summer. Peaches, pecans, pears, and small fruits do well on this soil. Oats yield 25 bushels, corn 20 bushels, and cotton one-fourth bale per acre. Larger yields are produced in wet years. This soil is well supplied with plant food, except nitrogen. It needs legume crop rotation.

Miller Fine Sandy Loam.—The surface soil of this type is mellow, friable and easily tilled, with a depth varying from 12 to 24 inches. The surface soil is brown to grayish brown and from fine to very fine sand and silt. The subsoil is a red sticky sandy clay.

The Miller fine sandy loam is found only along the Brazos River

and is the principal bottom type of the county. The main bodies are found in the bends of the river, the largest near Waco and Patrick. The surface of this type is terraced and each terrace is nearly level.

The Miller fine sandy loam can be worked much sooner after a rain than any other soil in the county except Miller fine sand. Water penetrates easily, but is held in the subsoil and a large percentage of the rainfall is conserved. The drainage is good except in a few local spots, which could be easily drained by open ditches, or closed tile drains.

The Miller fine sandy loam is a deposit laid down by the Brazos River in times of flood and belongs to the present geological time. Along the lower terraces, which are overflowed, it is still in the process of formation.

This soil seems well adapted to the growing of garden truck. Peaches, pears, plums, blackberries, etc., do well also. Cotton is the chief crop grown at present, and yields from one-third to two-thirds bale per acre. Prior to the advent of the boll weevil the soil yielded three-fourths to one bale per acre. In favorable seasons corn yields 50 to 60 bushels per acre, the average, however, being from 20 on the poorest tracts, to 35 on the best. Alfalfa does well when once established. One sample of this soil is well supplied with potash and phosphoric acid, though low in nitrogen. The other sample is low in phosphoric acid and nitrogen.

Travis Gravelly Loam.—The surface soil of this type, to a depth of about 10 inches, consists of a medium to a fine sand or sandy loam, and is a gray to a grayish brown in color. The subsoil (10″-36″) is a mass of coarse sand and small rounded gravel, in a matrix of stiff, heavy, red clay.

The largest body of this soil lies east of Elm creek, extending from the northern border of the area surveyed to the vicinity of the mouth of Whiterock creek. Another area of considerable size is found east of Whiterock creek at Ross.

The topography is undulating to quite rolling and the drainage is excellent on the greater part of the areas. In some localities, notably in the vicinity of Ross, open ditches would be of much value.

The Travis gravelly loam is adapted to the production of peaches, pears, plums, berries, etc. Cotton averages one-third bale per acre, corn from 25 to 30 bushels per acre, and oats from 35 to 40 bushels per acre. All crops do much better in wet seasons. This sample of this soil is low in nitrogen. It needs legume crop rotation.

Houston Clay.—This type is a dark brown to black clay with an average depth of about 10 inches. The surface is friable and easily cultivated, but becomes baked and cracked in areas not cultivated.

The subsoil is a stiff clay, of somewhat lighter color than the surface, and contains small fragments of limestone. Under the subsoil is a layer of rotten limestone or chalk, and on many of the slopes erosion has caused this limestone to appear at the surface.

The main body of this type occurs in a strip extending from the

Brazos River, north of Waco, in a southwest direction to the southern boundary of the area.

The topography of the Houston clay is rolling and the soil is well drained. The soil is formed by the weathering of the Austin chalk. Cotton usually matures earlier on the Houston clay than on the Houston black clay, the average yield being from one-third to one-half bale per acre. Corn yields better in wet seasons, but the average under ordinary conditions lies between 20 and 25 bushels per acre. Millet, sorghum, and wheat are also grown.

Houston Gravelly Clay.—This type is a heavy dark drab or black clay loam containing a large quantity of small rounded gravel, varying in size from the coarse sand to pebbles 2 or 3 inches in diameter. At 10 inches below the surface the soil becomes a stiff dark drab to dark brown clay, much lower in gravel content. This soil is of very limited extent, and occurs in the vicinity of Elm Matt and Ross.

Crops do not yield as well on the Houston gravelly clay as on Houston black clay or "black land." Oats are a surer crop than corn and yield about 30 bushels per acre. They are best sown in the fall. Corn averages 20 bushels per acre, and cotton one-fourth bale. The effect of drouth is much more marked than on the heavier "black land."

Houston Loam.—The typical soil of the Houston loam is a gray to light brown loam from 10 to 12 inches deep, containing a large amount of silt. The subsoil is a drab to slate colored silty clay, which also contains a large amount of sand. The subsoil becomes heavier as the depth increases.

The Houston loam occurs in irregular shaped areas of varying extent in the northeastern part of the county surveyed. The topography is gently rolling and the drainage is generally good.

The greater part of the material forming the type consists of a combination of a fine sand alluvial deposit and the heavier material composing the black prairie soil.

The Houston loam is better adapted to the earlier maturing crops, as the drouths of the late summer seriously affect the yields. Cotton produces from one-third to one-half bale per acre, corn about 25 bushels, oats about 35 bushels, and wheat (rarely grown) from 10 to 12 bushels per acre. Sorghum is grown with good results. In general, crops grown on this type are subject to serious damage from drouths, but during favorable seasons fair yields are always obtained. This soil needs nitrogen and legume crop rotation.

Crawford Clay.—The Crawford clay is one of the most important types found in the area. The soil averages 8 to 10 inches in depth and consists of a brown, slightly reddish clay, which is stiff and tenacious when wet, but friable and granular when dry and in a well cultivated condition. The subsoil (10″-36″) is a stiff tenacious clay of a lighter reddish brown color, which becomes stiffer and more compact as the depth increases.

The Crawford clay occurs in large unbroken areas occupying almost

all the gently rolling area and more level sections of the prairie in the western half of the area surveyed. The whole section is a gently rolling upland plateau. The soil is excellently drained, yet it holds water well enough to produce in an average season all the crops grown.

A large proportion of the grain produced in the county is grown on this soil and it is well adapted to corn and oats. Oats yield 30 to 40 bushels per acre and wheat 15 bushels in an average year. Corn is seldom a failure and will average from 10 to 15 bushels in a dry year and 30 to 40 bushels in a wet season. Cotton averages one-third bale per acre, but in a favorable season and when well cultivated, three-fourths to one bale per acre has been obtained. Millet, rye, sorghum, plums, and peaches are successfully grown. This soil is well supplied with plant food.

Crawford Stony Clay.—This soil is of little importance both in extent and agricultural value. It is a dark reddish brown clay, carrying limestone fragments, and is very shallow, the underlying limestone occurring at depths varying from 12 to 20 inches. The topography is very rolling and the area is well drained; the soil is so shallow and stony that very little moisture is conserved.

The Crawford stony clay is formed from the weathering of the Fort Worth limestone.

The areas covered by this type are not suited to cultivation, but they support an excellent growth of native grasses and are used almost exclusively as pasture lands. Small areas that are comparatively free from stones are sometimes cultivated, and if there is an abundance of rainfall during the growing season a fair crop is secured. Under these conditions the average yields are: corn, 15 bushels; wheat, 6 bushels; oats, 20 bushels, and cotton, one-sixth to one-fifth bale per acre.

Crawford Loam.—The soil of this type is about 12 inches deep, and is a brown to reddish brown loam, containing a relatively large percentage of silt and fine sand. The subsoil is a heavy brown loam, grading at 20 to 25 inches into a stiff reddish compact sandy clay. The principal area occurs north of the Bosque River and southeast of the China Spring. The topography is rolling but there is no serious erosion, and the soil is well drained. The soil is easy to cultivate, and can be worked very shortly after heavy rains.

The Crawford loam is formed from the weathering of the sandy ferruginous clays, impure limestone, and sandstone, which compose the geological formation.

The soil is well suited to the cultivation of cotton, corn, fruits, and also produces fair yields of wheat and oats. Small fruits and vegetables do well. Cotton produces one-third bale per acre under ordinary cultural conditions, but when care is taken one-half bale per acre has been secured year after year. Corn yields 20 bushels per acre, wheat 10 to 15 bushels and millet 1½ tons per acre. Sorghum does exceedingly well. This soil needs nitrogen and crop rotation.

Miller Heavy Clay.—This soil is a clay 8 or 10 inches deep, brown or reddish brown in color, stiff and tenacious when wet, and bakes and cracks on drying. The subsoil is stiffer, lighter, and redder in color.

The Miller heavy clay occurs chiefly in the bottom lands of Tehuacan and Aquilla creeks.

The topography is almost level but the surface as a whole has a gentle slope towards the Brazos River. The surface is generally well drained, but some areas would be greatly improved by artificial drainage.

The type owes its origin to material deposited by the Brazos River, combined with the fine material brought down from the upland prairies by the smaller streams.

Cotton produces one-half bale per acre, corn from 30 to 35 bushels per acre, and oats 40 bushels per acre. Larger yields are procured in the more favorable seasons.

Miller Silt Loam.—The Miller silt loam consists of a fine grained silt loam with a depth of about 15 inches, brown in color and containing a relatively large portion of fine and very fine sand. The subsoil is darker and heavier, but still contains sand. The soil becomes hard and compact and cracks slightly when dry, but breaks up into a mellow seed bed when cultivated.

There are a few small areas of this type, these being west of the river below Waco. The surface is nearly level. The origin of the Miller silt loam is due to deposition of the sediments on the flood plain of the Brazos River, the red color being due to the origin of the material brought down.

A considerable part of this type is used for Johnson grass for pasturage. Cotton, when well cultivated, yields from one-third to one-half bale per acre, corn from 25 to 30 bushels, oats from 30 to 40 bushels, and wheat from 12 to 15 bushels per acre. This type is considered strong for general farming, crops standing the drouth better than those on the more sandy soils.

TABLE 10. COMPOSITION OF SOILS—McLENNAN COUNTY.

	Crawford Clay.		Crawford Loam.		Houston Black Clay.		Houston Black Clay (probably).	Houston Loam.		Miller Fine Sandy Loam (probably).	
	Surface 3343	Subsoil 3344	Surface 3339	Subsoil 3340	Surface 3335	Subsoil 3336	Surface 4565	Surface 3333	Subsoil 3334	Surface 3205	Subsoil 3206
Percent.											
Phosphoric Acid	.21	.14	.04	.03	.54	.09	.09	.02	.01	.03	.04
Nitrogen	.15	.10	.06	.05	.12	.08	.15	.03	.04	.03	.02
Potash	.68	.64	.26	.27	.79	.78	.41	.21	.19	.31	.32
Total Potash	.94	1.00	.74	.94	1.64	1.54	....	.70	.84	1.17	.40
Lime	1.34	1.28	.34	.35	3.30	4.39	8.27	.17	.19	.16	.15
Magnesia	.29	.32	.23	.28	1.12	1.05	.42	.17	.16	.28	.28
Alumina and Oxide of Iron	7.95	10.22	4.51	6.00	11.66	11.85	13.7	2.73	3.58	4.84	4.37
Insoluble and Soluble Silica	80.14	77.20	90.81	88.59	69.78	67.67	56.55	94.84	92.72	91.68	92.71
Loss on Ignition	5.53	5.67	2.17	2.69	8.25	8.17	8.59	1.49	1.99	1.83	1.42
Moisture	3.27	3.78	1.18	1.99	4.60	5.21	7.46	.54	1.09	1.09	0.96
Parts Per Million.											
Active Phosphoric Acid	414	462	54	14	379	259	22.50	21	18	20	24.6
Active Potash	587	461	280	246	447	288	191.2	155	113	129	51
Acidity	0	0	0	0	0	0	0	0	0	0	0

TABLE 10—Continued—COMPOSITION OF SOILS—McLENNAN COUNTY.

	Miller Fine Sandy Loam.		Miller Fine Sandy Loam. (probably).	Susquehanna Fine Sandy Loam.		Travis Gravely Loam.		Yazoo Clay.	
	Surface 3337	Subsoil 3338	Surface 4564	Surface 3345	Subsoil 3346	Surface 3331	Subsoil 3332	Surface 3341	Subsoil 3342
Percent.									
Phosphoric Acid	.05	.04	.04	.05	.06	.05	.04	.25	.25
Nitrogen	.05	.04	.06	.05	.04	.04	.06	.15	.15
Potash	.20	.23	.26	.13	.94	.24	.17	.70	.87
Total Potash	1.32	1.46	....	.51	.66	1.58	.65	1.10	1.08
Lime	.15	.15	.41	.23	.11	.25	.22	3.09	2.70
Magnesia	.14	.29	.13	.10	.16	.17	.20	.41	.43
Alumina and Oxide of Iron	2.57	3.83	2.19	1.78	3.20	2.82	1.29	7.59	8.76
Insoluble and Soluble Silica	94.87	93.20	94.19	95.70	94.24	94.22	95.67	75.14	74.23
Loss on Ignition	1.53	1.48	1.52	1.46	1.39	1.58	1.74	6.61	6.23
Moisture	.34	.73	.50	.37	.72	.58	.36	3.06	3.89
Parts Per Million.									
Active Phosphoric Acid	122	90	161	92	94	65	80	1117	649
Active Potash	309	240	....	319	273	222	126	998	849
Acidity	0	0	0	0	0	0	0	0	0

DESCRIPTION OF SAMPLES.

3343. Crawford clay: 0″-7″; dark brown; powders very well in wet season; behaves poorly when dry; six miles east of Waco; Dr. Sanderson's farm; does not crack or run together; no fertilizer used; has not been cultivated much; produces well in wet seasons, but does not dry out rapidly; produced 15 bushels corn, 25 bushels oats.

3344. Subsoil to 3343: 7″-14″; black clay.

3339. Crawford loam: 0″12″; reddish brown sand; four miles west of Waco; Mr. Biggs' farm; no fertilizer used; crumbles; powders well in wet season; small yield in dry season; 2 years in cultivation; cotton and corn chiefly raised; vegetables and fruits do well.

3340. Subsoil to 3339: 12″-24″; reddish brown sand.

3335. Houston black clay: 0″-12″; black clay; very sticky when wet; packs; dries into clods; does not wash; dirt does not wash onto it; Waco, Mrs. Ellis Blake's orchard; 30 to 40 years in cultivation; no fertilizer used; produces one-half bale cotton, 35 bushels corn.

3336. Subsoil to 3335: 12″-24″; black clay.

4565. Houston black clay: 0″-10″; black clay; waxy; in Waco, Dr. Pond's place.

3333. Houston loam: 0″-10″; light brown, sandy; suffers from drouth; four and one-half miles from Waco; J. N. Worthy's farm; good soil; upland; rolling prairie; no fertilizer used; cultivated since 1882; produces 25 to 30 bushels corn, one-fourth to three-fourths bale cotton.

3334. Subsoil to 3333: 10″-22″; dark brown loam.

3205. Miller fine sandy loam: 2″-6″; moderately good; part very fertile; Waco, H. M. Mineir's farm; Brazos bottom land; cultivated 44 years; produces one-eighth to one-third bale cotton.

3206. Subsoil to 3205: 8″ depth.

3337. Miller fine sandy loam: 0″-12″; light brown, sandy; behaves well in wet and dry seasons; very good soil; Waco, Mrs. Ellis Blake's orchard field; does not pack, crack or wash; crumbles; cultivated 30 to 40 years; cotton, corn, fruit, and vegetables raised; produces 30 to 35 bushels corn, one-half to one bale cotton.

3338. Subsoil to 3337: 12″-24″; yellow clay.

4564. Miller fine sandy loam: 0″-10″; brown sandy loam; near Waco; Dr. Pond's place; Brazos bottom.

3345. Susquehanna fine sandy loam: 0″-12″; brown; sticky in spots in wet season; suffers from drouth; Waco, J. N. Worthy's place; good soil; no fertilizer used; barnyard manure used on small patches with poor results; does not wash; rather dark and heavy; produces 25 bushels corn, one-half bale cotton.

3346. Subsoil to 3345: 12″-24″; light brown sand.

3331. Travis gravel: 0″-12″; does not pack or crack; perfectly loose; three miles northeast of Waco; F. M. Shick's farm; does best in wet season; nothing grown in dry season; washes only in excessive rains; hilly; water sinks rapidly; cultivated 50 years; C/S fertilizer used, and

doubles yield; 50 bushels to acre barnyard manure, always good increase; fine crops, cantaloupes, melons, etc., chiefly grown.

3332. Subsoil to 3331: 12″-24″; dark brown sand.

3341. Yazoo clay: 0″-12″; black clay; little sticky in wet seasons; works well in dry seasons; does not pack, crack or wash; crumbles; six miles east of Waco; Dr. Sanderson's farm; bottom not subject to overflow; cultivated 50 years; no fertilizer used; produces one-half bale cotton, 40 to 50 bushels oats, and 45 bushels corn.

3342. Subsoil to 3341: 12″-24″; black clay.

TABLE 11. INTERPRETATION OF SOIL ANALYSES OF McLENNAN COUNTY.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibility in bushels per acre for		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Crawford clay	good	good	good	74	182	43
Crawford loam	good	good	good	30	120	18
Houston black clay	good	good	high	50	182	33
Probably Houston black clay	good	good	high	18	51	43
Houston loam	low	good	fair	18	80	13
Probably Miller fine sandy loam	.....	good	fair	12	37	13
Miller fine sandy loam	fair	good	fair	45	157	18
Probably Miller fine sandy loam	good	good	good	40	120	13
Susquehanna fine sandy loam	good	good	good	40	157	18
Travis gravelly loam	low	good	good	35	29	13
Yazoo clay	good	good	high	74+	207+	48+

TABLE 12. CROPS GROWN WITH FERTILIZER IN McLENNAN COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
3343	Crawford clay.	Oats, 1910	19.8	19.8	17.7	9.0	20.7
		Corn, 1911	42.0	38.7	40.3	6.1	39.6
		Corn, 1913	49.7	.....	.....	29.2	.....
		Sorghum, 1913.	45.6	.....	.....	10.5	.....
		Sorghum, 1914.	36.2	.....	.....	11.0	.....
		Corn, 1915	44.0	.....	.....	17.2	.....
3344	Crawford clay, subsoil.	Corn, 1914	44.4	.....	.....	30.6	.....
		Sorghum, 1914.	23.5	.....	.....	4.8	.....
		Corn, 1915	47.3	.....	.....	8.5	.....
		Corn, 1915	25.5	.....	.....	.....	25.4
3339	Crawford loam.	Corn, 1911	42.0	4.4	53.2	11.3	40.8
		Sorghum, 1910.	60.5	56.0	43.2	17.2	60.5
		Mustard, 1910.	4.4	2.9	3.2	1.4	2.0
3340	Crawford loam.	Sorghum, 1910.	62.6	57.0	29.0	16.5	57.4
		Mustard, 1910.	2.4	1.7	1.2	.5	1.0
		Corn, 1911	50.3	37.1	10.5	7.4	28.8
		Corn, 1914	35.7	.....	.....	21.0	.....
		Sorghum, 1914.	33.5	.....	.....	2.5	.....
		Corn, 1915	36.8	.....	.....	5.5	.....
3335	Houston black clay.	Oats, 1910	.....	6.8	5.8	5.5	7.8
		Corn, 1911	35.3	40.7	23.3	11.0	43.2
		Corn, 1913	29.7	.....	.....	17.7	.....
		Sorghum, 1913.	40.2	.....	.....	6.1	.....
		Corn, 1914	44.5	.....	.....	10.0	.....
		Sorghum, 1914.	46.0	.....	.....	9.1	.....
		Corn, 1915	30.4	.....	.....	7.2	.....
3336	Houston black clay.	Corn, 1914	22.3	.....	.....	22.4	.....
		Sorghum, 1914.	30.0	.....	.....	5.5	.....
		Corn, 1915	53.4	.....	.....	4.9	.....

TABLE 12—Continued. CROPS GROWN WITH FERTILIZER IN McLENNAN COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
3333	Houston loam.	Corn, 1913....	41.0	.....	32.8	.....	.....
		Sorghum, 1913.	22.5	.....	18.0	.....	.....
		Sorghum, 1914.	29.5	.....	.....	3.5	.....
		Corn, 1914....	42.5	.....	.....	22.7	.....
		Sorghum, 1914.	32.6	.....	21.9	.....	.....
		Corn, 1914....	40.7	.....	19.2	.....	.....
		Corn, 1915....	37.2	.....	.....	5.2	.....
3334	Houston loam.	Corn, 1914....	42.9	.....	.....	20.5	.....
		Sorghum, 1914.	32.0	.....	.....	2.0	.....
		Corn, 1915....	38.8	.....	.....	3.2	.....
3337	Miller fine sandy loam.	Corn, 1910....	24.7	23.7	24.7	11.0	26.7
		Corn, 1913....	31.9	.....	.....	21.5	.....
		Sorghum, 1913.	6.6	.....	.....	5.5	.....
		Corn, 1914....	32.3	.....	.....	8.8	.....
		Sorghum, 1914.	4.0	.....	.....	5.8	.....
3338	Miller fine sandy loam.	Corn, 1914....	46.5	.....	.....	17.9	.....
		Sorghum, 1914.	31.8	.....	.....	2.0	.....
		Corn, 1915....	37.5	.....	.....	3.3	.....
4564	Susquehanna fine sandy loam.	Sorghum, 1910.	55.5	5.3	47.6	17.9	41.5
		Mustard, 1910.	1.5	2.0	1.8	.7	1.1
		Corn, 1911....	48.2	49.1	35.5	8.2	44.1
		Corn, 1914....	48.4	.....	.....	20.2	.....
		Sorghum, 1914.	32.4	.....	.....	5.4	.....
		Corn, 1915....	35.4	.....	.....	3.8	.....
3346	Susquehanna fine sandy loam.	Sorghum, 1910.	40.5	40.7	41.7	6.6	40.7
		Mustard, 1910.	1.6	.....	.....	.....	1.9
		Corn, 1911....	48.4	.....	.....	.....	41.2
		Corn, 1914....	42.7	.....	.....	14.2	.....
		Sorghum, 1914.	30.5	.....	.....	2.2	.....
		Corn, 1915....	36.4	.....	.....	4.5	.....
3331	Travis gravel.	Sorghum, 1910.	50.4	49.5	17.5	10.7	47.0
		Mustard, 1910.	5.5	4.5	3.2	2.0	2.6
		Corn, 1911....	50.8	47.8	15.2	5.4	43.3
		Corn, 1913....	39.5	.....	.....	12.4	.....
		Sorghum, 1913.	33.2	.....	.....	1.1	.....
		Corn, 1914....	51.0	.....	.....	5.2	.....
		Corn, 1914....	35.7	.....	.....	10.0	.....
		Sorghum, 1914.	25.5	.....	.....	2.0	.....
		Sorghum, 1914.	41.4	.....	.....	4.3	.....
		Corn, 1915....	36.9	.....	.....	4.0	.....
		Corn, 1915....	29.1	.....	.....	5.7	.....
3332	Travis gravel.	Sorghum, 1910.	50.5	47.5	42.7	14.5	46.9
		Mustard, 1910.	2.7	5.1	3.5	4.6	2.9
		Corn, 1911....	46.8	54.6	26.9	21.9	49.3
		Corn, 1913....	45.2	.....	.....	18.5	.....
		Sorghum, 1913.	33.2	.....	.....	9.1	.....
		Corn, 1914....	40.5	.....	.....	6.4	.....
		Sorghum, 1914.	26.5	.....	.....	5.7	.....
		Corn, 1915....	47.3	.....	.....	49.3	.....
3341	Yazoo clay.	Oats, 1910....	13.2	10.3	9.8	8.4	9.9
		Corn, 1911....	38.0	44.2	31.9	15.0	39.4
3342	Yazoo clay.	Corn, 1915....	28.41	.....	.....	25.4	.....

SOILS OF TITUS COUNTY.

This area occupies 426 square miles, and is in what is known as the hard timber region of East Texas. The soils, with the exception of a small prairie region in the northeastern corner, are characteristic of the Gulf Coastal Plain. Elevation is from 300 to 500 feet above sea level. The county is well drained. Thirteen different types have been mapped by the Soil Survey of the United States Department of Agriculture. The areas occupied by these types are given in Table 13.

TABLE 13. TITUS COUNTY.

Areas of Different Soils.

Soil.	Acres.	Per cent.
Susquehanna fine sandy loam	125,824	46.2
Norfolk fine sandy loam	61,952	22.7
Meadow	18,432	6.8
Sanders clay	15,104	5.5
Susquehanna gravelly loam	14,848	5.4
Trinity clay	12,032	4.4
Norfolk fine sand	11,136	4.1
Wilson loam	5,824	2.1
Lufkin fine sandy loam	2,368	0.9
Caddo fine sandy loam	1,920	0.7
Susquenanna clay	1,856	0.7
Sanders silt loam	960	0.4
Wilson clay loam	384	0.1
Total	272,640	.....

The soils of this section are generally low in nitrogen, showing a need for crop rotation, including legumes for the purpose of securing nitrogen from the air. Some of the soils, however, are well supplied with nitrogen at present. As the soils are cultivated, the nitrogen will be exhausted and the need for crop rotation with legumes will be more manifest.

Some of these soils are very well supplied with active phosphoric acid, although a number of them are low in total phosphoric acid. There are, however, some soils very low in active phosphoric acid, especially the Norfolk fine sandy loam. Norfolk fine sand is unusually high in active phosphoric acid for this type of soil. The pot experiments show a need for phosphoric acid and for nitrogen for a number of these soils, Two samples of these soils were found to be acid, these being the Susquehanna gravelly loam and the Susquehanna fine sandy loam. It would require about 600 pounds of quicklime, or stone lime, per acre or 1200 pounds of ground limestone to neutralize the acidity of these soils to a depth of seven inches.

All of the other samples of the soil were not acid, although the lime is low in some of them, comparatively speaking.

DESCRIPTION OF SOIL TYPES OF TITUS COUNTY.

Norfolk Fine Sand.—This is the sandiest soil found in the area. The surface soil for 6 inches consists of a gray fine sand. Below this the soil is composed of the same grades of sand, growing lighter in color as the depth increases. At 3 or 4 feet is found a yellow sandy clay. The soil is loose and incoherent. It occurs in a few areas of several square miles and in a number of smaller areas in nearly all parts of the county, extensive stretches occurring on the central ridge.

The soil is naturally well drained, is one of the warmest soils of the county, and well suited for the production of early truck crops. The agricultural value of the soil depends largely upon its depth; when the sand is too deep it is not productive. Such areas suffer in drouths, lack organic matter, and are very difficult to improve. This land,

locally known as "blackjack" land, is not cultivated. The larger part of the Norfolk fine sand, however, is a valuable farming land. It is remarkably productive for a sandy land. Most areas in this county seem to be as productive after years of cultivation as when first cleared.

The principal crops grown have been corn and cotton, but there is a tendency towards diversification. Legumes, especially peanuts, have been grown with success. The yield of cotton ranges from one-fourth to one-half bale per acre; that of corn from 15 to 25 bushels. Where the soil is not too deep and leachy, peach orchards are uniformly successful. This soil needs nitrogen and legume rotation.

Norfolk Fine Sandy Loam.—The soil of this type consists of a gray or yellowish gray fine sandy loam or loamy sand. The depth ranges from 10 to 20 inches, averaging about 12 inches. The subsoil is a yellow or brownish yellow sandy clay, which passes at 3 feet or more into a mottled gray or yellow clay. The surface soil for 2 inches is darkened with organic matter. This type is found in all of the upland part of the county outside of the prairies. The larger uniform areas occur in the southern part of the county. It is not confined to any one kind of topography, nor to any particular elevation, but is more likely to be found on flats where the drainage is slightly retarded and weathering has taken place under conditions different from those that produced the mottled and red subsoil.

The greater part of the type has good natural drainage. Any part can be drained by the simplest methods and at small expense for ditching. The Norfolk fine sandy loam is regarded by some as the most desirable soil in the county for the system of farming now practiced. It stands drouth as well as any other soil in the county. It is especially adapted to truck and peanuts. Corn and cotton are the principal crops, cotton yielding from one-fourth to one-half bale per acre and corn from 15 to 25 bushels. Cowpeas, peaches and potatoes do well on this soil. This soil needs phosphates, and nitrogen, with a legume rotation.

Susquehanna Fine Sandy Loam.—This is the most extensive and important soil type in Titus county. The soil is a gray, fine, very sandy loam, and in some places almost a sand. The depth ranges from 6 to 18 inches, averaging 12 inches. The subsoil is usually a red and yellow clay mottled with drab, passing, before a depth of 3 feet is reached, into a less weathered clay of solid drab or brown color. The surface soil is similar to that of the Norfolk fine sandy loam. It is loose, porous and easily cultivated. The subsoil is a fine clay, stiff and waxy but not so impervious as to be injurious to crops where the position of the land is favorable to drainage.

South of White Oak creek and between it and Sulphur River, are numerous low, poorly drained areas, where the soil is more silty and the drab color predominates in the subsoil. The Susquehanna fine sandy loam is found in all parts of the upland, except in the prairies and in the northwestern section of the county. The largest stretch of the type lies between Sulphur River and White Oak creek. The topography is generally gently rolling to hilly. A large part of the type is

still uncleared, the native forest growth consisting of oak, hickory, ond other hardwoods.

The type is productive and holds its fertility well. Cotton yields from one-fourth to one-half bale per acre and corn from 15 to 20 bushels, these being the principal crops. Peanuts, potatoes, sweet potatoes, cowpeas, and all truck crops do well. Fertilizers are used to a small extent.

The soil is easily eroded,—a fault that should be guarded against by contour plowing, terracing, and the growing of cover crops. This soil is fairly well supplied with phosphoric acid, but needs nitrogen and legume rotation, and one sample needs lime.

Susquehanna Gravelly Loam.—The soil is a gray or reddish gray, very sandy loam to an average depth of about 10 inches. The subsoil is a deep red clay, with more or less sand passing at lower depths into a heavy mottled red and yellow clay. A considerable quantity of gravel is scattered over the surface and through both soil and subsoil, consisting of fragments of iron crusts and small iron concretions.

The type is found in small areas in nearly all parts of the upland, but there are several large areas southeast of Mount Pleasant. The large areas cover high ridges and sharply rolling country. The soil is well drained and considered one of the earliest and most desirable soils in the county. Good crops are produced without fertilizers and the soil is stronger than any other in the county. Cotton yields from one-fourth to two-thirds bale per acre and corn about 20 bushels. The soil is not so well adapted to peaches as the more sandy types; peanuts do well and this should be a favorite crop. This soil needs a legume rotation.

Lufkin Fine Sandy Loam.—The soil is a silty, fine sandy loam, 12 inches deep and dark gray to brown in color. The subsoil is a stiff impervious compact, brown clay. It is usually poorly drained and when so is hard to handle as it runs together when wet and becomes compact and cohesive.

This soil is limited to the prairie regions and to some small sparsely wooded areas on the edge of the prairie. The largest area lies south of White Oak creek, and west of Ripley creek. The surface is level, and artificial drainage is needed badly. Very little of this type is cultivated. It is adapted to cotton, corn, and oats. The greater part is used for pasture. Where wooded, the growth is principally post oak and scrub oak. This soil needs phosphoric acid and a legume rotation.

Wilson Loam.—This soil to the depth of 8 inches is a heavy brown loam, containing very fine sand and a large percentage of silt. The subsoil is a yellow to brown, sticky, impervious clay to a depth of 3 feet or more. When dry the soil pulverizes readily, and may be easily kept in good condition, but in wet seasons it turns up in clods and is liable to puddle and bake. Crops upon this soil are quickly damaged by too much rain and do not stand drouth well. But where drainage is good this is one of the most valuable types of the county. This is a prairie soil and is largely pasture. Where well drained, it produces

one-half to two-thirds of a bale of cotton, and with good cultivation produces a bale to the acre in favorable years. Corn yields 20 to 30 bushels; potatoes and garden truck do well, and ribbon cane is grown on the lower portion.

According to the chemical analysis of the sample, this soil is low in phosphoric acid and will need nitrogen and crop rotation after it has been in cultivation for a short time. It is possible, however, that the samples do not fairly represent the area.

Sanders Clay.—The Sanders clay consists of a heavy, brown silty clay to a depth of 9 inches, with a lighter colored clay loam subsoil. In some places the subsoil is streaked or mottled by brown iron stain. The soil varies considerably in character, as it is an alluvial soil which receives the wash from adjacent hills. It is found as a continued body along White Oak creek. Very little of this type is cultivated and the crops are uncertain on account of the danger of overflows.

The chemical analysis shows that the samples are well supplied with phosphoric acid and potash, but one of them is somewhat low in nitrogen. A crop rotation would, therefore, be of benefit.

TABLE 14. COMPOSITION OF SOILS—TITUS COUNTY.

	Lufkin Fine Sandy Loam.		Norfolk Fine Sand.		Norfolk Fine Sand.		Norfolk Fine Sandy Loam.		Norfolk Fine Sandy Loam.	
	Surface 2342	Subsoil 2343	Surface 2335	Subsoil 2336	Surface 2352	Subsoil 2353	Surface 2331	Subsoil 2332	Surface 2348	Subsoil 2349
Percent.										
Phosphoric Acid	.04	.02	.02	.01	.03	.02	.01	.03	.02	.03
Nitrogen	.08	.09	.05	.05	.04	.02	.06	.04	.03	.04
Potash	.20	.41	.15	.17	.18	.11	.04	.17	.10	.22
Total Potash	.54	.58	.66	.76	.72	.68	.60	.56	.27	.70
Lime	.16	.47	.16	.07	.11	.12	.17	.11	.14	.12
Magnesia	.20	.38	.14	.09	.15	.07	.12	.17	.13	.16
Alumina and Oxide of Iron	4.31	12.65	1.62	1.67	1.79	1.44	3.28	4.88	1.86	7.08
Insoluble and Soluble Silica	90.64	75.67	96.07	97.36	96.71	96.86	93.74	88.45	96.79	87.25
Loss on Ignition	2.84	5.27	1.35	.74	1.22	.82	2.02	2.42	.96	2.64
Moisture	1.16	4.78	.21	.16	.22	.20	.55	1.42	.28	1.10
Parts Per Million.										
Active Phosphoric Acid	7	12	94	17	88	52	12	.....	6	2
Active Potash	132	301	113	281	142	107	150	.....	90	113
Acidity	0	0	0	0	0	0	0	200	0	0

TABLE 14—Continued. COMPOSITION OF SOILS—TITUS COUNTY.

	Norfolk Fine Sandy Loam. (probably).		Sanders Clay.		Sanders Clay.		Susquehanna Fine Sandy Loam.	
	Surface 7179	Subsoil 7180	Surface 2333	Subsoil 2334	Surface 2340	Subsoil 2341	Surface 2337	Subsoil 2338
Percent.								
Phosphoric Acid	.03	.02	.02	.08	.09	.05	.09	.03
Nitrogen	.03	.04	.05	.05	.14	.08	.11	.04
Potash	.10	.17	.11	.04	.05	.42	.41	.40
Total Potash	.....	.....	1.16	1.52	1.44	1.24	1.44	1.22
Lime	.15	.08	.13	.17	.31	.14	.19	.12
Magnesia	.07	.09	.13	.44	.63	.45	.49	.34
Alumina and Oxide of Iron	1.67	5.60	2.78	9.65	8.78	9.18	9.31	16.26
Insoluble and Soluble Silica	96.10	91.29	94.94	83.91	79.97	82.43	82.34	73.79
Loss on Ignition	1.12	1.82	1.52	3.30	6.15	4.15	5.30	5.75
Moisture	.30	.76	.32	2.47	3.45	3.29	2.77	3.19
Parts Per Million.								
Active Phosphoric Acid	45	.18	38	65	36	17	71	96
Active Potash	147	124	175	150	278	147	206	159
Acidity	0	400	0	0	0	0	0	0

TABLE 14—Continued. COMPOSITION OF SOILS—TITUS COUNTY.

	Susquehanna Gravely Loam.		Susquehanna Gravely Loam.		Susquehanna Fine Sandy Loam.		Wilson Loam.	
	Surface 2329	Subsoil 2330	Surface 2346	Subsoil 2347	Surface 2350	Subsoil 2351	Surface 2327	Subsoil 2328
Percent.								
Phosphoric Acid	.03	.04	.05	.04	.02	.02	.04	.05
Nitrogen	.05	.03	.08	.03	.01	.04	.09	.07
Potash	.16	.19	.14	.17	.13	.35	.29	.49
Total Potash	.80	.90	.26	.....	.42	.78	.98	1.23
Lime	.11	.14	.17	.10	.11	.33	.15	.28
Magnesia	.10	.31	3.30	.23	.16	.23	.25	.25
Alumina and Oxide of Iron	3.17	9.30	3.02	9.86	2.66	18.86	6.59	15.01
Insoluble and Soluble Silica	93.38	85.49	83.24	85.23	95.35	74.04	86.59	72.85
Loss on Ignition	1.80	3.00	.65	3.52	1.40	4.35	3.75	5.60
Moisture	.40	1.47	.36	1.15	.40	5.26	1.64	4.00
Parts Per Million.								
Active Phosphoric Acid	21	4	185	6	9	4	11	.....
Active Potash	151	96	200	148	86	92	137	.....
Acidity	0	500	200	200	200	200	0	0

DESCRIPTION OF SAMPLES.

2342. Lufkin fine sandy loam: 0″-8″; light brown; bakes in dry years; hard to cultivate in wet years; C. M. Block's farm, Winsfield; level; fairly productive, but uncultivated; produces one-third to one-half bales cotton or 15 to 20 bushels corn.

2343. Subsoil to 2342: 9″-20″; whitish brown.

2335. Norfolk fine sand: 0″-12″; dark brown; easily handled in wet weather; crops suffer from drouth; 1000 feet northwest of water tower, Mt. Pleasant; no fertilizer used; produces one-third to one-half bales cotton or 20 bushels corn.

2336. Subsoil to 2335: 13″-22″; dark brown.

2352. Norfolk fine sand: 0″-6″; light brown; Mary May's farm, one and one-half miles south of Mt. Pleasant; rolling; soil good; produces one-fourth to one-half bales cotton or 15 to 25 bushels corn.

2353. Subsoil to 2352: 7″-22″; light brown.

2331. Norfolk fine sandy loam: 0″-12″; light brown; four miles northwest of Mt. Pleasant, Chas. A. Hinson's farm; holds water in wet years; crops do well in dry years; produces one-half bale cotton or 15 bushels corn.

2332. Subsoil to 2331: 13″-22″; light brown.

2348. Norfolk fine sandy loam: 0″-10″; light brown; easily handled in wet and dry seasons; five miles southeast of Mt. Pleasant, W. T. Edwards' farm; land run down due to constant cropping with cotton and careless farming; produces one-fourth to one-third bale cotton or 15 to 20 bushels corn.

2349. Subsoil to 2348: 11″-21″; reddish brown.

7179. Norfolk fine sandy loam: 0″-8½″; light brown sand; four miles south of Cookville; W. E. Rus' farm; poor; produces 400 pounds cotton or 10 bushels corn.

7180. Subsoil to 7179: 8½″-17½″; yellowish red, sandy clay.

2333. Sanders clay: 0″-12″; whitish brown; one-half mile north of Evans' bridge; overflows every year; produces three-fourths bale cotton or 30 bushels corn; not used much.

2334. Subsoil to 2333: 13″-24″; whitish brown.

2340. Sanders clay: 0″-8″; light brown; hard to cultivate when wet; works well when dry; T. B. Caldwell's farm, Mt. Pleasant; subject to overflow; unused; produces three-fourths bale cotton or 30 bushels corn.

2341. Subsoil to 2340: 9″-21″; light brown.

2337. Susquehanna fine sandy loam: 0″-16″; light brown; withstands drouth well; easily cultivated; rolling; produces one-third to one-half bale cotton; 20 bushels corn.

2338. Subsoil to 2337: 17″-24″; red.

2350. Susquehanna fine sandy loam: 0″-12″; reddish brown; washes; easily tilled in wet years; withstands drouth; one mile east of Mt. Pleasant, Carr heirs' farm; no fertilizer; produces one-fourth to one-half bale cotton or 20 to 30 bushels corn.

2351. Subsoil to 2350: 13″-24″; red; 2 per cent. gravel.

2329. Susquehanna gravelly loam: 0″-8″; reddish brown; easily tilled in wet and dry seasons; withstands drouth; two and one-half miles east of Mt. Pleasant, F. W. Fitzpatrick's farm; produces one-half to two-thirds bale cotton.

2330. Subsoil to 2329: 9″-20″; light red.

2346. Susquehanna gravelly loam: 0″-10″; reddish brown; withstands drouth and wet seasons; four and one-half miles east of Mt. Pleasant, J. C. Kirby's farm; very productive; produces one-half bale cotton or 20 bushels corn.

2347. Subsoil to 2346: 11″-22″; red.

2327. Wilson loam: 0″-10″; light brown, puddles when wet and is hard to cultivate; bakes when dry and crops suffer; one mile east of Daphne, J. M. Clark's farm; produces one-half to three-fourths bale cotton, 30 bushels corn; level to gently rolling prairie.

2328. Subsoil to 2327: 11″-20″; light brown.

TABLE 15. INTERPRETATION OF SOIL ANALYSIS OF TITUS COUNTY.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibilities in bushels per acre for		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Lufkin fine sandy loam	fair	good	fair	6	51	23
Norfolk fine sand	low	good	good	35	51	18
Norfolk fine sand	low	good	good	35	51	18
Norfolk fine sandy loam	low	low	fair	12	51	18
Norfolk fine sandy loam	low	low	fair	6	37	13
Probably Norfolk fine sandy loam	low	low	fair	30	51	13
Sanders clay	low	low	good	24	80	18
Sanders clay	good	low	good	24	120	38
Susquehanna fine sandy loam	fair	good	fair	35	120	33
Susquehanna gravely loam	low	good	fair	18	80	18
Susquehanna gravely loam	fair	fair	fair	45	80	23
Susquehanna fine sandy loam	low	fair	fair	40	37	8
Wilson loam	fair	good	fair	12	51	28

TABLE 16. CROPS GROWN WITH FERTILIZERS IN TITUS COUNTY SOIL. (WEIGHT IN GRAMS.)

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
2342	Lufkin fine sandy loam.	Corn, 1910	50.0	53.5	6.3	15.0	49.0
		Sorghum, 1910	40.9	48.4	9.9	7.0	32.5
		Mustard, 1910	.2	1.8			0.1
		Corn, 1911	51.2	47.6			23.7
2343	Lufkin fine sandy loam.	Corn, 1910	4.05	41.0	4.5	19.5	37.1
		Sorghum, 1910	42.4				31.7
		Corn, 1912	35.1		4.2		
		Sorghum, 1912	20.4		6.2		
		Corn, 1913	34.2		5.2		
		Sorghum, 1913	16.8		1.1		
		Sorghum, 1913	34.2		1.5		
		Corn, 1914	39.0			14.0	
		Sorghum, 1914	20.7		.5		
2352	Norfolk fine sand.	Mustard, 1909	6.8	6.5	6.2	3.5	6.0
		Corn, 1910	36.5	44.0	22.5	8.0	38.2
		Corn, 1910	25.2	20.7			15.2
		Mustard, 1911	0.8	0.6	0.5	0.8	0.5
		Corn, 1911	36.6	40.8	25.3	11.8	9.5

TABLE 16—Continued. CROPS GROWN WITH FERTILIZERS IN TITUS COUNTY (WEIGHT IN GRAMS).

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
2353	Norfolk fine sand.	Mustard, 1909.	1.6	0.6	2.2	1.9	3.0
		Corn, 1910....	26.6	30.1	14.0	3.7	19.1
		Corn, 1910....	29.4	31.7	15.2	3.2	17.2
		Corn, 1913....	51.7	.....	15.4	.....	.....
		Sorghum, 1913.	33.7	.....	28.7	.....	.....
		Corn, 1914....	49.2	.....	36.9	.....	.....
		Sorghum, 1914.	15.7	.....	11.2	.....	.....
2348	Norfolk fine sandy loam.	Mustard, 1909.	2.3	2.5	1.2	1.6	2.0
		Corn, 1910....	33.0	48.2	6.0	12.0	37.0
		Corn, 1910....	5.1	6.3	.....	.....	4.0
		Mustard, 1910.	0.3	3.0	.....	.....	0.8
		Corn, 1911....	42.2	47.8	.....	.....	18.8
7179	Norfolk fine sandy loam.	Corn, 1914....	48.2	.....	.....	17.2	.....
		Sorghum, 1914.	44.9	.....	.....	3.2	.....
		Corn, 1915....	28.2	.....	.....	4.0	.....
7180	Norfolk fine sandy loam.	Corn, 1914....	49.6	.....	.....	18.6	.....
		Sorghum, 1914.	31.4	.....	.....	1.5	.....
		Corn, 1915....	26.7	.....	.....	2.8	.....
2340	Sanders clay.	Mustard, 1909.	1.5	5.1	40	3.0	3.5
		Corn, 1910....	41.5	38.5	26.7	23.5	50.3
		Sorghum, 1910.	44.7	44.2	45.2	10.7	45.7
		Mustard, 1910.	6.2	5.7	0.9	1.8	2.0
2341	Sanders clay.	Mustard, 1909.	4.0	5.0	2.3	2.8	1.9
		Corn, 1910....	37.0	40.0	3.0	18.0	30.0
		Sorghum, 1910.	28.9	36.4	15.3	2.1	27.7
		Mustard, 1910.	0.1	.....	.....	.....	0.1
		Corn, 1911....	40.4	.....	.....	.....	29.3
		Corn, 1912....	38.5	.....	.....	.....	43.5
		Sorghum, 1912.	16.9	.....	.....	.....	17.1
2350	Susquehanna fine sandy loam.	Mustard, 1909.	2.9	2.0	0.1	3.0	3.0
		Corn, 1910....	48.0	27.2	6.0	7.0	23.5
		Sorghum, 1910.	46.4	.....	.....	.....	27.0
		Corn, 1913....	40.2	.....	8.4	.....	.....
		Sorghum, 1913.	31.4	.....	10.0	.....	.....
		Corn, 1914....	34.5	.....	8.7	.....	.....
		Sorghum, 1914.	30.3	.....	.....	2.5	.....
		Corn, 1914....	47.0	.....	.....	20.4	.....
		Sorghum, 1914.	19.7	.....	.....	2.2	.....
		Corn, 1915....	36.2	.....	.....	3.3	.....
2351	Susquehanna fine sandy loam.	Mustard, 1909.	0.2	2.0	0.2	.....	0.1
		Corn, 1910....	15.0	22.2	2.5	8.5	16.2
		Corn, 1910....	.....	.....	.....	.....	1.3
		Mustard or Oats, 1910...	3.9	2.9	0.5	2.2	0.3
2346	Susquehanna gravelly loam.	Corn, 1910....	45.6	38.6	21.0	25.0	46.0
		June Corn, 1910	7.9	.....	.....	.....	5.5
2347	Susquehanna gravelly loam.	Mustard, 1909.	3.0	5.0	2.6	2.3	3.2
		Corn, 1910....	25.2	22.0	2.0	10.0	27.1
		Sorghum, 1910.	24.5	.....	.....	.....	22.2
		Corn, 1913....	22.7	.....	.....	15.2	.....
		Sorghum, 1913.	23.2	.....	.....	2.6	.....
		Corn, 1914....	36.2	.....	.....	3.9	.....
		Sorghum, 1914.	34.5	.....	.....	1.5	.....
		Corn, 1915....	26.9	.....	.....	2.8	.....

SOILS OF TYLER COUNTY.

The area surveyed covers 100 square miles in the central part of Tyler county. The area surveyed is characterized by hilly, rolling topography, with some alluvial soil in the stream bottoms. Four types of soil have been recognized in this area. The areas are given in Table 17. The soils analyzed are all low in nitrogen, low in potash, and with one exception, low in active phosphoric acid. Three of the

four samples of soil are also acid,—a condition that shows the need of lime.

This area needs a rotation of crops, including a legume, to be supplemented by an application of acid phosphate and, very likely, potash fertilizers. The soils should also receive an application of a sufficient quantity of lime to correct the acidity.

TABLE 17. WOODVILLE AREA.

Areas of Different Soils.

Soil.	Acres.	Per cent.
Norfolk sandy loam	52,864	82.6
Meadow	5,568	8.7
Lufkin clay	4,416	6.9
Orangeburg sandy loam	1,152	1.8
Total	64,000	.....

DESCRIPTION OF SOILS OF TYLER COUNTY.

Norfolk Sandy Loam.—The surface soil of this type is a loose, gray to grayish yellow sand of a uniform and medium texture, except near the boundary line dividing it from the Lufkin clay, where it is rather compact. It varies in depth from 12 inches to 36 inches, or more. In some localities the soil contains a small percentage of rounded iron concretions which often increases to between 10 to 25 per cent near the boundary line between it and the Orangeburg sandy loam. The subsoil is a brownish yellow to greenish red clay, usually containing a high percentage of sand, and often mottled with gray.

The Norfolk sandy loam is the most extensive type of the area and is very generally distributed. It is generally rolling and the drainage is generally excellent, although the water sometimes stands on the peat-topped hills for some time after heavy rains.

Not over 5 per cent. of the total area of this type is in cultivation (1903); the remainder being covered by forest. Corn and cotton are the principal crops, the latter producing in favorable seasons upward of one-half bale per acre. The forest growth consists of magnolia, willows, and water oaks in the moister places, short leaf and loblolly pine, white oak, beech, ironwood, hickory, sweet gum, and holly on the lower hills, and long leaf pine on the higher elevations. This should be a valuable truck soil. This soil is low in all forms of plant food and is acid and needs lime.

Lufkin Clay.—This type varies considerably, both in depth and texture. The typical profile consists of 3 to 8 inches of fine sand, or sandy loam, underlain by a yellowish or reddish yellow clay, which usually contains a considerable percentage of sand. It is generally mottled—red, yellow, and white.

The largest area of this type occurs one mile east and southeast of Woodville. In general, the topography is rolling, although a few small areas are level. The drainage is satisfactory except on the level areas.

Comparatively little of this type is cultivated; it produces about three-fourths bale cotton or 25 bushels of corn per acre.

This is considered to be the best soil for general farming in the area. While not so strong as the small areas of alluvial soil near the streams, it is better drained, retains moisture well, always cultivatable, and much more productive than the Norfolk sandy loam. This soil is low in plant food and is acid and needs lime.

Norfolk Sand.—Norfolk sand, although not mapped in the area named, probably occurs in this county, and one of the samples belongs to this type. Norfolk sand is a light, sandy soil, and is characterized by a sandy subsoil to a depth of about 3 feet. It is a good soil for early vegetables, but does not produce very large crops of corn or cotton. The sample examined is low in phosphoric acid, potash, and nitrogen, and is acid and needs an application of lime.

TABLE 18. COMPOSITION OF SOILS—TYLER COUNTY.

	Lufkin Clay.	Norfolk Sand (probably).		Norfolk Sandy Loam.	Norfolk Sandy Loam. (probably).	
	Surface 3976	Surface 4648	Subsoil 4649	Surface 3977	Surface 9139	Subsoil 9140
Per Cent.						
Phosphoric Acid	.03	.02	.03	.02	.....	.04
Nitrogen	.03	.02	.01	.04	.03	.03
Potash	.23	.10	.04	.03	.08	.04
Total Potash	.....	.....	.52	.16	.....	.....
Lime	.19	.04	.09	.08	.22	.59
Magnesia	.24	.05	.05	.05	.07	.07
Alumina and Oxide of Iron	8.71	1.43	1.11	1.39	.80	2.25
Insoluble and Soluble Silica	84.94	97.18	97.80	96.42	97.16	93.95
Loss on Ignition	3.09	1.26	.67	1.69	.94	1.19
Moisture	2.26	.23	.12	.16	.21	.86
Parts Per Million.						
Active Phosphoric Acid	12	14	10	17	124	8
Active Potash	100	70	74	92	62	28
Acidity	1000	200	200	200	460	230

DESCRIPTION OF SAMPLES.

3976. Lufkin clay: 0″-12″; yellowish red clay; one mile southwest of Woodville, H. A. Cruse's farm; level; produces 25 bushels corn.

4648. Norfolk sand: 0″-6″; white, sandy; very poor; upland; one mile west of Woodville; commercial fertilizer does not increase yield appreciably; soil does not pack, crack, and washes a little; surface soil very shallow; produces one-eighth bale cotton or 10 bushels potatoes.

4649. Subsoil to 4648: 6″-16″; white, sandy.

3977. Norfolk sandy loam: 0″-9″; yellowish red; three-fourths mile northwest of Woodville, H. A. Cruse's farm; formerly fertilized; produces 25 to 30 bushels corn; moderate soil.

9139. Norfolk sandy loam: 0″-6″; light gray; one-half mile northwest of Woodville, J. B. Riley's farm; 300 pounds to acre fertilizer; produces 20 bushels corn or 100 bushels potatoes; is rolling.

9140. Subsoil to 9139: 6″-14″; sandy clay.

TABLE 19. INTERPRETATION OF SOIL ANALYSIS OF TYLER COUNTY.

Type and County.	Phosphoric acid.	Potash.	Lime.	Corn possibility in bushels per acre for		
				Active phosphoric acid.	Active potash.	Total nitrogen.
Lufkin clay	low	fair	low	12	37	13
Probably Norfolk sand	low	fair	low	12	37	8
Norfolk sandy loam	low	low	low	12	37	13
Probably Norfolk sandy loam	.....	low	good	45	37	13

TABLE 20. CROPS GROWN WITH FERTILIZER IN TYLER COUNTY SOIL. (WEIGHT IN GRAMS).

Lab. No.	Addition.		KPN	KPNCa	KN	KP	PN
3976	Lufkin clay.	Oats, 1910	13.0	14.5	2.8	8.1	11.1
		Corn, 1911	31.8	30.5	3.4	4.2	24.3
3977	Norfolk sandy loam.	Oats, 1910	14.6	13.0	6.0	7.9	13.5
		Corn, 1911	27.7	25.2	6.7	4.6	22.6

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SUMMARY AND CONCLUSIONS.

This bulletin contains a description of soil types in Grayson, Lee, McLennan, Titus, and Tyler counties, together with chemical analyses of representative samples and a discussion of their needs for plant food.