TEXAS AGRICULTURAL EXPERIMENT STATIONS.

Bulletin No. 125

The Chemical Composition of Some Soils of Angelina, Brazoria, Cameron, Cherokee, Delta, Lamar, Hidalgo, Lavaca, Montgomery, Nacogdoches, Robertson, Rusk, Webb and Wilson Counties.

By

G. S. FRAPS, Chemist.

Postoffice

College Station, Brazos County, Texas.

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The following is a list of Bulletins of this Experiment Station available for distribution. The others are out of print. Any of these Bulletins will be sent free of charge. Requests should be directed to the Director of the Experiment Station, College Station, Texas.

79 Cotton Breeding.
84 Tomato Fertilizers at Troupe.
88 Munson's Bulletin on Grapes.
90 The Feed Control in 1905-06.
91 Food Adulteration in Texas.
92 A Test of the Producing Power of Some Texas Seed Corn.
96 Commercial Fertilizers and Poisonous Insecticides 1906-07.
97 Kaffir Corn and Milo Maize for Fattening Cattle.
98 Summary of All Bulletins from No. 1 to 94, Inclusive.
99 The Composition and Properties of Some Texas Soils.
100 Chemical Composition of Some Texas Soils.
102 Texas Honey Plants.
104 Digestion Experiments.
105 Notes on Forest and Ornamental Trees.
107 Commercial Fertilizers and Poisonous Insecticides, 1907-08.
108 Winter Bur Clover.
109 Alfalfa.
110 Steer Feeding Experiments.
111 Texas Fever.
112 Nature and Use of Commercial Fertilizers.
113 Spray Calendar.
114 Composition of White Lead and Paints.
115 Fertilizer Test With Onions.
117 Commercial Feeding Stuffs in 1907-08.
119 Infectious Anaemia of the Horse.
120 Corn and Cotton Experiments for 1908.
121 Report of Progress at the Troupe Sub-Station.
122 The Effect of Salt Water on Rice.
123 Commercial Fertilizers and Poisonous Insecticides 1908-09.
124 The Pecan-Case Bearer.

First, 2nd., 4th., 5th., 8th., 9th., 10th., 11th., 12th., 13th. Annual Reports.

H. H. HARRINGTON,
Director.

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CHEMICAL COMPOSITION OF SOME SOILS OF ANGELINA, BRAZORIA, CAMERON, CHEROKEE, LAMAR, DELTA, HIDALGO, LAVACA, NACOGDOCHES, MONTGOMERY, ROBERTSON, RUSK, WEBB, AND WILSON COUNTIES

By G. S. FRAPS.

This bulletin records the results of the study of a number of Texas soils. Bulletin No. 99 of this Experiment Station contains a description of the composition and properties of soils from Houston, Anderson, Lamar, Travis, Bexar, and Hays Counties. This bulletin is a continuation of the work there reported, and the study is being continued.

The samples have been collected in a systematic way, and represent definite areas and types of soil in the State. Most of the samples represent types of soils in areas surveyed by the Bureau of Soils of the U. S. Department of Agriculture, and were sent to us by agents of said Bureau while making the survey. Some of the samples were collected by chemists of this Experiment Station. Analyses of samples of this kind are of much greater value to the State than analyses of miscellaneous samples sent in by interested parties. In addition to the chemical analyses, tests for deficiencies were made by means of pot experiments upon a number of the soils. This work, it is believed, shows to a large extent, the properties and deficiencies of the soils studied, in spite of the fact that there is some variation in the composition and properties of the soil of a given type. The work, while of particular interest to the counties represented, is also of general interest, since many of the soils represented are widely distributed through the State.

Besides the work recorded in these pages, many of these samples of soil are undergoing scientific investigation with respect to their fundamental chemical characteristics. The work, so far, has been largely upon phosphoric acid and humus, but is being extended over other phases of soil fertility. The details of the work are largely of general scientific interest; but the general results are of considerable importance to Texas agriculture and will be published in succeeding bulletins.

ESSENTIALS OF CROP PRODUCTION.

It is essential for the proper growth of plants that they should have a sufficiency of water, light, the proper amount of space, a suitable temperature, a suitable physical condition of the soil, and be well supplied with plant food. If any of these essentials are deficient, the crop production will be deficient also, and the decrease in production will be, to a certain extent, in proportion to the deficient conditions.

We wish to emphasize the fact that plant food is only one of the conditions which are necessary for the production of crops. The other conditions are equally important. Chemical analysis deals almost entirely with the plant food of the soil. The other conditions we have mentioned are largely conditioned by the situation of the soil, the climatic conditions which affect it, and its physical character and structure.

Plant Food. Material which is essential to the growth of plants, is termed plant food. Plants require a number of substances, but experience has shown that practically all soils contain a sufficiency of of all kinds of plant food with the exception of phosphoric acid, nitrogen, and potash. The term "plant food" is often confined to these three substances, which are so often needed.

Lime may also be needed by the soil, but the object of an addition of lime is to correct the acidity of the soil, or perform other functions, rather than to serve as a plant food.

The object of *fertilizers* is to supply phosphoric acid, nitrogen or potash, in available forms; that is, supplied in such compounds that plants can easily take up the plant food.

A soil, to be fertile, must contain plant food in such forms that plants can secure a sufficient amount of it. A soil may contain a large quantity of plant food, yet not produce good crops, because the plants can not secure the food which it contains. We apply the term *active plant food* to the plant food contained in the soil in such forms that plants can easily take it up.

PHYSICAL DEFICIENCIES OF SOILS.

Some of the physical deficiencies of soils will here be mentioned only briefly.

The soil may be *too shallow.* If this is caused by rock near the surface, the soil is not suitable for cultivated crops. If caused by hardpan, it must be broken up. If caused by water, the soil may be drained. Soils in arid regions should be deeper than those in humid regions.

The soil may be *too wet.* If properly situated, this condition may be remedied by drainage, either by ditches or by tile drains.

Porous and stiff soils are both benefited by organic matter, such as is produced by manure or green crops plowed under. Lime may improve stiff soils, making them more easily worked.

Soils which blow too easily, may receive benefit from manure. A wind-break may also be of advantage.

CHEMICAL DEFICIENCIES.

Acid soils contain an excess of acid. The remedy is to apply lime in sufficient amounts to correct the acid. Acid soils, judging from our work under way, are not found to any large extent in Texas.

Definite conclusions, however, cannot be reached until further work has been done.

Alkali soils contain too much soluble salts. These consist of sulphate of soda, chloride of soda, and carbonate of soda, as a rule, but we have sometimes found calcium chloride to be present. Crops vary in their sensitiveness to alkali. Some plants will not stand much, while others will stand very large quantities. Alfalfa, when young, will not stand much alkali, but it appears to endure a large quantity when it is old and well established.

Most of the alkali which has been brought to our notice occurs in comparatively small spots, but often is very troublesome on account of its effect upon the appearance of the field in which it occurs. The remedy for alkali is under-drainage, either by means of deep ditches or tile drains. The subject of alkali soils is being studied by us, and will be made the subject of a later bulletin.

Deficiency of Active Plant Food. A soil cannot be productive unless it supplies the plant with sufficient food; that is, unless it contains sufficient "active" plant food. The amount of active plant food depends upon conditions surrounding the soil, as well as on the chemical and physical character. The presence of sufficient moisture, and of decaying vegetable matter, appear to aid in the maintenance of a supply of active plant food in the soil. A "run-down" soil may often be "brought up" by increasing the activity of the agencies which make inactive plant food active.

The probable needs of Texas soils for plant food is shown in the discussion of the analyses of the different types of soils.

Deficiency of Lime. A soil which receives benefit from lime is usually considered to be an acid soil, but this is not necessarily the case, since lime has other effects upon the soil in addition to correcting acidity.

Whether Texas soils should or should not be limed is a matter which requires further study. The following statements are made subject to further modification.

Rice soils should not be limed. The lime may cause an excessive growth of straw, so that the rice may fall down. The effect of lime on these soils may be different when the nitrogen has been decreased by continuous cultivation.

Alfalfa does best upon a lime soil. When lime is not present in sufficient amounts, a liberal application of lime should be made, or a durable stand of alfalfa need not be expected.

Cowpeas and *melons* do not need lime.

Peanuts should be limed if grown on a soil poor in lime. This statement applies especially to the large varieties of peanuts. If there is a deficiency of lime, the pods do not fill well. The small Spanish peanuts are not so sensitive to a deficiency in lime.

Cotton and *corn,* as a rule, do not need lime.

Soils of the western part of the State, and in the black belt, usually contain an abundance of lime. There are, of course, exceptions to this statement. The probable needs of Texas soils for lime is shown in the analyses of the various soil types, and the interpretation which we have given.

Deficiency in Organic Matter. Organic matter contains the reserve store of nitrogen of the soil. It aids in producing a supply of active plant food, and it has a favorable effect upon the physical character of the soil. Organic matter decreases in a cultivated soil, and it becomes deficient under clean cultivation.

Many Texas soils are deficient in organic matter, and respond well to applications of it. Manure is very lasting in its effects. Green crops turned under or grazed, give good results.

CONSERVING SOIL FERTILITY.

Soil fertility is lost in a variety of ways, some of which are unavoidable, while others are, to a greater or less extent, avoidable.

Losses in Crops. This may be characterized as unavoidable loss. The loss of plant food involved in wasting the by-products of the farm may be considerable. This should be avoided as much as possible.

The average number of pounds of plant food removed per acre by a number of Texas crops is shown in Table I.

Table No. 1.—Plant Food Removed by Crops in Pounds Per Acre.

	Phosphoric Acid	Nitrogen.	Potash.	Valuation Per Acre.
Corn, 40 bu, corn and cob	19	38	13	$ 9.14
Wheat, 25 bu.	13	29	8	6.77
Oats, 40 bu.	10	25	7	5.77
Cotton, 250 lbs lint	0.1	0.8	0.7	.20
Potatoes, Irish, 100 bu.	10	20	36	6.56
Potatoes, sweet, 200 bu.	20	28	72	10.84
Alfalfa, 4 tons	50	183*	143	46.35
Sorghum, 3 tons	29	84	134	25.74
Sugar cane, 20 tons	15	153	44	32.61
Onions, 30,000 lbs.	37	72	72	20.21
Rice, 1,900 lbs	12	23	5	5.39

*A part of this nitrogen comes from the a ir.

The table also shows the valuation of the plant food in the crops at the valuation used in Texas during 1909-10 for commercial fertilizers. The cost per pound of plant food is placed at 19 cents for nitrogen, and 6 cents for potash and phosphoric acid. Furthermore, the above figures apply only to the unmixed fertilizers; the cost in mixed fertilizers is greater, owing to the cost of mixing, sacking, handling, and manufacturer's and dealer's profit. Considering further, that the plant food applied in a fertilizer is never completely appropriated by the plant, we find that the cost (valuation) of the plant food in the crop is below what it would cost in commercial fertilizers.

Loss in By-Products. This loss is largely avoidable. The amounts of plant food in by-products of crops of the size specified, are shown in Table 2. The valuation is also given, showing what this plant food would cost, if bought in commercial fertilizer materials.

Table No. 2.—Plant Food in By-Products of Crops in Pounds Per Acre.

	Phosphoric Acid. Lbs.	Nitrogen. Lbs.	Potash. Lbs.	Valuation Per Acre.
Cotton (seed, 500 lbs.)	7	16	8	$ 3.94
Cotton (stalk and leaves)	12	32	23	8.18
Corn (stalk and leaves)	6	22	29	6.28
Wheat (straw)	5	13	14	3.61
Oats (straw)	4	10	21	3.40
Rice (2250 lbs. straw)	3	14	37	5.06

The by-products from the farm should, therefore, be utilized as much as possible. The man who sells his cotton seed may have to buy back the plant food he is selling, and pay a good deal more for it than he received for his seed. The rice farmer who wastes his rice straw ashes is losing about 37 pounds of potash per acre, which he will be obliged to buy back some day. The rice farmer loses about $2.60 worth of nitrogen per acre when he burns his straw. Cotton stalks, when burned, lose their nitrogen. Burning may be necessary on account of the boll weevil, but the loss of nitrogen may be $3 per acre. However, it is possible that many of the leaves have already fallen back on the soil when the stalks are burned. The loss of plant food involved in wasting the by-products of the farm may be considerable. This loss should be avoided as much as possible.

Winter rains may wash out fertility from a porous sandy soil, when it is bare. The loss falls upon the most expensive plant food, the nitrogen. The loss can be avoided by growing a cover crop during a winter, a practice which has been adopted to some extent in East Texas. The sandy soils of East Texas are more likely to lose fertility in this way than the heavier soils of Central Texas or those of West Texas, where there is less rainfall. It is probable that fertilizer residues are washed out of the soil to a considerable extent from some of the light sandy soils. A winter cover crop is therefore recommended for the light sandy soils of East Texas. Mustard has been suggested, and oats are sometimes used, but a leguminous crop, if a suitable one can be found, would be preferable. Bur clover would be excellent for this purpose.

Washing. In some sections of the State, unsuitable practices have been followed, with the result that the surface soil has been washed off, leaving the subsoil exposed. This is, of course, a serious loss, and such methods as prevent it should be followed. Terracing or hill-side ditches, deep plowing or plowing in a proper manner, or other well-known methods of preventing washing, should be used.

Manure. Texas soils need all the manure which can be saved for them. Manure is more lasting in its effect than fertilizers, and has effects upon the soil which fertilizers do not have. In dry regions, the manure should be well rotted. Part of the plant food in manure is washed out when the manure is exposed to rain. It should, therefore, be protected from rain. The manure pile should be kept moist and compact. If the manure is allowed to dry out, plant food is lost. If it is too loose, it ferments too rapidly. This is, however, too broad a subject to be discussed here in detail.

MAINTAINING SOIL FERTILITY.

Soil fertility is maintained by keeping up the supply of plant food and maintaining the soil in good physical condition. The studies in the succeeding pages of this bulletin show the probable needs for plant food of various types of Texas soils.

For soils which need phosphoric acid, phosphoric acid should be applied in the form of acid phosphate, bone meal, tankage, rock phosphate, or in some other form.

To soils which need potash, potash salts should be supplied. As information concerning fertilizers is published in Bulletin No. 112 of this Station, we will not go into this subject here.

To soils which need nitrogen, nitrogen may be supplied in small amounts, but nitrogen is entirely too expensive to be purchased in sufficient quantities to maintain the fertility of our soils for the growing of staple crops. The small quantities of nitrogen supplied in ordinary mixed fertilizers to cotton and corn do not contain but a fraction of the nitrogen needed by the crop. The soil cannot be maintained in fertile condition by this means.

The supply of nitrogen in the soil must be maintained by growing crops which take it from the air. These can be grazed, or plowed under, or fed and the manure applied. Crops which take nitrogen from the soil can then be grown. Only by such a method as this can we look forward to maintaining our soils in a fertile condition.

In view of the rapidly increasing price of nitrogen, which is already expensive, it is hoped that efforts to adopt a system of rotation which will keep our soils fertile will become increasingly effective.

Fertility may be maintained:—

(a) By using manure liberally, both to supply plant food and to keep the soil in good physical condition.

(b) By growing leguminous crops to gather nitrogen from the air. They can be grazed, or they can be plowed under, or they can be fed and the manure used. But to keep a soil fertile, and grow staple crops profitably, a rotation must be adopted, sooner or later, which includes legumes. Nitrogen is too expensive for the grower of staple crops to purchase sufficient quantities of it to keep his soil fertile; and it is becoming more expensive. The grower of staple crops must secure the bulk of his nitrogen from the air.

(c) By the use of fertilizers. The proper use of fertilizers in connection with all the manure which can be saved, and the growing of leguminous crops, will keep the soil fertile. For a full discussion of fertilizers see Bulletin 112 of this Station.

HOW TO INCREASE FERTILITY.

It is unnecessary to repeat what has been said in preceding sections, which may aid in ascertaining soil deficiencies or devising aids for increasing fertility. Under the discussion of analyses of the different types of soils are given some information which may aid in increasing their fertility.

In order to increase fertility, the cause, or causes of the low yield should be ascertained, if possible, and the proper remedy applied. Manure, legumious crops, and fertilizers are efficient aids when needed, as is very often the case. Lime, or under-drainage should be used when necessary.

WHAT A CHEMICAL ANALYSIS SHOWS.

Chemical analysis of a soil shows the reserve store of plant food which it contains. It indicates how well the soil will wear—whether it will be productive and durable or whether it will deteriorate rapidly under cultivation.

Chemical analysis shows the probable deficiencies of the soil in plant food. It shows whether the soil contains a large store of plant food, or only a small quantity, and it indicates which kinds of plant food will probably be needed first.

Chemical analysis shows whether phosphoric acid, potash, or nitrogen will probably be most needed.

Chemical analyses, and other studies, it is hoped, will enable us to apply the results of fertilizer experiments and experience on a given type of soil in a certain section, to other types of soil in the same section and the same type in other sections of the State.

WHAT CHEMICAL ANALYSIS DOES NOT SHOW.

Chemical analysis does *not* show which of two fertilizers of similar composition should give best results. For example, it does *not* show whether an 8-2-2 or a 10-2-2 fertilizer would be better for cotton on the soil analyzed. That would depend upon the method of plowing and cultivation practiced, the quantity and distribution of rainfall, and other conditions aside from the fertility of the soil.

Chemical analysis does not show what crops are adapted to the soil. This depends more largely upon the physical character and structure of the subsoil, climatic conditions, and other factors not related to chemical composition. The chemical analysis deals with the plant food contained in the soil, and not with the physical characteristics which modify its adaption to various kind of plants. There is, to some extent, a relation between the physical character of the soil and the crops best suited to the soil, but the climatic conditions must always be given serious consideration.

WHAT POT EXPERIMENTS SHOW.

Pot experiments, such as we have carried on with many of the soils described in this bulletin, show the immediate needs of the soil for plant food. They do not show the strength or wearing qualities of the soil. They do not show the exact formula of the fertilizer which should be used on a given crop to give the best results; this will depend upon the season, and other conditions. Pot experiments show in what elements of fertility the soil is deficient, at the time of the experiment. They point out the method of strengthening our soils.

In the interpretation of pot experiments, we must remember that they are carried on under conditions different from those prevailing in the field. In some respects conditions are more favorable; in others, more unfavorable. The depth of the surface and subsoil must also be considered.

A soil may be very productive, and yet may appear deficient in pot experiments. That is to say, the application of some form of plant food may cause an increase of crop. This deficiency may not appear in the field in an unfavorable season, in which the effect of the season reduces the yield below the capabilities of the soil. In a favorable season, when climatic conditions exceed the capabilities of the soil, the fertilizers would have an effect.

The application of pot experiments to field treatment requires thorough study. The results of our pot experiments apply to these experiments; in their application to the natural soil, other factors may be more important than the plant food.

In carrying out pot experiments, we place about ten pounds of the soil in each of several pots. One pot receives fertilizers containing phosphoric acid, potash and nitrogen (P K N), another phosphoric acid and potash (P K), another phosphoric acid and nitrogen (P N) and another potash and phosphoric acid (P K). The difference between the pot receiving the complete fertilizer (P N K) and that receiving no nitrogen (P K) shows the effect of nitrogen. The difference between the pot receiving the complete fertilizer (P N K) and that receiving no potash (P N) shows the effect of potash. The difference between the complete pot (P N K) and the one receiving no phosphoric acid (N K) shows the effect of the phosphoric acid.

CHEMICAL CHARACTERISTICS OF TEXAS SOIL TYPES.

As we pointed out in Bulletin No. 99, the different types of soils have definite chemical characteristics, and these are related to their productiveness and wearing qualities. This can be seen by considering the tables of analyses, the interpretation, and the known productiveness of the soil. In some cases, naturally fertile soils are situated under unfavorable physical or climatic conditions, which prevent them from showing the effects of their fertility.

Table 3 shows the average composition of types of Texas soils, of which two or more analyses are given in this bulletin. These averages are made from the analyses presented in this bulletin, and not from all analyses we have made. These analyses were made by the methods of the Association of Official Agricultural Chemists, with strong hydrochloric acid.

The following description is a general one of some types of soils which are found in several Texas localities. The soils in particular localities may deviate in some particulars from the general description. The general description, however, covers the types fairly well.

Norfolk Soils. The Norfolk soils are light colored, upland, sandy soils with a yellow clay or sandy clay subsoil. They are found mostly in the coastal plains and are especially abundant in East Texas. These soils are better suited to fruit and truck than to corn and cotton.

TABLE 3—AVERAGE PERCENTAGE COMPOSITION OF TYPICAL SOILS

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia
Norfolk fine sandy loam (5 samples)......	.02	.06	.09	.08	.03
Norfolk fine sand (5 samples)...........	.02	.02	.08	.06	.06
Susquehanna fine sandy loam (3 samples..	.02	.04	.12	.11	.92
Lufkin fine sandy loam (3 samples).......	.04	.06	.12	.14	.16
Lufkin clay (2 samples..................	.08	.09	.62	......	......
Orangeburg fine sandy loam (6 samples)...	.08	.07	.63	.20	.35
Orangeburg fine sand (3 samples).........	.01	.07	.12	.12	.09
Wabash clay (3 samples).................	.09	.13	.88	......	......
Houston clay (3 samples.................	.04	.12	.25	.51	.40
Houston black clay (6 samples)...........	.04	.11	.40	......	......

The Norfolk soils are low in phosphoric acid and nitrogen, and are lower in potash and lime than any of the other types of soil which were averaged.

Orangeburg Soils. Orangeburg soils are gray to brown, upland surface soils with a red or yellowish red sandy subsoil. These soils are widely distributed, especially in East Texas. They are somewhat more productive and durable than the Norfolk soils. Our analyses show that the Orangeburg soils are better supplied with plant food than the Norfolk soils, especially with potash and lime.

Lufkin Soils. The Lufkin soils are gray soils with heavy, very impervious, plastic gray and mottled subsoils. On account of the heavy clay of the subsoil, these soils are generally damp and poorly drained. They have a lower agricultural value than the Norfolk or Orangeburg soils.

The content of plant food in the Lufkin fine sandy loam is approximately intermediate between the Norfolk and Orangeburg soils. The two samples of Lufkin clay examined are well supplied with plant food.

Susquehanna Soils. These soils are gray to brown in color with heavy plastic red mottled clay subsoil. They are somewhat similar to the Lufkin soils, being retentive of water and not very well drained. Only three samples were averaged. They are about the same as the Norfolk soils in phosphoric acid and nitrogen, and a little higher in potash and lime.

Houston Soils. These are black, calcareous soils, and are very productive and durable. They are found extensively in the central portion of the State, but are also distributed to some extent in East Texas and in the coast country.

Their content of phosphoric acid is low, but lasts well on account of the quantity of lime with which it is associated. They are well supplied with lime and potash, and better supplied with nitrogen than the soils previously mentioned. On account of the very variable amount of lime present, no average was made for this content in the Houston black clay.

Wabash Soils. These are alluvial soils, and are the strongest of all the soils averaged, being well supplied with all forms of plant food.

Detailed descriptions and discussions of these soils are presented in the pages which follow. The soils of the various areas are not precisely similar to the general types just discussed, but conform in general to them, while differing in details.

SOILS OF ANGELINA COUNTY.
(Lufkin Area.)

The Lufkin area occupies about 100 square miles around Lufkin. The following is a description of the soil types of this area whose analyses are here given. Samples of Lufkin clay, Orangeburg fine sandy loam, and Meadow, also found in this area, have not yet been analyzed from this area.

A full description and map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as Soil Survey of the Lufkin Area, Texas, by W. Edward Hearn and party. (Advance sheets—Field Operations of the Bureau of Soils, 1903.)

DESCRIPTION OF SOILS.

Norfolk Fine Sandy Loam. This is a whitish or gray medium sand having an average depth of 22 inches, although in many places reaching three or more feet. The subsoil is a yellowish sandy clay, slightly sticky.

This soil usually occupies knolls and ridges and has an elevation of several feet above the surrounding soils. Surface water runs off readily and the porous nature of the soil allows free circulation of ground water, so that the soil can be tilled immediately after a rain. The soil gives fairly good yields of cotton and corn. Tomatoes are grown with good results. This soil is best adapted to truck, small fruits, and peaches. It is easily tilled, but lacks organic matter and has to be heavily fertilized to give good results.

Lufkin Fine Sand. This consists of a gray fine sand with an average depth of 10 inches, resting on a material of much the same character to a depth of 36 inches. At from 3 to 5 feet occurs a gray or mottled stratified clay. The Lufkin fine sand is the most important soil type in the area, both in respect to extent and agriicultural value.

The surface is uniformly level or gently rolling. The surface drainage is for the most part good. The level or depressed areas need drainage and when drained will become warm and suitable to the production of late fruit crops. Only a small portion of this soil is under cultivation, the greater part being covered with a dense growth of scrubby pine and oak. The part that is tilled produces medium crops of corn and cotton, which are the principal crops grown. The secondary crops are tomatoes, potatoes and peaches. The Lufkin fine sand is an easily tilled soil and one which responds freely to fertilizers. This soil occupies a large area immediately around Lufkin.

DESCRIPTION OF SAMPLES.

No. 162—Black sandy soil used in potato experiments by E. C. Green (0-9"), Lufkin, Texas.

No. 163—Semi-subsoil of No. 162 (9"-13"). Lufkin, Texas.

No. 164—Deep subsoil of No. 162. Red sandy clay. Lufkin, Texas.

No. 895—Lufkin fine sand (0-12"), farm of F. M. Smith, Lufkin, Texas.

No. 896—Norfolk fine sandy loam, Berry Robbin's farm, Lufkin, Texas.

No. 1145—Lufkin fine sand, subsoil (12"-22") farm of F. M. Smith, Lufkin, Texas.

TABLE NO. 4—PERCENTAGE COMPOSITION OF SOILS OF ANGELINA CO.

	Black Sandy Soil			Norfolk fine sandy loam		Lufkin fine Sand	
	162	163	164	896	1283	895	1145
	Surface	Semi Sub Soil	Sub Soil	Surface	Subsoil	Surface	Subsoil
Phosphoric Acid	.05	.05	.06	.02	.01	.03	.01
Nitrogen	.09	.02	.04	.11	.04	.06	.07
Potash	.05	.07	.25	.08	.06	.09	.09
Lime	.11	.04	.11	.09	.09	.16	.13
Magnesia	.04	.03	.40	.03	.01	.14	.21
Alumina	.82	.88	8.88				
Oxide of Iron	.31	.48	3.56	2.08	1.34	1.96	3.62
Soluble and Insoluble Silica	93.53	96.94	75.29	94.86	97.17	95.46	92.22
Loss on Ignition	3.52	1.39	6.84	3.16	1.42	2.22	2.41
Moisture	.63	.30	4.71	.28	.26	.69	.98

The soils of this area are low in phosphoric acid, contain fair amounts of potash, and fair to good quantities of nitrogen. We judge that these soils need phosphoric acid most of all, and their next need is nitrogen. They probably need organic matter, or humus, also. Potash is not, at present, deficient for ordinary crops, but may become deficient in time. There may be areas on which it is already deficient. This depends on the time which the soil has been in cultivation, and the treatment it has received.

TABLE 5—INTERPRETATION OF ANALYSES ANGELINA COUNTY

	Black Sandy	Norfolk Fine Sandy Loam	Lufkin Fine Sand
Phosphoric Acid	Moderate	Low	Low
Nitrogen	Fair	Good	Moderate
Potash	Fair	Fair	Fair
Lime	Moderate	Low	Good
Depth of soil	....	22"	10"

SOILS OF BASTROP COUNTY.

(Bastrop Area.)

This area comprises the whole of Bastrop County, an area of 928 square miles. Twenty-three types of soil were established in this county, some of them being of relatively little importance. A number of these types are not represented in the description and analyses which follow.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Bastrop Area, Texas," by R. A. Winston et al. (Advance sheets —Field Operations of the Bureau of Soils, 1907.)

DESCRIPTION OF SOILS.

Lufkin Fine Sandy Loam. The soil of this type to an average depth of 15 inches is a medium to a fine sandy loam, containing in localities a small percentage of gravel. On the better drained areas the soil may have a reddish to grayish red tinge. On higher divides the surface soil is only a few inches deep. That on the lower lying areas may be 20 inches deep.

The subsoil varies in color, owing to local conditions of drainage, aeration and oxidation. The more rolling areas of the Lufkin fine sandy loam will often have a stratum of dark red to reddish brown sandy clay, a few inches thick immediately beneath the surface soil. This subsoil passes into a gray or mottled yellow and gray sandy clay. This type occurs only along the eastern edge of the county, in gently rolling to level areas, with good surface drainage.

For general farming this soil gives fair yields of cotton and corn. A large percentage of this type is still in its virgin state, supporting a timber growth of post oak and black-jack oak. When first cultivated this soil is productive, but its fertility is soon reduced under continuous cultivation of cotton and corn. Peanuts do well but are only grown for home use and as pasturage for hogs.

Norfolk Fine Sand. This consists of about 7 inches of a loose gray to whitish fine sand, underlaid by a material of practically the same structure and texture and showing a yellowish gray color. The organic matter contained in the first few inches gives the surface soil a grayish color. The topography is rolling with excellent surface drainage.

The soil is fairly retentive of moisture, and when first cleared produces a fair yield of cotton.

Much of this type might be profitably planted to fruits, melons, grapes, and vegetables for early markets, the addition of much organic matter, such as stable manure or green manure, being essential. The available supply of moisture is greatly conserved by the sand mulch which exists during dry seasons.

Watermelons do well and many are shipped yearly to distant markets. Cotton, corn, and sorghum give only fair results.

Bastrop Clay. To a depth of 6 to 10 inches this varies from a dark clay loam to a heavy clay and is underlaid to a depth of 36 inches by a dark gray, compact, and plastic clay. Both soil and subsoil contain large amounts of silt and organic matter. This type represents the heaviest of the Colorado River bottoms; the drainage is not very good.

The cultivation of this soil requires much care, as the soil when wet is very sticky and bakes hard when dry. It should not be plowed too soon after a rain or when too wet, as it then breaks into clods that dry very hard, thus preventing a desirable tilth as well as diminishing its productiveness. It cannot be plowed very dry, as it is then too hard.

General farming is practiced over this type, cotton, corn and sorghum being the chief crops grown. Cotton produces one-half to three-fourths bale to the acre, corn 25 to 50 bushels, sorghum one-half to two and one-half tons.

Bastrop Sandy Loam. To a depth of 10 to 24 inches, this is a grayish brown to reddish brown light sandy loam. The subsoil to 36 inches is reddish to dark reddish sandy clay. It occurs irregularly over the river bottoms.

The topography of the type is rolling and the drainage good, the soil being a loose open texture. The cultivation is easy. This soil is adapted to the cultivation of cotton and corn. Cotton produces one-half to three-fourths bale per acre, and corn yields 25 to 35 bushels.

The addition of green and stable manure or proper rotation of crops, are essential to maintain productiveness. It is a warm soil and capable of being brought to a high state of productivity.

Houston Loam. This is a brown to grayish brown loam, 8 to 12 inches deep, underlaid to 36 inches by a brownish to drab colored clay subsoil. It occupies a narrow strip between the black prairie soils and the rolling sandy uplands. The topography is rolling, and natural drainage is good.

The surface soil generally has a high percentage of silt and some organic matter. If properly handled, it is a loose, friable soil, and much more easily cultivated than the Houston black clay.

Much of the type is under cultivation and constitutes desirable land for general farming. The summer droughts occasionally injure the late maturing crops, though good yields of cotton, corn, oats, and sorghum are produced. Thorough and careful tillage with a system of rotation of crops would substantially increase the productiveness of this soil.

Houston Black Clay. The soil to a depth of 8 to 14 inches is a black to drab colored clay, containing some lime concretions and a high percentage of organic matter. This type is known as the "black land" and constitutes the rich black prairie soil of the area.

Being a heavy clay, it is less easily handled than the lighter textured types, and much care is necessary to secure proper tilth. After careful cultivation for several years, it is a loose friable soil, but it becomes very sticky when wet. Unless often cultivated, the surface bakes and cracks into blocks. These cracks are often two to three inches wide and as many feet deep, affording a ready channel to the subsoil where the winter rains can be stored and used during the summer. This soil is adapted to general farming and ordinarily produces large yields.

This soil occurs on gently rolling country, with good natural drainage. It is found as a narrow strip along the Colorado River.

DESCRIPTION OF SAMPLES.

No. 910—Houston black clay (0"-10"), Elgin, Texas.
No. 911—Norfolk fine sand (0"-8"), Bastrop, Texas.
No. 912—Bastrop sandy loam (0"-10"), Bastrop, Texas.
No. 913—Susquehanna fine sandy loam (0"-10"), Bastrop, Texas.
No. 914—Lufkin fine sandy loam (0"-10"), Bastrop, Texas.
No. 933—Bastrop clay (0"-9"), Bastrop, Texas.
No. 936—Barton sandy loam (0"-12"), Bastrop, Texas.
No. 941—Houston loam (0"-10"), Bastrop, Texas.
No. 961—Norfolk fine sand, S. S. (8"-36"), Bastrop, Texas.
No. 964—Bastrop sandy loam, subsoil, Bastrop, Texas.
No. 968—Houston black clay (10"-36") Bastrop, Texas.
No. 969—Houston black clay 9"-36"), Bastrop, Texas.
No. 970—Barton sandy loam (12"-36"), Bastrop, Texas.
No. 971—Houston loam (10"-36"), Bastrop, Texas.
No. 1067—Susquehanna fine sandy loam (10"-36"), 2 miles north Bastrop, Texas.

TABLE 6—PERCENTAGE COMPOSITION OF SOILS OF BASTROP COUNTY

	Lufkin fine sandy loam	Susquehana Fine Sandy Loam		Norfolk Fine Sand		Bastrop Sandy Loam		Bastrop Clay	Bastrop Sandy Loam		Houston Loam		Houston Black Clay		Houston Black Clay
	914	913	1067	911	961	936	970	933	912	964	941	971	910	968	969
	Surface	Surface	Sub-soil	Surface	Sub-Soil	Surface	Sub-Soil	Surface	Surface	Sub-Soil	Surface	Sub-soil	Surface	Sub-soil	Sub-soil
Phosphoric Acid	.02	.02	.02	.01	.02	.03	.03	.14	.10	.04	.04	.08	.04	.04	.10
Nitrogen	.04	.04	.05	.02	.01	.03	.06	.12	.12	.08	.12	.07	.11	.07	.09
Potash	.10	.16	.59	.07	.06	.18	.47	1.35	.61	.69	.48	.44	.43	.38	.90
Lime	.18	.12	.46	.06	.12	.07	.62	9.06	1.02	.86	.43	.65	.56	1.06	10.62
Magnesia	.13	.13	.57	.04	.04	.18	.36	2.49	.54	.64	.50	.67	.58	.78	1.49
Alumina															
Oxide of Iron....	1.99	2.37	14.75	.51	.43	1.57	6.39	20.83	5.88	9.27	9.72	14.13	10.19	10.87	12.78
Soluble and In-Soluble Silica...	95.93	95.94	74.27	98.34	99.01	96.78	87.63	58.24	86.50	80.72	81.61	72.86	78.19	76.22	54.35
Loss on Ignition.	1.08	1.21	4.18	1.06	.29	.95	3.28	8.32	3.66	4.90	5.22	6.50	5.47	6.28	14.16
Moisture	.37	.20	4.16	.05	.11	.30	1.90	2.92	1.10	3.32	1.56	5.54	3.88	4.83	4.75

TABLE 7—INTERPRETATION OF ANALYSES BASTROP COUNTY

	Lufkin Fine Sandy Loam	Norfolk Fine Sand	Bastrop Sandy Loam	Bastrop Clay	Houston Loam	Houston Black Clay
Phosphoric Acid ...	Low	Low	Low	Good	Low	Low
Nitrogen	Low	Very low	Low	Good	Good	Fair
Potash	Fair	Fair	Good	High	Good	Good
Lime	Good	Low	Good	High	Good	Good
Depth of soil	15"	7"	10-24"	6-10"	8-12"	8-14"
Yield of cotton—bales	0.2—.5	...	0.5—.8	0.5—.8	0.5	0.5—.8
Yield of corn, bu.....	12-25	...	25-35	25-50	15-30	30-40

TABLE 8—WEIGHT OF CROP PRODUCED AFTER ADDITION TO SOILS OF BASTROP COUNTY

Laboratory Number		Kind of Crops	Addition to Soil NK	PNK	PK	PN
			Grams	Crops	Per	Pot
914	Lufkin fine sandy loam.....	Corn-07	6.6	10.9	4.4	7.8
		Grass-08	1.5	3.8	3.1	.1
913	Susquehanna fine sandy loam, surface	Corn-07	3.1	6.4	6.0	3.7
907	Norfolk fine sand, surface..	Corn-07	2.5	5.4	7.4	......
		Grass-08	1.4	2.5	1.7	3.
936	Bastrop sandy loam	Corn-07	7.7	8.7	7.5	......
		Wheat-08	1.2	1.6	.7	......
		Corn-08	17.2	11.3	4.8	10.
933	Bastrop clay, surface	Corn-07	5.0	3.1	6.3	5.7
		Grass-08	0.4	5.5	4.9	3.4
912	Bastrop sandy loam, surface	Corn-07	4.2	4.2	5.2	1.0
941	Houston loam, surface	Corn-07	2.4	13.2	10.7	......
		Grass-08	3.2	7.0	3.7	......
910	Houston b'ack clay, surface.	Corn-07	3.9	6.5	6.0	6.1
		Grass-08	6.2	5.4	4.3	5.8

DISCUSSION OF RESULTS.

The conclusions from the analyses are shown in Table 9. Most of the soils are low in phosphoric acid, the exception being the Bastrop clay. The first three soils are also very low in nitrogen. Most of the soils are fairly well supplied with potash, and contain fair amounts of lime.

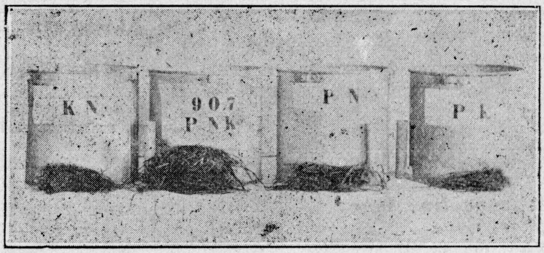
The pot experiments show us that most of the soils need phosphoric acid, and many of them respond to applications of nitrogen.

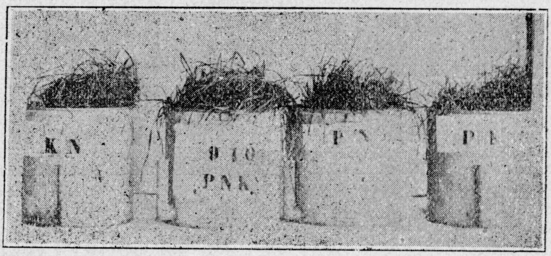
In the pot experiments, the letter N stands for an application of nitrogen, K for potash, and P for phosphoric acid. We compare the pot NK with the pot PNK to see the effect of phosphoric acid. If the crop with PNK is ten per cent or more larger than that with NK, we consider the soil to be deficient in phosphoric acid. If it is twice as large, we consider the soil to be very deficient.

Table 9.—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Lufkin fine sandy loam	D	DD	D
Susquehanna fine sandy loam	DD	S	S
Norfolk fine sand	DD	S	
Bastrop sandy loam	D	D	
Bastrop clay	D	S	D
Bastrop sandy loam	S	S	D
Houston loam	DD	D	
Houston black clay	D	S	S

DD—very deficient; D—deficient; S—sufficient.





Pot Experiments—No. 910, Houston Black Clay. No. 907, Norfolk Fine Sand.

SOILS OF BRAZORIA COUNTY.

(Brazoria Area.)

This area covers 845 square miles, about three-fifths of the total area of Brazoria County. Eight types of soil are found in this area, five of which have been subjected to analysis, and are described in the following pages. These samples were collected for us by Mr. S. A. McMillan, at that time a student, now a graduate of this College.

A full description and map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Brazoria Area, Texas," by Frank Bennet, Jr., and Grover B. Jones. (Reprint—Field Operations of the Bureau of Soils, 1902.)

DESCRIPTION OF SOILS.

Yazoo Sandy Loam. The Yazoo sandy loam is a dark gray sandy loam to a depth of from 6 to 15 inches, underlaid by a drab clay loam containing some sand. Immediately below this is a yellow or light chocolate colored clay which extends to a depth of three feet or more. It occurs in narrow ridges, seldom, if ever, exceeding one and one-half miles in width along sloughs and lakes and both sides of the Brazos River.

The principal timber growth is usually ash, liveoak and pecan. For general farming purposes the Yazoo sandy loam is considered one of the best soils in the area, being easily cultivated and well adapted to sugar cane, corn, and cotton. While very little truck has been grown on this soil type, the indications are that it should be one of the leading truck soils of the county. Irish potatoes have been found to do very well, yielding 200 to 300 bushels per acre. The soil is very fertile and at the same time has the light friable texture needed to secure the best results in the production of early truck for northern markets.

Most of the areas bordering on the Brazos River have at some time been under cultivation, but they are now largely a second growth of forest, principally pecan, and there are large areas where the trees are from three to five years old.

Yazoo Clay. The Yazoo clay is a yellow loam with a depth of 8 inches containing silt and small amounts of fine sand. From 8 to 36 inches the subsoil is a stiff chocolate colored clay. There are small spots of yellow silt loam varying in depth from 12 inches to three feet, which occur quite frequently, and are from one-fourth to two acres in extent.

The Yazoo clay occurs as a ridge on both sides of Oyster Creek, following the stream almost its entire length; it never extends more than half a mile back from the creek. This type has been formed principally by Oyster Creek, although the Brazos River has aided in its formation, as material is carried into this creek by the river during overflows. The principal timber growth is pecan and ash.

This is one of the most desirable soils of the bottom, as it is very fertile, has good drainage, and is easily cultivated. Most of it is under cultivation at present. Sugar cane is the principal crop grown, but the soil is also well adapted to cotton and corn. The yield of cane is about 20 tons per acre, producing about 150 pounds sugar per ton. The majority of sugar mills in the county are located on Oyster Creek where this soil is principally found.

The yield of oats ranges from 40 to 65 bushels per acre.

Calcasieu Fine Sandy Loam. The Calcasieu fine sandy loam is a compact, gray to dark gray sandy loam, 6 to 18 inches deep, resting on a clay loam which grades into a black or yellow subsoil containing a few iron concretions and large quantities of lime nodules. This soil usually occurs along streams in broad areas, extending back into the prairie for one-fourth to two miles.

Small white spots free from vegetation occur in this type. The soil in such places is a very white sand and silt from 2 to 4 inches deep, underlaid by an impervious yellow clay containing a very large proportion of lime nodules; this yellow clay has been formed by the decomposition of these packets of calcareous nodules. The spots vary in size from a few square feet to one-fifth of an acre. A chemical analysis shows this soil to contain from a trace up to 0.5 per cent of water-soluble salts or alkali.

One of the characteristic features of the Calcasieu fine sandy loam is the sand mounds which rise from 10 to 12 inches to three feet or more above the surrounding surface. These mounds are from 10 square feet to 6 1-4 acres in extent. A large part of the area of this soil has been formed through the erosion of these mounds, which are so numerous in most areas of this type as to make the topography slightly rolling.

The Calcasieu fine sandy loam is the principal truck soil of the area.

Sharkey Clay. The Sharkey clay is a very stiff, waxy clay to a depth of 8 inches, varying in color from black to light chocolate. It contains lime nodules, iron concretions, and small particles of shell.

The subsoil is a very stiff, impervious clay having the same color as that of the soil. In dry seasons the surface cracks readily, the cracks being from one to three inches wide and two to four feet deeep. It is locally known as "buckshot land" or "elm plots."

This type occupies about three-fourths of the entire Brazos bottoms, forming the lowest areas, and it is very difficult to drain. Where it can be well drained it is a strong soil for sugar cane, corn, and cotton. During the overflow of the bottom lands the coarser materials are deposited near the stream, while the finer particles are held in suspension and carried back from the stream and deposited on the low flats, forming Sharkey clay. During each deposit a large quantity of leaves, and various kinds of vegetable growth, is covered over by the sediment, thus making the soil very rich in organic matter. The soil is subject to overflow almost every year, as a rise of 6 or 8 feet in the river is sufficient to back the waters up the numerous small streams and bayous that flow into it. When the water is high enough to overflow the natural terrace along the banks of the river, the basin-shaped depressions which form a large part of the Sharkey clay, are covered with water from 3 to 10 feet deep. The only outlets for this water are the small streams, and with the slight slope it takes a long time for it to drain back into the river. A thorough drainage and dyke system will have to be had before this soil can be utilized to any great extent for agricultural purposes.

The timber growth is principally elm, with a dense undergrowth of vines and various kinds of bushes. The undergrowth furnishes cattle and grass protection from the cold winds which prevail during some parts of the winter, thus making this land very desirable for winter grazing.

Houston Black Clay. The Houston black clay is a black or drab clay from 6 to 10 inches deep, underlaid by a drab or yellow waxy clay, containing lime nodules and occasionally small quantities of iron concretions . It becomes compact and cracks into very hard irregular blocks on drying, but when well cultivated it is quite friable and has a texture much like a clay loam. In very dry seasons the cracks in the lower areas of this type are from 2 to 6 inches wide and from 3 to 6 feet deep. There is a phase of the soil locally known as "hog wallow," where the surface is rather uneven. Alkali spots and similar mounds to those occurring in the Calcasieu fine sandy loam, occur on this type but the mounds are comparatively rare. In some places, on the other hand, the alkali spots are very plentiful, though of small extent, rarely exceeding three feet square. They are usually in depressions from 5 to 10 inches lower than the surrounding soil.

The Houston black clay comprises about three-fifths of the area of the treeless prairie and is found in parts having the least elevation. The larger part of this soil is used as a range for cattle, but where it can be well drained it is considered good for general farming purposes. Even truck crops and pears have been found to do well on it. Rice has been found to give a good yield.

The yield of prairie grass is very heavy and a large quantity of it is cut and baled each year.

DESCRIPTION OF SAMPLES.

No. 1925—Yazoo sandy loam, surface soil, very productive. Dark color. Farm of T. J. McMillian, between Oyster Creek and Scoby Lake, near north fence. Anchor, Brazoria County, Texas.

No. 1926—Yazoo sandy loam, subsoil to 1925. Dark red, more sandy than top soil; color changes from 5" to 8".

No. 1927—Peach Ridge land, surface soil; black, rich loam, very fertile; good drainage. Island on Scoby Lake, Anchor, Brazoria County, Texas.

No. 1928—Peach Ridge land, subsoil to 1927. Subsoil begins at 8" to 10" Sandy.

1929—Yazoo clay. Surface soil; good soil, chocolate, stiff clay, very tenacious. "Red cane land," bank of Oyster Creek, farm of E. Nedinghours, near county bridge, two miles southwest Anchor, Brazoria County, Texas.

No. 1930—Yazoo clay, subsoil to 1929. Lighter and more sandy than surface soil.

No. 1931—Calcasieu fine sandy loam, surface soil 0"-11"; dark sandy loam, easily cultivated; good for truck. Found on ridges. One and one-half miles north of Anchor, Texas.

No. 1932—Calcasieu fine sandy loam, subsoil to 1931. Grayish sand.

No. 1933—Sharkey clay, surface soil 0"-10"; good when well drained. Dark tto light chocolate, very tenacious clay; poor drainage. Local name, "buckshot." Near county bridge on Kelley Lake, farm of McBeth.

No. 1934—Sharkey clay, subsoil to 1933. Lighter than surface, contains calcareous concretions.

No. 1935—Houston black clay, pasture land. Black, heavy clay. East line of pasture of L. J. McMillian, Anchor, Texas.

No. 1936—Subsoil to 1935. Light gray.

TABLE 10—PERCENTAGE COMPOSITION OF SOILS OF BRAZORIA COUNTY

	Yazoo Sandy Loam		Yazoo Clay		Peach Ridge Loam		Calcasieu Fine Sandy Loam		Sharkey Clay		Houston Black Clay	
	1925	1926	1929	1930	1927	1928	1931	1932	1933	1934	1935	1936
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid	.10	.09	.12	.09	.04	.06	.02	.01	.03	.05	.05	.02
Nitrogen	.16	.06	.19	.24	.21	.10	.09	.05	.12	.09	.22	.23
Potash	.66	.58	.67	71	.84	.59	.24	......	.62	.62	.60	.69
Lime	.70	2.01	.99	1.65	.47	.46	.16	.21	.73	.81	.84	.98
Magnesia	......	.93	1.73	1.44	.95	.94	.19	.17	.76	1.33	.75	1.81
Sulphur Trioxide	.07						.04		.04	.05	.08	.04
Alumina and Oxide of Iron	7.23	6.85	11.43	8.50	14.20	6.92	1.78	1.88	13.82	11.41	12.45	13.49
Soluble and Insoluble Silica	82.46	83.17	73.64	80.18	83.83	86.09	95.08	96.26	71.64	75.33	71.55	66.93
Loss on Ignition	5.85	3.60	7.07	4.53	6.35	3.39	2.29	1.29	8.41	5.15	11.31	10.39
Moisture	2.30	2.00	4.09	1.67	2.05	1.52	.62	.43	4.11	4.29	4.22	5.32

TABLE 11—INTERPRETATION OF ANALYSIS, BRAZORIA COUNTY

	Yazoo Sandy Loam	Yazoo Clay	Calcaseiu Fine Sandy Loam	Sha'key Clay	Houston Black Clay	Peach Ridge
Phosphoric Acid....	Good	Good	Low	Low	Fair	Fair
Nitrogen	Good	Excel-lent	Fair	Fair	Excel-ent	Excel-ent
Potash	Good	Good	Good	Fair	Good	Good
Lime	Good	Good	Fair	Good	Good	Good
Depth of soil	6-15"	8"	6-18"	8"	6-15"	.....

TABLE 12—CROP PRODUCED AFTER ADDITIONS TO SOIL

Laboratory Number		Addition KPN	KPN	KP	KN	PN
		Grams Crop Per Pot				
1925	Yazoo sandy loam, surface........	43.75	39.50	32.55	31.10	40.35
1926	Yazoo sandy loam, subsoil	10.8	12.5	13.4	3.7	16.3
1929	Yazoo clay, surface	32.9	14.6	15.3	18.4	36.6
1930	Yazoo clay subsoil	8.1	16.2	5.0	2.6	11.8
1927	Peach Ridge land, surface	7.60	22.35	18.8	13.35	7.80
1931	Calcasieu fine sandy loam, surface	20.55	26.55	30.	21.45	10.80
1932	Calcasieu fine sandy loam, subsoil.	22.55	21.55	15.75	4.00	22.75
1933	Sharkey clay, surface	14.8	15.7	18.7	7.30	17.45
1934	Sharkey clay, subsoil...........	19.15	22.30	19.15	6.50	18.40
1935	Houston black clay, surface......	27.65	27.00	20.35	20.75	27.20
1936	Houston black clay, subsoil........	32.1	31.0	26.4	30.8	39.4

Table 13.—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Yazoo sandy loam, surface soil	D	D	S
Yazoo sandy loam, subsoil	DD	S	S
Yazoo clay, surface soil	D	D	S
Yazoo clay, subsoil	DD	D	S
Peach Ridge surface	D	S	D
Calcasieu fine sandy loam, surface	S	S	D
Calcasieu fine sandy loam, subsoil	D	DD	S
Sharkey clay, surface	D	..	S
Sharkey clay, subsoil	DD	D	D
Houston black clay, surface	D	D	S
Houston black clay, subsoil	S	D	S

DD—very deficient; D—deficient; S—sufficient.

DISCUSSION OF RESULTS.

The soils of this area are well supplied with plant food, especially with potash. A good supply of nitrogen is also present. Phosphoric acid is in good quantities, excepting in the Calcasieu fine sandy loam.

The pot experiments show, however, that these soils, as a rule, respond to phosphatic fertilizers, and a number of them to nitrogenous fertilizers. That is to say, that while highly productive without fertilizers, yet these soils respond to fertilizers under favorable conditions.

SOILS OF CAMERON COUNTY.
(Brownsville Area.)

This area comprises about 189 square miles of the southeastern part of Cameron County, including the town of Brownsville. Eight types of soil are mapped, and four of these are here discussed.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Brownsville Area, Texas," by A. W. Mangum and Ora Lee, Jr. (Advance sheets—Field Operation of the Bureau of Soils, 1907.)

DESCRIPTION OF SOILS.

Cameron Clay. The surface soil of the Cameron clay consists of a heavy dark brown to black clay, 12 to 15 inches deep. When wet the soil is sticky and tenacious and on drying the surface bakes and sun-cracks to such an extent that thorough cultivation is impossible. The subsoil is a heavy clay, lighter in color than the surface soil but containing a higher percentage of clay and silt.

The surface of the better drained areas breaks up under cultivation into a friable loamy condition. The poorly drained areas are hard to cultivate, as they remain in a wet condition for long periods; and when dry the surface is baked so hard that cultivation is almost impossible. This soil occurs in nearly every locality embraced in the area, and occupies the broad shallow basin which occurs between river channels and, as a whole, is very poorly drained.

This soil receives the drainage from the bordering soils and this with the lack of drainage has caused an accumulation of alkali in almost all of the lower depressions.

The better drained areas along the upper slopes support a heavy growth of mesquite, cactus and other native vegetation, but as the lower depressions are approached, the growth becomes less and the lowest portions support only a heavy growth of coarse grass. Where this soil is well drained, it produces profitable yields of cotton, corn, and sugar cane.

Only a small percentage of the total area of this soil is at present under cultivation, and its poorly drained condition as a whole has greatly hindered its agricultural development. The average yield of sugar cane is 25 to 30 tons per acre, but larger yields have been secured. Cotton is grown on both irrigated and non-irrigated lands, and gives an average yield of three-fourths to one bale per acre. Corn when irrigated produces 50 to 60 bushels per acre. The Cameron clay is not well adapted to vegetables.

Laredo Silty Clay. The surface soil of the Laredo silty clay is a heavy brown silty clay having an average depth of 15 inches. The subsoil is a stiff compact silty clay lighter in color than the surface. The surface of this soil does not bake and sun-crack to such an extent as to interfere with cultivation and, when plowed, breaks up easily into loose loamy condition.

The Laredo silty clay occurs only in two small areas in the north central part of the survey. The soil has a gentle slope, causing it to have fair drainage.

A large proportion is under cultivation. The unimproved land is not as well drained as that under cultivation, and alkali spots are more frequent on it.

When well drained the irrigated land produces profitable yields of corn, cotton, sugar cane, and several kinds of vegetables.

Rio Grande Silty Clay. The soil of the Rio Grande silty clay to an average depth of 12 inches is a dark brown to black silty clay. This grades into a lighter textured subsoil of silt and fine sand. When dry the soil becomes sun-cracked and hard.

This type of soil occupies the lower terrace in the larger bends of the Rio Grande, and is subject to overflow at times of high water. The areas embraced by this type are covered by a heavy growth of semi-tropical vegetation. None of this soil is under irrigation. The better drained areas are often cultivated in cotton and corn, and when these crops are not damaged by overflow they produce fairly good yields. Cotton produces three-fourths to one bale.

Laredo Silt Loam. This is a light brown to gray silt loam, 12 inches deep containing a large percentage of sand, with a subsoil of about the same texture but lighter in color. The soil is very easy to cultivate. It is found in small areas, occupying slight elevations or low ridges, and is naturally well drained. It is well adapted for early vegetables.

DESCRIPTION OF SAMPLES.

No. 693—Rio Grande silty clay, subsoil.

No. 982—Cameron clay, subsoil.

No. 1113—Rio Grande silty clay (0-12"); 2 1-2 miles southeast of Brownsville, Texas.

No. 1114—Laredo silt loam (0-12"); 2 1-2 miles east of Brownsville, Texas.

No. 1115—Rio Grande silty clay (0-10"); one mile south of Brownsville, Texas.

No. 1116—Cameron silty clay (0-14"); 2 1-2 miles northeast of Brownsville, Texas.

No. 1346—Cameron clay (0-12"). Dark brown clay; 1 1-2 miles east of Brownsville, Texas.

No. 1347—Cameron clay, subsoil to 1346 (12"-36"). Brown heavy clay.

TABLE 14—PERCENTAGE COMPOSITION OF SOILS OF CAMERON COUNTY

	Cameron Clay		Laredo Silty Clay	Rio Grande Silty Clay			Laredo Silt loam
	1346	1347	1116	1115	963	1113	1114
	Surface	Sub-soil	Surface	Surface	Sub-soil	Surface	Surface
Phosphoric Acid	.13	.13	.16	.13	.17	.14	.12
Nitrogen	.06	.06	.15	.10	.05	.06	.08
Potash	1.56	1.65	.84	.62	.71	1.32	.80
Lime	11.09	10.62	5.37	10.74	9.86	10.43	12.21
Magnesia	1.41	1.08	.62	1.53	1.17	1.17	1.67
Sulphur Trioxide	.11	.12					
Alumina and Oxide of Iron	14.52	14.54	9.51	15.96	10.47	18.11	8.60
Soluble and Insoluble Silica	51.91	52.49	66.64	51.90	60.73	50.67	62.42
Loss on Ignition	8.65	7.41	10.40	14.11	11.13	13.65	10.46
Moisture	4.88	5.15	2.54	3.81	2.78	4.02	1.33

TABLE 15—INTERPRETATION OF ANALYSES, CAMERON COUNTY

	Cameron Clay	Laredo Cilty Clay	Rio Grande Silty Clay		Laredo Silt Loam
Phosphoric Acid	Good	High	Good	Good	Good
Nitrogen	Low	High	Good	Low	Fair
Potash	High	High	High	High	High
Lime	High	High	High	High	High
Depth of soil, ...	12"-15"	15"	12"	.....	.....
Yield of cotton, bales......	3-4 to 1	fair	3-4 to 1		
Yield of corn, bu.	50 to 60 on irrigated land	Profitable 30			

DISCUSSION OF RESULTS.

The soils of this area which we examined are well supplied with phosphoric acid, potash, and lime. The Cameron clay, and Rio Grande silty clay are low in nitrogen.

Only one pot experiment was made on these soils, and that was on Cameron clay. The results are given under the soils of the Nacogdoches Area. (See Table 27.) This soil appears to need both phosphoric acid and nitrogen, and possibly some potash. It can, however, produce good crops without the use of any fertilizer.

SOILS OF CHEROKEE COUNTY.

(Jacksonville Area.)

This area occupies 100 square miles immediately around Jacksonville, Texas. Four types of soil were recognized, and two were subjected to analysis.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Jacksonville Area, Texas," by W. Edward Hearn and James L. Burgess. (Advance sheets—Field Operations of the Bureau of Soils, 1903.)

DESCRIPTION OF SOILS.

Norfolk Fine Sand. This is a fine gray sand with a depth of 12 inches. The subsoil is a yellowish fine sand 36 inches or more in depth, of fine texture, and loose incoherent structure. It is the most important type in the area, both in respect to extent and agricultural value

In the vicinity of Jacksonville, tomatoes and peaches are the main crops grown on this soil and the secondary crops are cotton, corn, and potatoes. Away from the railroad, cotton and corn are the principal crops. Cotton and corn do fairly well for a few years while the land is fresh. Potatoes do well, producing round smooth tubers of uniform size and excellent shipping qualities. This is an easily tilled soil, and very early. It responds freely to fertilizers. It can be considerably improved by plowing under cowpeas and other leguminous crops, which add large amounts of humus to the soil. The soil is adapted to peaches, truck and small fruits.

Orangeburg Fine Sandy Loam. The surface soil consists of a moderately light texture sandy loam, light to red in color with a depth of 10 to 20 inches. The subsoil to a depth of 36 inches is a red sandy clay, usually friable but sometimes stiff and hard.

The Orangeburg fine sandy loam owes its origin to the weathering of sand deposits. There are some areas of this soil adjoining the Orangeburg clay, which are in all probability derived from weathering of highly siliceous glauconite material. It is along these marginal areas that green sand is found in wells at a depth of 15 to 20 feet.

A considerable part of the Orangeburg fine sandy loam is under cultivation. It is an easily tilled and a comparatively early soil. Cotton, corn, tomatoes, peaches and truck are the principal crops. Cotton yields from one-half bale to one bale under favorable conditions. This is considered a good type for general farming and will produce fine peaches and tomatoes and is excellent for potatoes.

The heaviest phase of this type would probably grow fine Cuban filler tobacco, while the lighter phases would produce a good wrapper leaf.

DESCRIPTION OF SAMPLES.

No. 211—Probably Norfolk sand or fine sand, Dialville, Cherokee County, Texas.

No. 212—Subsoil of 211.

No. 897—Norfolk fine sand, Jacksonville, Texas, J. T. Cocke.

No. 958—Orangeburg fine sandy loam, Jacksonville, Texas, John Goodman.

No. 992—Orangeburg fine sandy loam, Jacksonville, Texas, John Goodman.

No. 1144—Norfolk fine sandy loam, Jacksonville, Texas, J. T. Cocke.

TABLE 16—PERCENTAGE COMPOSITION OF SOILS OF CHEROKEE COUNTY

	Probably Norfolk Fine Sand		Norfolk Fine Sand	Orangeburg Fine Sandy Loam	
	211	212	897	958	992
	Surface	Sub-soil	Surface	Surface	Surface
Phosphoric Acid	.06	.001	.03	.20	.15
Nitrogen	0.4	.02	.02	.13	.04
Potash	.08	.12	.07	...	.22
Lime	.07	.07	.02	.32	.29
Magnesia	.04	.01	.01	.35	.27
Alumina	.60	} 1.05			
Oxide of Iron	.45		1.16	20.74	16.09
Soluble and Insoluble Silica	95.75	97.57	97.56	68.56	76.96
Loss on Ignition	1.39	.75	1.03	7.36	5.42
Moisture	.22	.17	.02	1.69	1.08

TABLE 17—INTERPRETATION OF ANALYSES, CHEROKEE COUNTY

	Probably Norfolk Fine Sand	Norfolk Fine Sand	Orangeburg Fine Sandy Loam
Phosphoric Acid	Fair	Low	Good
Nitrogen	Low	Low	Good
Potash	Fair	Low	Good
Lime	Fair	Fair	Fair
Depth of soil	....	12"	10"-20"

DISCUSSION OF RESULTS.

The interpretation of the analysis for the several types of soil is shown in the table. These soils are inclined to be deficient both in phosphoric acid and nitrogen, and are also low in lime. Only one pot test was carried on with these soils, the samples being secured for other experimental work. The results of this test is given under the Nacogdoches Area. (See Table.) The Norfolk fine sand tested was deficient in phosphoric acid; the nitrogen deficiency was not tested.

SOILS OF DELTA AND LAMAR COUNTIES.

(Cooper Area.)

This area includes the whole of Delta County, and the southern part of Lamar County, and covers an area of about 625 square miles. Eight types of soil were located, and six of these are described and analyzed.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Cooper Area, Texas," by Thos. D. Rice and H. C. Smith. (Advance sheets—Field Operations of the Bureau of Soils, 1907.)

DESCRIPTION OF SOILS.

Lufkin Fine Sandy Loam. This is a gray fine sandy loam, varying in depth from 6 to 30 inches. It contains the finer grades of sand and much silt, though the silt content is not as high as in a typical Lufkin clay soil.

The subsoil is similar to that of the Lufkin clay, consisting of a compact impervious silty clay. In color it is dark or gray, mottled with yellow or red, but weathers to a uniform red where it is exposed on hillsides or washes.

This soil occurs in extensive tracts in the southwestern part of Lamar County and southern part of Delta County. It is found on level prairies as well as on the stream slopes. As a rule, the drainage is better than that of the Lufkin clay. Both the situation of the soil and its depth prevent water standing on the surface.

A large proportion of this soil on the level prairie has been brought under cultivation. It is a productive soil. Near the areas of the Houston loam, the Lufkin fine sandy loam changes so gradually into that type that the boundaries of the two can be determined only by the nature of the subsoil.

Cotton is the principal crop on this soil. The average yield is perhaps one-half bale per acre, but larger yields are secured by good cultivation. Corn is grown to some extent, and the yields are fairly good. The soil is well adapted to fruits and vegetables, but no trucking is done except for local markets.

Lufkin Clay. This soil is a silty loam, or, less frequently, a very fine sandy loam having a depth of less than six inches. Where it has a depth of more than six inches it has been called Lufkin fine sandy loam. In the Lufkin clay areas, the sandy top soil has sometimes been completely removed from small patches and the clay appears on the surface. The subsoil is a compact, impervious, silty clay of a dark or gray color mottled with yellow or red; the color depends on the drainage and extent of weathering. In flat, poorly drained localities, the clay has a dark color but where exposed it weathers to a uniform red.

In texture the subsoil is clay containing much silt and much very fine sand, the coarser grades of sand being absent. Both soil and subsoil when wet act like quicksand. In dry weather, the water does not readily rise, and the crops suffer from drought.

The soil is nearly always timbered and known as post oak land on account of the predominance of post oak on the level, poorly drained portions. On the better drained portions, hackberry, hickory, and several species of oak and other hardwood trees are found.

The Lufkin clay is cultivated to some extent, and successful farmers may be seen on this type, particularly in the vicinity of Charleston in Delta County. The greater part of this soil is in forests, North of Deport, in Lamar County, many farms have been abandoned, partly on account of the poverty of the soil, and partly on account of emigration of the tenant class to the western part of the State.

The average yield of cotton is low, varying from one-fourth to one-half bale per acle. The best farmers make from 25 to 35 bushels of corn per acre. The more sandy portions of the type are adapted to trucking and fruit, but little such is done.

Houston Loam. This soil is locally known as gray land. It varies considerably in texture but usually consists of a heavy, rather silty loam, underlaid by a dark or brown clay. The soil is lighter in color than the Houston black clay and contains a larger percentage of very fine sand. It lacks also the extreme tenacity of the Houston black clay and forms better roads.

The Houston loam occupies broad rolling prairies and some hilly areas. The rolling topography and the pervious character of the soil insure good drainage. For this reason, farming has been more certain on this type of soil than on the Houston black clay, and it is now considered the best land in the area.

Alfalfa has not been generally successful on this soil. It is possible to grow alfalfa on a greater part of it, but it seems difficult to get a good stand. This soil stands drought fairly well, as the subsoil is retentive of moisture. All things considered, it is a valuable soil, deserving its present high reputation.

Houston Black Clay. This is a black calcareous clay 6 to 10 inches deep with a most tenacious, gummy consistency. The subsoil to a depth of 36 inches is usually a dark clay, somewhat more plastic than the soil. Below 36 inches the subsoil becomes brown or yellow in color.

The Houston black clay on drying cracks up into small fragments, which give it a loamy character and permits of easy cultivation. When thoroughly dried, cracks several inches wide appear over the surface. The soil when wet assumes a sticky, gummy, consistency, and is very tenacious. The subsoil is somewhat impervious, and where drainage is not good the water may accumulate during a season of heavy rainfall and injure the cr p.

The surface of the Houston black clay is rolling. It occupies the tops of broad, gently rolling plateaus and is also found on slopes. The Houston black clay is a productive soil. In late years excessive rains have so decreased yields on the Houston black clay that it has declined in value and the Houston loam has supplanted it, but doubtless when drier years come, landowners will again rank it above the Houston loam. Cotton and corn are the principal crops. The yield of oats is good. It is adapted to alfalfa and yields 2 to 4 tons per acre. The native grasses make good hay, but the turf has mostly all been plowed and destroyed. Bermuda grass covers the land well and makes good pasture. The greater part of this soil was originally a treeless prairie, but some small strips of forests are found, usually along the streams.

DESCRIPTION OF SAMPLES.

No. 817—Lufkin fine sandy loam (0-16"), one-half mile southeast of Klondike.

No. 824—Lufkin fine sandy loam, No. 2, 1 1-2 mile southeast Klondike, Texas, I. Hunt's land.

No. 829—Houston loam (0-12"), dark brown loam, 1 1-2 mile northwest Cooper, Texas.

No. 878—Lufkin clay, subsoil (6"-36"), 3 miles east of Cooper, Texas.

No. 893—Lufkin clay (0-6"), Delta County.

No. 915—Houston black clay, subsoil (10"-36"), Delta County, Texas.

No. 939—Houston black clay (0-10"), Delta County.

No. 1305—Houston loam (0-10"), brown loam, 3 miles southwest Cooper, Texas.

No. 1306—Subsoil to 1305 (10"-36"), brown heavy clay, 3 miles southwest Cooper, Texas.

No. 1340—Lufkin fine sandy loam (0-12").

No. 1341—Lufkin fine sandy loam, subsoil (13"-36"), one mile south Cooper, Texas.

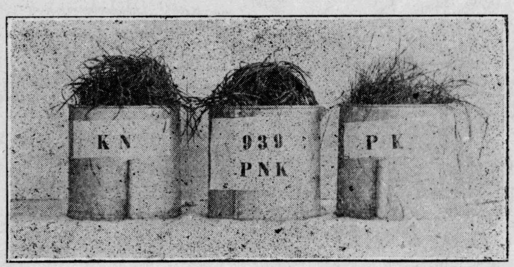
No. 1342—Lufkin fine sandy loam (0-12"), fine sandy loam, one mile northwest Klondike, Texas.

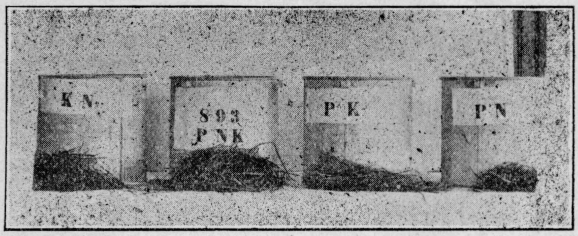
No. 1343—Lufkin fine sandy loam, subsoil (12"-36"), heavy mottled sandy clay, one mile northwest Klondike, Texas.

No. 1344—Lufkin clay (0-5"), fine sandy loam, 3 miles west of Charleston, Texas.

No. 1345—Lufkin clay, subsoil (5"-36"), heavy mottled clay, 3 miles west of Charleston, Texas.

Pot Experiments—No. 829, Houston Loam; No. 817, Lufkin Fine Sandy Loam.





Pot Experiments—No. 939, Houston Black Clay; No. 893, Lufkin Clay.

TABLE 18—PERCENTAGE COMPOSITION OF SOILS OF DELTA AND LAMAR COUNTIES

	Lufkin Fine Sandy Loam		Lufkin Fine Sandy Loam		Lufkin Fine Sandy Loam		Lufkin Clay		Lufkin Clay		Houston Loam	Houston Black Clay		Houston Loam	
	817	825	1340	1341	1342	1343	893	878	1344	1345	829	939	915	1305	1306
	Surface	Surface	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Surface	Sub soil	Surface	Sub soil
Phosphoric Acid	.07	.02	.04	.07	.07	.07	.03	.02	.04	.03	.04	.04	.05	.03	.03
Nitrogen	.07	.04	.08	.06	.06	.06	.10	.10	.10	.07	.13	.13	.13	.10	.08
Potash	.14	.25	.11	.26	.12	.23	.14	.18	.19	.32	.20	.39	.40	.08	.27
Lime	.15	.42	.12	.41	.14	.35	.35	.45	.26	.42	.67	1.42	1.55	.43	.59
Magnesia	.16	.40	.15	.29	.17	.38	.27	.28	.21	.38	.44	.89	.85	.23	.43
Sulphur Trioxide	...	...	.09	.06	.09	.12	...	.11	.08	.07	Tr.	...	...	.10	.10
Alumina ...... Oxide of Iron..	4.62	11.62	3.70	12.99	4.60	11.52	6.32	9.24	5.90	10.63	11.54	14.00	15.78	6.83	10.37
Soluble and Insoluble Silica.	91.91	76.89	92.44	77.11	91.75	79.23	87.70	81.65	88.14	81.14	76.09	67.71	63.83	85.57	79.66
Loss on Ignition	2.29	4.33	2.73	4.80	2.66	4.57	3.97	3.28	4.76	4.11	8.27	8.51	9.07	4.39	5.06
Moisture	1.13	5.24	.75	4.04	.75	3.58	1.20	2.77	1.16	3.18	3.10	5.45	7.27	2.39	3.71

TABLE 19—INTERPRETATION OF ANALYSES, COOPER AREA

	Lufkin Fine Sandy Loam		Lufkin Clay		Houston Loam	Houston Black Clay
Phosphoric Acid	Fair	Low	Low	Good	Low	Low
Nitrogen	Fair	Low	Good	Good	Fair	Good
Potash	Fair	Good	Low	High	Fair	Good
Lime	Good	Good	Fair	H·gh	Good	High
Depth of soil	6to30 ins.	....	6 ins.	5 ins.	9 ins.	6to10 ins.
Yield of cotton	1-2	....	....	1-4to1-2	3-4	1-2to1
Yield of corn............	....	....	....	25to35	35to40	30to40
Local opinioin	Prod'ctve.	....	....	Poor	Rich	Rich

TABLE 20—CROPS PRODUCED AFTER ADDITIONS TO SOILS

Laboratory Number		Crops and Year	Additions: NK	PNK	PN	KN
			Grams Crop per Pot			
829	Houston loam	Corn '07	18.5	31.4	32.5	21.0
		Corn '07	1.2	5.0	2.8	5.0
		Grass '08	14.4	7.2	7.3	2.8
893	Lufkin clay	Corn '07fall	4.6	5.5	6.8	5.5
		Grass '08	2.2	4.6	.9	2.6
939	Houston black clay	Corn '07fall	74.3	6.5		5.2
		Grass '08	7.0	3.3		3.3

DISCUSSION OF RESULTS.

The soils of this area, as a rule, are low in phosphoric acid. The lime is generally good, and so is the potash. Nitrogen is good in most of the soils.

The three soils tested by means of pot experiments, are deficient in phosphoric acid. They are also deficient in nitrogen, or become deficient under cultivation. Deficiency in potash is not very apparent.

SOILS OF HIDALGO COUNTY.

No survey has been made of this area, but a series of soils was collected for us by Mr. Rockwell, Irrigation Expert, U. S. Department of Agriculture. The description and analyses of these soils follow:

DESCRIPTION OF SOILS.

Nos. 1359 and 1360. A medium fine sand colored black with organic matter. Subsoil is a dark brown, fine sandy loam. This is a fertile soil, which has never been cultivated. It represents 15,000 acres in this county. There is a heavy growth of mesquite and cactus. No crops have been grown as yet. This soil requires careful handling all the time and needs care in drainage. It becomes sticky when wet and bakes and cracks when dried by sun and wind. The soil lies quite level, and the drainage is fair. There is quite a growth of grass on this land, growing in benches, 6 to 8 inches high when the sample was taken. The subsoil is a yellowish clay or silt from three feet six inches down.

Nos. 1361 and 1362. Surface soil is a brown loam. Subsoil is a light brown fine sand. This land has never been cleared. It represents 100,000 acres in Hidalgo County. It works well with careful handling, in very wet seasons is inclined to get sticky. The land is slightly rolling; drainage good.

These samples are a type of the soil of the high ground bordering on *resacas* and *onajas* back from 3 to 10 miles from the river. It represents quite an acreage but not nearly so large as some others. The ground is covered with mesquite and cactus.

Nos. 1363 and 1364. Surface soil is very dark clay loam. Subsoil is light brown, very fine sandy loam. This is a fertile soil, but has never been cultivated. It represents 150,000 acres in this county. Will drain well in wet seasons and with cultivation will hold moisture well in dry seasons. The land is gently rolling; drainage good.

Mr. Wood has a small amount of garden truck in his yards, which is doing well, being irrigated. The truck consists of onions, tomatoes, potatoes and radishes. His well is 31 feet deep. Water came in in a strata of quicksand. Water soft. Subsoil four feet and deeper. A yellowish sandy clay. A deposit of many years ago.

Nos. 1365 and 1366. Surface soil a light brown clay, subsoil of which is clay; good soil. Represents 75,000 acres or more in county. Cotton chiefly grown. Soil requires careful handling under irrigation; drainage is of equal importance with irrigation. Will run together, bake, and crack if not very carefully handled. Drainage not very good, needs artificial drainage; the land is quite level. This ground was cultivated by Mexicans, who raised cotton, until about two years ago. Land is of late formation by overflows.

Nos. 1367 and 1368. Surface soil a brown clay loam. Subsoil a light brown clay loam. Is a moderate soil; has never been cultivated. A type covering 25,000 acres or more. No crops grown as yet. If not carefully handled and the least permissible amount of water used, it will run together and bake, contracting and cracking. Lies very level; poor drainage; needs artificial drainage. No water should be allowed to stand; should be kept moving either down or off the surface. The land is covered with brush, and here and there a mesquite bush. No cactus.

Nos. 1369 and 1370. Fine light brown sandy loam, surface soil. Subsoil a light brown fine sand. Moderately fertile soil; has never been cultivated. Type 15,000 acres. Requires careful handling. As small amount of water as possible should be used, with much cultivation. Very level and has poor drainage. Land is covered with mesquite brush and cactus. The cactus is not as rank as on higher land. Land is subject to overflow. Has been flooded recently. Land of late formation by overflow.

TABLE 21—PERCENTAGE COMPOSITION OF SOILS, HIDALGO COUNTY

	Hidalgo Co Soils		Hildago Co Soils		Hidalgo Co Soils		Hidalgo Co Soil		Hidalgo Co Soil		Hidalgo Co Soil	
	1365	1366	1367	1368	1369	1370	1359	1360	1361	1362	1363	1364
	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil
Phosphoric Acid	.21	.18	.16	.15	.14	.17	.12	.10	.19	.15	.13	.08
Nitrogen	.13	.08	.09	.06	.11	.07	.12	.06	.17	.10	.12	.09
Potash	.35	.41	......	88	1.00	.82	1.67	1.02	1.94	1.18	.27	.29
Lime	5.47	12.71	10.50	12.99	13.47	13.61	5.08	7.05	8.34	7.74	1.30	2.74
Magnesia	4.30	.98	2.97	1.02	1.30	1.35	.91	.87	.04	2.84	.53	.67
Sulphur Trioxide	.03	.15	.09	....	......	......	.10	......	.27	.11	.08	.04
Alumina and Oxide of Iron	9.16	8.84	12.67	13.83	12.60	13.20	9.56	10.02	11.24	10.16	5.99	6.86
Soluble and Insoluble Silica	61.43	59.61	50.66	50.55	48.49	48.12	69.15	66.44	59.18	58.51	82.91	80.34
Moisture	2.37	2.73	4.40	5.05	6.36	6.83	5.14	4.79	4.83	5.01	2.52	2.98

TABLE 22—INTERPRETATION OF ANALYSES, HIDALGO CO.

	1359	1361	1363	1365	1367	1369
Phosphoric Acid	Good	High	Good	High	Good	Good
Nitrogen	Good	High	Good	Good	Fair	Good
Potash	High	High	Good	Good	....	High
Lime	High	High	High	High	High	High

DISCUSSION OF RESULTS.

These soils are well supplied with plant food. The differences in the properties and value of the soils are due largely to their position and physical character. There are, however, some differences in the plant food contained in these soils.

SOILS OF LAVACA COUNTY.
(Lavaca Area.)

This area occupies the whole of Lavaca County, an area of approximately 995 square miles. Only three types of soil were established, and all have been analyzed.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of Lavaca County, Texas," by Charles N. Mooney, et al. (Advance sheets—Field Operations of the Bureau of Soils, 1905.)

DESCRIPTION OF SOILS.

Lufkin Sandy Loam. This consists of a medium or fine sand varying in texture from an incoherent sand to a sandy loam, in color from gray to dark brown, depending largely on the amount of organic matter present. The depth of the soil varies from 8 to 20 inches, with an average depth of 14 inches.

The subsoil consists of a dark and yellow mottled sandy clay often streaked with iron stains. It is a stiff, tenacious, impervious clay. Ponds and tanks dug in it, retain water, and water falling on the surface is held and lost through evaporation rather than percolation. Its water holding capacity is high and the clay is always found moist. It erodes badly where the slope is sufficient, and gullies are common.

It occurs on flat to rolling areas. Wherever the surface is rolling the drainage is good, there being plenty of stream courses to carry off the water, but the flat low-lying areas lack surface drainage and the subsoil being impervious, the water stands on the surface for some time after rains. These flat areas in their present condition are unfit for cultivation, but do fairly well for pasture.

The principal crops grown are cotton and corn. More attention, however, is paid to cotton. It does well on this soil, the yield being from one-half to three-fourths bale, and sometimes a bale per acre. These yields are secured without the use of any fertilizers. The land is easy to till, and responsive.

Corn does not do as well as cotton, except on the lower slopes near the streams where the soil is deeper and more loamy. The corn grown is mostly a white dent variety, and yields from 15 to 18 bushels per acre. Sorghum is grown and does well.

This soil is well adapted to truck crops. The average yield of Irish potatoes is between 75 and 100 bushels.

Lufkin Sand. This consists of a loose incoherent gray, medium to fine sand, the surface foot usually having a brownish color. The depth of the soil usually exceeds 36 inches. Beneath the sand is found the same drab and yellow mottled sandy clay that forms the subsoil of the Lufkin fine sandy loam. In fact the only difference between the Lufkin sandy loam and Lufkin sand is the difference in depth of the sand overlying the clay and the consequent difference in agricultural value.

This type occupies the sandy ridges in the post oak section of the county and along some of the streams. The soil readily absorbs water and its location on the ridges insures good surface drainage.

It is a poor soil and but little of it is cleared and under cultivation. Crops grown on this soil usually suffer from lack of moisture, but in favorable seasons when there is plenty of rain, fair crops of cotton are obtained. This soil seems well suited to sweet potatoes. Early trucking crops might also do well.

Houston Black Clay. The soil of the Houston black clay varies from a heavy loam or clay loam to a stiff waxy clay, but consists largely of the latter and is called "hog wallow" or "black waxy." It ranges in depth from 8 to 20 inches with an average of 12 inches. The subsoil is a stiff, very tenacious black clay, generally lighter colored than the surface soil on account of the lower content of organic matter.

This soil occurs on flat to high rolling prairies. The lower and more level areas lack surface drainage, and having an impervious clay subsoil are wet the greater part of the year.

This is the most valuable soil in the county for staple crops, and the farms of this soil are highest in price. It is treeless with the exception of live oaks along the streams.

The crops grown are cotton and corn. Cotton yields one-half to one bale to the acre. Corn does fairly well, producing 25 to 50 bushels per acre. For corn the lower locations are the best, where the soil is more loamy and better moisture conditions prevail. Some onions are grown on this soil and give good results. Sorghum and millet are grown for forage and give large yields. Alfalfa has been grown on a similar soil in other parts of the state, and if grown here would prove a profitable forage crop and soil improver as well. The cowpea is another legume which should be extensively grown, as no doubt it would thrive here. The growing of legumes, aside from being profitable as a forage crop, would afford a desirable step in crop rotation, eliminating the necessity of keeping so much under pasture.

Under the present methods, a large part of the wet places is kept in the native pasture, consisting of sage and mesquite grasses.

No. 1588—Lufkin sandy loam (1"-8"), virgin soil. Moderately level; poor drainage. Near Hallettsville on lower Sublime road 2 miles.

No. 1589—Lufkin sandy loam, subsoil (8"-14").

No. 1590—Deep subsoil to 1588 (14"-20").

No. 1591—Lufkin sand (1"-8"). Poor, virgin soil; good drainage; rolling. Productive, one-fourth bale cotton. Hallettsville, 4 miles from lower Sublime road. This soil is a very fine sand almost as fine as sugar—no difference in surface and subsoil.

No. 1592—Lufkin sand, subsoil (8"-12").

No. 1593—Houston black clay (1"-5"). Good soil; fair drainage. Produces three-fourths bale of cotton; black sticky. Hallettsville, 1 1-2 miles north.

No. 1594—Houston black clay, subsoil (5"-12".) Whitish.

TABLE 23—PERCENTAGE COMPOSITION OF SOILS OF LAVACA COUNTY

	Lufkin Sandy Loam			Lufkin Sand		Houston Black Clay	
	1588	1589	1590	1591	1592	1593	1594
	Surface	Sub soil	Sub soil	Surface	Sub soil	Surface	Sub soil
Phosphoric Acid	.01	.01	.01	.10	.03	.04	.03
Nitrogen	.02	.02	.02	.03	.01	.09	.06
Potash	.80	.25	.38	.06	.12	.40	.20
Lime	.09	.03	.32	.11	.03	1.93	6.33
Magnesia	.09	.24	.36	.11	.04	.63	.62
Sulphur Trioxide	.06	.04	.05	.04	.03	.08	.07
Alumina, Oxide of Iron	.64	5.62	8.53	.64	.52	10.33	10.23
Soluble and Insoluble Silica	97.30	89.45	84.73	98.29	98.85	79.26	71.67
Loss on Ignition	.80	.82	3.03	.83	.36	5.32	5.94
Moisture	.34	1.95	1.32	.14	.08	3.36	5.48

TABLE 24—INTERPRETATION OF ANALYSIS, LAVACA CO.

	Lufkin Sandy loam	Lufkin Sand	Houston Black Clay
Phosphoric Acid	Low	Low	Low
Nitrogen	Low	Low	Fair
Potash	Good	Low	Fair
Lime	Low	Good	Moderate
Depth of Soil	8to20 ins.	36 ins.	8to20 ins.
Yield of cotton, bales	1-2to3-4	....	1-2to1
Yield of corn, bushels,	15to18	....	25to50
Local opinion,	Good	Poor	Rich

DISCUSSION OF RESULTS.

These soils are low in phosphoric acid and nitrogen, and low to good in potash. The samples were secured for experimental purposes, and no pot tests were made.

SOILS OF MONTGOMERY COUNTY.
(Willis Area.)

This area occupies 137,730 acres in Montgomery County, immediately around Willis, Texas. Five types of soil were distinguished, and we have two types described and analyzed in this bulletin.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Willis Area, Texas," by J. O. Martin. (Reprint—Field Operations of the Bureau of Soils, 1901.)

DESCRIPTION OF SOILS.

Norfolk Fine Sandy Loam, mapped as Willis Sand. The surface soil varies in depth from 10 to 18 inches and is a grayish yellow medium sand with a considerable amount of silt. The subsoil is a sticky yellow, red and gray mottled sand containing some iron. This is the most widely distributed and important soil in the tobacco section of Montgomery County. With the exception of the Norfolk sand, it is the best tobacco soil of the county. It grows a fine grade of filler leaf under proper methods of cultivation. Less than 10 per cent of this soil is cleared of forest, the major part being covered with pine and hardwood timber.

The natural growth on this soil consists of pine, sweet gum, and oak. There is also a fair covering of forest grasses which, with the undergrowth, furnishes good grazing for cattle.

With good methods of cultivation, Willis sand is a fairly productive soil; besides growing good filler tobacco, it is especially adapted to the growing of truck and small fruits.

Houston Black Clay, mapped as San Jacinto Clay. This soil is not fitted for the growth of cigar leaf tobacco, but is an important and fertile soil for other crops. The local name is "black land," due to the color.

The soil of the San Jacinto clay consists of 4 to 6 inches of drab to black clay, friable when dry and well cultivated, but waxy and sticky when wet, and if not constantly cultivated, it cakes into a very hard and compact mass, which cracks into irregular blocks on drying. The soil contains varying percentages of carbonate of lime. The subsoil consists of a drab to waxy clay, very stiff and tenacious and in some places 20 feet deep.

For general purposes this is one of the richest and best agricultural soils in this part of the State. Some of the prairie farms have been under cultivation for a quarter of a century without fertilizer and are still growing good crops of cotton and corn.

Corn and cotton are the chief crops grown on this soil, but with proper handling it will grow good crops of grass, especially Bermuda grass. Alfalfa also grows very well. The natural growth consists of various shrub and wild grasses.

DESCRIPTION OF SAMPLES.

No. 1584—Willis sand (1"-6"). Light colored virgin soil; produces three-fourths bale of cotton. Rolling; drainage good. Holds moisture well; runs together in wet seasons. Tobacco and truck grown; 4 feet to white clay subsoil. Willis, Texas.

No. 1585—Subsoil to 1584 (4"-12").

No. 1586—San Jacinto clay (1"-6"). One-fourth bale cotton Level; poor drainage; virgin soil; 3 miles west of Montgomery road, Willis, Texas. This soil has a sandy surface soil with a white yellow streaked subsoil.

No. 1587—San Jacinto clay, subsoil (6"-12"). Virgin soil, yellow streaked with white.

TABLE 25—PERCENTAGE COMPOSITION OF SOILS OF MONTGOMERY AND NACOGDOCHES CO'S.

	Willis Sand		San Jacinto Clay.		Norfolk Fine Sandy Loam	Probably Norfolk Fine Sandy Loam	Orangeburg Clay
	1584	1585	1586	1587	894	76	993
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface
Phosphoric Acid	.02	.01	.02	.02	.04	.01	.05
Nitrogen	.04	.02	.03	.04	.07	.05	.05
Potash	.14	.04	.10	.11	.11	.02	.22
Lime	.07	.13	.12	.23	.06	.06	.02
Magnesia	.02	.03	.09	.12	.04	.03	.....
Alumina and	.....	.....	.....	.....	.....	.....	4.40
Oxide of Iron	1.14	1.28	1.73	5.92	3.33	.44	.....
Soluble and Insoluble Silica	97.07	97.63	95.91	89.26	94.35	97.51	93.54
Loss on Ignition	1.53	.94	1.85	3.03	1.50	1.38	1.48
Moisture	.21	.16	.17	1.44	.27	.28	.45

TABLE 26—INTERPRETATION OF SOIL ANALYSES MONTGOMERY AND NACOGDOCHES COS.

	Willis Sand	San Jacinto Clay	Norfolk Fine Sandy Loam	Orangeburg Clay
Phosphoric Acid	Low	Low	Low	Low
Nitrogen	Low	Low	Fair	Low
Potash	Good	Low	Fair	Fair
Lime	Low	Low	Low	Low
Depth of soil	10-18"	4-6"	15-30"	5-9"
Yield of cotton, bale	....	....	....	1-3 to 1
Yield of corn, bu.	....	....	....	25-60

DISCUSSION OF RESULTS.

The soils are low in phosphoric acid and nitrogen and need these forms of plant food. They probably need organic matter also.

SOILS OF NACOGDOCHES COUNTY.

Nacogdoches Area.

This area covers about 100 square miles around Nacogdoches. Five types of soil are mapped, but only two are here discussed. The samples were collected by Mr. E. C. Carlyle, Assistant Chemist, in this laboratory.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Nacogdoches, Area, Texas," by W. Edward Hearn and James L. Burgess. (Advance sheets—Field Operations of the Bureau of Soils, 1903.)

DESCRIPTION OF SOILS.

Norfolk Fine Sandy Loam. This consists of a medium light gray or whitish sand from 15 to 30 inches deep, underlaid by a subsoil of yellow sandy clay, sometimes friable, but generally sticky. This subsoil holds water fairly well, and when wet acts like clay.

The greater part of this soil has excellent natural drainage, and its rolling character gives it a good surface drainage, while the loose character of the soil is such that the under-drainage is free and rapid and is so thorough that in many places the soil can be tilled immediately after a rain. Some areas are underlaid with green sand marl at a depth of 15 to 30 feet. At present the chief crops raised on this soil are cotton, corn, tomatoes, potatoes, and other vegetables. Cotton yields from one-third to two-thirds bale to the acre. Tomatoes net from $75 to $100 per acre in favorable seasons, while potatoes yield from 60 to 125 bushels per acre.

Only about 35 per cent is under cultivation, the rest being covered with pine, scrub oak, and other trees. The soil is comparatively warm and early and responds freely to fertilizers. The soil is too light for general farming, being especially adapted to truck, small fruits, and peaches.

Orangeburg Clay. This soil is usually known as "red land" and consists of a deep loamy soil 5 to 9 inches deep, the texture ranging from a heavy sandy loam to a clay loam. The subsoil consists of a stiff red clay containing a few iron concretions and fragments of limonite and green sand marl.

The surface characteristics of this soil vary considerably. The largest areas occupy high, evenly rolling land, while the smaller areas are more rolling. The principal crops are cotton, corn, and oats. Under the present cultural methods, one-half to one bale of cotton and from 25 to 60 bushels of corn are produced. With more careful cultivation these yields might be increased. The soil is inclined to be droughty. This soil is believed to be adapted to the raising of fine Cuban filler leaf tobacco.

DESCRIPTION OF SOILS.

No. 76—Probably Norfolk fine sandy loam. Light soil. Nacogdoches, Texas.

No. 894—Norfolk fine sandy loam (0-6"). Farm of J. M. Plupert, Nacogdoches, Texas.

No. 993—Orangeburg clay. Farm of J. T. Burgess, Nacogdoches, Texas.

TABLE 27—POT EXPERIMENTS, CAMERON, NACOGDOCHES AND CHEROKEE COS.

		Weight of Crop in Grams			
		KPN	KP	PN	KN
982	Cameron Co.—Cameron clay, subsoil.....	50.9	30.4	41.1	26.1
76	Nacogdoches Co.—Probably Norfolk fine sandy loam	9.2	.....	......	4.7
206	Cherokee Co.—Probably Norfolk fine sand—corn	4.9	......	.52	2.9

DISCUSSION OF RESULTS.

The analysis are given with those of Montgomery county. (See Table 25-26). The soils tested are low in phosphoric acid, low to fair in nitrogen, and fair in potash.

SOILS OF ROBERTSON COUNTY.

(Robertson Area.)

This area includes the whole of Robertson County, about 852 square miles. Twenty-eight types were mapped, and twelve are here discussed and analyses reported.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of Robertson County, Texas," by Hugh H. Bennett and Chas. F. Shaw. (Advance sheets—Field of Operation of the Bureau of Soils, 1903.)

DESCRIPTION OF SOILS.

Orangeburg Fine Sandy Loam. This is a well drained, upland soil, locally called "red land." The soil consists of 5 to 15 inches of dark gray, or reddish brown fine sandy loam varying in texture from light to heavy. Generally a small quantity of iron and sandstone gravel occurs in the upper portion of the soil, and some of the knolls are quite gravelly. The subsoil is a pale red to deep red sandy clay moderately friable in the upper portion and becoming stiffer and heavier with increasing depth. It contains iron oxide hardpans and concretions. It occurs in two nearly continuous belts crossing the country from northeast to southwest, roughly parallel. There are also a number of isolated knolls, ridges, and slopes, in the sandy region of the southern half of the county.

The soil has good surface and under-drainage, does not crust, and is not droughty. The timber growth is mainly post oak and hickory.

The Orangeburg fine sandy loam is the most productive of the upland soils. The heavy red phase, like that in the Little Flock and Henry Prairie neighborhoods, produces one-half bale of cotton and 25 to 40 bushels of corn per acre. Peaches, pears, plums, figs, blackberries, dewberries, and strawberries do well in this soil. From 100 to 150 bushels of Irish potatoes, over 100 bushels of tomatoes and fine crops of sweet potatoes and melons are made. This is the soil on which a fine quality of cigar tobacco has been grown in Eastern Texas. The soil is durable, and responds well to cultivation.

Orangeburg Fine Sand. This is a well drained upland soil. The surface soil is a dark gray to reddish brown fine sand increasing in redness with depth. It passes into a red sticky, sandy loam or sandy clay at 18 to 36 inches. Iron concretions and iron sandstone fragments are present, especially on knolls.

This type occurs generally as knolls or as narrow strips along the streams. Only a small percentage of this soil is under cultivation. General farm crops give only moderate yields. The soil is better suited to fruit and truck farming, but is inconveniently situated.

Norfolk Fine Sandy Loam. This soil consists of gray to dark gray loamy fine sand to a light fine sandy loam, underlaid at six inches by a light gray or pale yellow material of the same texture. The true subsoil is a bright yellow sandy clay at a depth of 14 to 22 inches.

This type generally occurs along slopes and stream courses and in depressions around the heads of streams. It maintains a favorable supply of moisture, so that crops rarely suffer from drought. Some of the depressed and flat areas could be improved by drainage ditches.

This soil is well suited to general farming, yielding 400 to 1200 pounds of seed cotton, 15 to 30 bushels of corn, and 200 to 500 gallons of syrup. Sugar cane contains more sugar than on the deep Norfolk fine sand. Much of this type would not be considered good fruit land, owing to its low position and lack of under-drainage. Irish potatoes, sweet potatoes, melons, peanuts, and cowpeas do well.

Norfolk Fine Sand. This consists of a gray to dark gray, loose, fine sand underlaid at 6 to 10 inches by a light gray to pale yellow, incoherent fine sand. A yellow (or sometimes red) fine sandy loam or clay is encountered at 3 to 20 feet. The soil of flat or nearly flat areas is sometimes compact and almost void of organic matter. Newly cleared land contains considerably more organic matter and has a darker color than that which has been under cultivation for a number of years.

The Norfolk fine sand occurs as the predominating type in a broad belt running from northeast to southwest, and included between the prairie belt and the mixed prairie and timber land region. The topography varies from gently undulating to rolling with gentle slopes, including many small flat areas.

The loose texture of the soil and subsoil permit excellent drainage by downward percolation, but a remarkably good supply of moisture is maintained. In a droughty season crops may be better than on heavier soils. This soil is commonly called a "cold natured deep sandy land," being the latest soil in the area. The natural vegetation consists largely of black jack, with a scattering growth of hickory and post oak, especially on the flat compact phase.

In the vicinity of Franklin the Norfolk fine sand is being used for peaches and truck. Away from the railroad it is largely used for cotton and corn. It is an excellent truck soil, yielding from 80 to 150 bushels or more of tomatoes. Good crops of watermelons and sweet potatoes are made. The type is well suited to figs, plums, Keiffer pears, peaches and small fruits. Good crops of sorghum and sugar cane are grown, particularly along the streams. The luxuriant growth of wild grapes indicates its adaptation to the grape. Peanuts and cowpeas do well. Corn and cotton make fair average yields. In favorable seasons the yield of cotton is as high as one-half bale to the acre. In dry years corn does better on this soil than on the heavier types. The silty compact phase is best for cotton and corn, and moderately open soil for truck and fruit, while the loose incoherent phase is a leachy, rather unproductive soil.

This soil is generally deficient in organic matter, and after a period of two to five years it begins to deteriorate in productiveness. In plowing, the pale yellow or light colored subsoil should not be turned up, for it seems to have an injurious effect on plants.

Wabash Clay. The Wabash clay is a dark drab to black stiff clay underlaid at a depth of 4 to 8 inches by an extremely stiff clay, nearly black or dark brown in color mottled with drab. The subsoil is sometimes exposed on the surface of the hummocks, and is then drab or dark gray in color. The soil becomes extremely sticky when wet.

The Wabash clay occurs largely in the bottoms of the Navasota

River and Steel Creek, and also of the Brazos to some extent. The surface is flat, or broken only by channels of tributaries and old stream beds of sloughs. The soil consists of fine dark colored material deposited by overflows, derived largely from the black lands along the upper Navasota and its tributaries.

With the exception of an occasional small glade or prairie, the entire Navasota and Steel Creek bottoms are heavily timbered with pin oak, post oak, elm, hackberry, and a scattering of holly and hickory.

On account of frequent overflows, none of the type is cultivated, except narrow strips along the outer edge and the areas in the Brazos bottom. The soil is very productive, sometimes producing as much as a bale of cotton and from 30 to 75 bushels of corn per acre.

Sanders Silt Loam. This is a dark gray or nearly black, heavy, compact silt loam, with an average depth of 12 inches, frequently mottled with drab or brown immediately beneath the surface. The subsoil is variable in color and texture, but is generally a dark gray or brown silt loam mottled with drab, passing into a brown fine sandy loam in the lower portions.

This is an alluvial soil and occupies bottom land along a number of creeks, the most extensive areas being along Walnut, Duck and Mineral creeks. The native timber comprises pin oak, ash, pecan, hackberry, elm, cottonwood and some scattering walnut, box elder, and holly.

The soil is subject to overflow, but otherwise is a good soil. It is the strongest corn soil in the area, producing from 45 to 75 bushels per acre without fertilizing. Cotton also does well. Johnson and Bermuda grasses yield three heavy cuttings per year of excellent hay. Heavy yields of syrup are obtained. The soil is remarkably strong and durable.

Sanders Loam. This soil is 12 to 24 inches deep and varies fron a dark gray to nearly black loam to a fine sandy loam. The subsoi varies from a dark brown loam to a silty fine sandy loam. In some places the texture changes in short distances from loamy fine sanc to a silt loam. In some cases sand has been washed upon the soil giving the soil the appearance of a deep dark gray fine sandy loam and often decreasing its value.

The Sanders loam is confined largely to the upper course of th large creeks, Walnut, Mineral, and Duck. It supports a growth of pi oak, pecan, post oak, ash, cottonwood, elm, and hackberry, with a occasional sprinkling of walnut. Although subject to overflow, the soi is very desirable. It produces 40 to 75 bushels of corn. Cotton an grass do well.

Lufkin Fine Sandy Loam. This consists of a dark gray compac fine sandy loam 8 to 15 inches deep. It frequently becomes light gra in color and quite silty immediately below the surface soil. The subsoi is a stiff, very plastic and dull yellow clay, sometimes mottled wit red, which generally becomes mottled yellow and gray as the dept increases. In the poorly drained places, the subsoil may be an extremel stiff clay, very dark or ashy gray in color. When moist, this clay wi run out from between the fingers like soap; when dry it cracks and shrinks somewhat like joint clay.

Occasionally a small amount of gravel or lime concretions is present throughout the subsoil. The line of separation between soil and subsoil is sharply defined. Owing to the sandy nature of the soil, cultivation is easy; the type is known locally as "hard post oak land."

This type occurs through the uplands on flat, or only slightly rolling areas. There are two large bodies, one lying between Campbell and Spring creeks in the southwestern part of the county, and the other contiguous to the Navasota bottom in the northwestern part of the county. Frequently small, well drained areas are found in depressions around the heads of "dugouts" and streams. In seasons of normal rainfall the drainage of the flat areas is generally good, in spite of the impervious character of the subsoil, but during wet seasons water sometimes stands in pools on the surface. There is a fairly well distributed system of natural drainage ways, streams, gullies, and "dugouts." Dugouts, once started, rapidly encroach on the nearly flat areas and several bodies of an acre or more have been rendered unfit for cultivation in this way. Some of the flat areas need ditches to carry off the surface water. In dry weather such moisture is lost by surface evaporation, and crops may suffer unless the soil is well cultivated. A large portion of this soil is forested with a rather sparse growth of heavy post oak and hickory, which is scattering in places, giving rise to the term "glady land." Only a small amount of this soil is cultivated.

In favorable seasons good yields of cotton and corn are secured with proper cultivation.

Some good peaches are seen on slight elevations having good natural drainage, but the flat stretches are not well suited to fruit. Sweet potatoes and ribbon cane do well, but Irish potatoes do not do well. Cowpeas and peanuts can be grown successfully in connection with hog raising.

Lufkin Clay. This occurs in small, flat, low lying areas near the heads of streams or "dugouts." As it has no timber growth, this land is locally called "glady or prairie land."

The surface soil is derived from the surrounding slopes, and is quite variable texture. The surface material may be a very fine sandy loam, a silt loam, or a silty clay, but it is always compact and black in color and only a few inches deep. The subsoil is a stiff black clay, very impervious, which sometimes becomes ashy gray mottled with red in the lower portions.

The general appearance of the type suggests an unproductive soil, and but little of it is under cultivation. Its structure is very unfavorable to drainage, and tillage. Some fair crops of cotton and corn, and good Johnson grass have been made on spots where the drainage has been improved by the intrusion of "dugouts."

Susquehanna Fine Sandy Loam. This consists of a light brown to dark brown fine sandy loam, averaging about 10 inches in depth. While generally the soil is uniform in depth, in places the soil changes suddenly within a foot or two from a few inches to two feet in depth.

The subsoil is a stiff plastic clay, either red in color or red mottled with drab or yellowish brown, the color generally changes in the lower portions to a mottled red or gray or yellow and drab. Frequently the subsoil at three feet or more contains more sand than the overlying material. The line of demarcation between the soil and subsoil is very distinct. Here and there lime concretions are seen in the yellow substratum exposed in "dugouts," and road cuts. The type is free from stones, but occasionally iron concretions and fragments of limestone are found scattered over the surface of small areas. The type embraces both timber and prairie land. The prairie land is darker in color and the subsoil more mottled.

The soil tends to assume a crusty and compact structure after rain, necessitating prompt cultivation to conserve moisture. A favorable tilth can be easily maintained by timely cultivation.

The Susquehanna fine sandy loam is the most extensive and important type in this county, including about 26 per cent of the total area. The topography varies from nearly flat along the railroad to the rolling land or gently sloping prairies in the northern port of the county.

The numerous dugouts and branches insure good surface drainage to a large part of the type; the prairies being particularly well drained. Owing to the tendency to assume a close, compact, structure, the soil is inclined to be droughty. Corn is apt to suffer from this cause in June or July.

The timber growth is mainly post oak, and generally the heavier the post oak growth, the better the soil. The black spots of the prairie originally supported a growth of mesquite.

The Susquehanna fine sandy loam is a productive soil and very desirable. Though adapted to a large number of crops, it is almost entirely devoted to corn and cotton. In average seasons and with fair cultivation, it yields one-third to one-half bale of cotton and with proper treatment a bale to the acre. Corn yields from 10 to 20 bushels ordinarily and 30 to 40 bushels in favorable seasons.

The best crops are made by breaking the land early to a depth of 8 to 10 inches, planting early, and giving frequent shallow cultivation. Fair yields of oats are made when sown in the fall on thoroughly prepared land. From 10 to 20 bushels of wheat have been produced, but none is grown at present.

The Susquehanna fine sandy loam does not seem so well suited to peaches as the character of the soil and topography would indicate. This may be attributed to the stiff plastic clay subsoil, which is unsuited to the peach tree anywhere. The trees frequently die when about five years old. Figs, plums, Keiffer pears, and berries do well. Irish potatoes are of good quality and make good yields where the land is manured and carefully handled. Generally the late summer and fall are too dry or the rainfall too irregularly distributed for good late crops. Sweet potatoes, beets, cabbage, onions, beans, sorghum, and peanuts do well.

This soil is considered fairly early. Cotton is planted a little later than in the Brazos bottom, but usually earlier than on the Norfolk fine sand. The soil is very durable, some of it having been under cultivation continuously for 30 or 40 years without fertilizers and with little attention to rotation and is still producing moderate crops. Most of the soil, however, has been badly run down.

Meadow Land. Meadow land comprises the bottom land having too little uniformity of texture to warrant recognition as a distinct type. It occurs largely in narrow strips along the smaller streams, and its texture is predominately sandy, but variable. A small area may include patches of silt loam, sandy loam and deep sand. Much of this soil is under cultivation and good yields of corn and cotton are made.

Miller Silt Loam. This is a light chocolate or reddish brown silt loam averaging about 18 inches in depth. Not infrequently it grades into a Miller fine sandy loam with such imperceptible changes that it is difficult to determine the exact boundaries between the two types. The surface soil grades into a slightly heavier subsoil of chocolate or reddish brown color.

The type occurs on an almost imperceptible ridge included between the belts of Miller clay following the Big and Little Brazos rivers. This ridge in the highest position is only about ten feet above the bank of the river. The surface is nearly flat or only slightly uneven and the drainage excellent. The Miller silt loam represents material brought down from the Panhandle region and deposited in time of overflow.

Pecan, elm, ash, and hackberry constitute the principal forest growth. Cockelburrs are very troublesome. Colorado grass grows luxuriantly but is easy to handle. Most of the soil is under cultivation.

The soil is inclined to run together when wet and harden with subsequent open weather, but it is easily put into excellent mellow tilth.

The Miller silt loam is especially adapted to cotton, the yield being from one-half to one bale per acre. Corn does fairly well, but the average yield is not as good, on account of drought, as the strength of the soil would indicate. The average is about 25 bushels, but as high as 70 bushels have been secured in favorable seasons. Owing to ease of cultivation and good average yields, the Miller silt loam is generally considered the most desirable of the Brazos bottom soils.

Miller Clay. The surface soil consists of a chocolate to chocolate red, heavy clay, 5 to 10 inches deep. When drying out the soil breaks into small aggregates that impart a very crumbly or gravel like structure, giving rise to the name of "buckshot land." The subsoil is a stiff cocholate red clay, frequently mottled with dark drab.

Notwithstanding the extreme stickiness of the soil when wet, it can be cultivated within a comparatively short time after rains. Owing to the tendency of the clods to crumble and disintegrate as they dry, a fairly good tilth can be maintained.

The highly clay content would make this an extremely intractable impervious soil were it not for the flocculation of the soil particles, due to the lime present. This renders the soil structure open and friable. This type is nearly perfect in this respect as any clay soil known.

The Miller clay is confined to the lower bottoms between the Big and Little Brazos rivers. It is an alluvial soil representing material brought down from the red lands of Northwest Texas. Most of the type is under cultivation and it is considered one of the best cotton soils of Texas; without interference from insect pests the yield ranges from one-half to one bale per acre, but during bad boll weevil years, many of the fields failed to produce enough to warrant picking.

Corn generally yields from 20 to 40 bushels, and as much as 75 bushels in good seasons. Some good crops of cabbage and late tomatoes of excellent quality have been produced. The soil is adapted to alfalfa and as much as six cuttings a year have been obtained. Good stands can be securea by keeping the seed bed well pulverized and keeping stock off for the first two years and in the spring, so as to enable the plants to regain the vitality lost during the cold weather.

The surface drainage would be improved by ditching and good results have been had by ditching both sides of the turning rows, throwing the dirt to the center.

DESCRIPTION OF SAMPLES.

No. 819—Norfolk fine sandy loam (0-22"). Situated on a gentle slope. Dark gray to yellowish light fine sandy loam, taken 1 1-2 mile north of courthouse, Franklin, Texas; three-eights mile from Wash Rilley's house.

No. 875—Subsoil to 819 (22"-36").

No. 165—Potato test soil, surface (0-15"); sandy soil from Calvert.

No. 166—Subsoil to 165 (15"-25"). Below is red clay.

No. 828—Norfolk fine sand considered good cotton land (0-6"); produced 300 pounds seed cotton in 1906 and was damaged by weevils. Occupies a rolling upland. It is a dark gray, loose incoherent fine sand almost totally free from organic matter, located 1 1-2 miles south of depot of Franklin on Henry Prairie road north of O. C. Crutchfield's house.

No. 874—Subsoil to 828.

No. 821—Orangeburg fine sand (0-28"), occupying a gentle slope. A dark gray loose fine sand becoming slightly loamy and reddish brown. Taken 150 yards south of county home and one mile west of courthouse, Franklin.

No. 885—Orangeburg fine sand subsoil 28 to 36 inches, taken one mile west of courthouse.

No. 832—Orangeburg clay. This is a good soil, but requires cultivation under limited condition of moisture; taken (0-4") 1 1-2 miles east of Henry Prairie church at J. J. Sandifer's residence.

No. 873—Subsoil to 832, 36", 1 1-2 miles east of Henry Prairie church.

No. 834—Orangeburg fine sandy loam. One of the best general farming fields in the county (0-21") and raised three-fourths bale of cotton in 1906. Reddish brown fine sandy loam and holds moisture well. Taken 1 1-2 miles east of Henry Prairie church, 100 yards southwest of J. J. Sandifer's residence on west side of Franklin-Wheelock road.

No. 823—Orangeburg fine sandy loam; subsoil to 834: 12 to 36 inches. Red sandy clay with a yellow iron oxide hardpan at 25 inches.

No. 822—Lufkin fine sandy loam, a good soil but little of it under cultivation (0-15"). Produced good peaches in 1906 and occupies a nearly flat situation. Local name is "hard post oak land." Taken 2 1-2 miles southeast of Franklin, just in front of S. R. McWomack's residence.

No. 853—Lufkin fine sandy loam. Subsoil to 822 taken 15 to 36 inches.

No. 978—Lufkin clay (0-12").

No. 854—Lufkin clay, subsoil of 978 (12"-36"). A dark brown stiff plastic clay mottled with yellow below 30 inches.

No. 935—Lufkin clay (0-8").

No. 932—Miller silt loam (0-18"); from Hearne, Texas.

No. 960—Miller silt loam, subsoil to 932.

No. 979—Miller clay (0-9").

No. 818—Sanders loam, Mineral Creek bottom land (0-20"). Produces three cuttings Bermuda grass per year. A dark brown fine sandy loam; an alluvial soil and overflows occur annually. Located on Easterly-Hays road on R. W. Cole's farm.

No. 826—Sanders loam, subsoil to 979. Taken 20 to 30 inches. A brown silt loam but at 30 to 36 inches a black fine sandy loam is mixed.

No. 845—Sanders silt loam 0-12 inches. An alluvial soil subject to overflow; little under cultivation but very productive and occupies a flat position. A black heavy silt loam. Located in bottoms of Duck Creek on C. A. Cares farm on Marquez road.

No. 881—Subsoil to 845.

No. 843—Wabash clay, 0 to 8 inches. An alluvial soil subject to frequent overflow, practically none cultivated. A black stiff clay, very sticky when wet. Taken three-fourths mile west of Navasota River on Marquez road.

No. 884—Wabash clay, subsoil 8 to 36 inches, from Masata, Texas.

No. 820—Susquehanna fine sandy loam. A good cotton and corn soil. Brown fine sandy loam. Taken one-fourth mile west of Easterly on north side of Franklin road. C. J. Easterly's farm.

No. 855—Subsoil to 820; 12 to 36 inches. Red mottled with gray plastic clay.

No. 3004—Sanders loam, alluvial soil, overflows annually, 0" to 20". Very productive. Dark brown fine sandy loam. Located in Mineral Creek bottom on Easterly-Hays road. Collected by H. H. Bennet. Robertson County.

No. 3005—Sanders loam, mixed subsoil of 3004, 20" to 36". Black fine sandy loam; located in Mineral Creek bottom. 20"-30" brown silt loam, 30"-36" black.

No. 3006—Sanders loam, flat alluvial land subject to overflow, 0-12", very productive, 40 bushels corn 1906; little cultivated. Black, heavy silt loam. Located in bottom of Duck Creek on Marquez road, Robertson County.

No. 3007—Sanders silt loam, subsoil to 3006, 12"-36", dark brown silt loam.

No. 3008—Wabash clay, subject to frequent overflow, alluvial soil, 0-8", practically none cultivated. Black stiff clay, very sticky when wet, three-fourths mile west of Navasota River on Marquez road, Robertson County.

No. 3009—Wabash clay, subsoil to 3008, 8"-36"; slightly mottled with drab; black, extremely stiff and tenacious, heavy clay.

TABLE 28—PERCENTAGE COMPOSITION OF SOILS OF ROBERTSON COUNTY.

	Orangeburg Fine Sandy Loam		Orangeburg Fine Sandy Loam		Wabash Clay		Sanders Silt Loam		Lufkin Fine Sandy Loam		Lufkin Clay		Lufkin Clay	Susquehana Fine Sandy Loam		Norfolk Fine Sand	
	832	893	834	823	843	884	845	881	822	853	978	854	935	820	855	828	874
	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soil	Surface	Sub soi	Surface	Surface	Sub soil	Surface	Sub soil
Phosphoric Acid ...	.07	.09	.09	.09	.06	.04	.14	.09	.02	.03	.12	.01	.11	.02	.02	.05	.01
Nitrogen	.08	.10	.09	.08	.17	.06	.19	.08	.04	.07	.07	.03	.11	.04	.05	.02	.02
Potash	.27	.29	.38	.80	.36	.42	.40	.29	.10	.54	1.05	.24	1.10	.11	.24	.09	.10
Lime	.16	.45	.27	.45	.49	.67	.51	.14	.10	.31	1.47	.33	.37	.16	.42	.08	.01
Magnesia	.31	.....	.12	.80	.38	.65	.50	.38	.06	.56	1.54	.33	.26	.11	.20	.08	.14
Sulphur Trioxide...	.....	.....	.....	Tr.	.....	.....	.....	.15	.....	.....	.....	.....	.....	.....	Tr.	.....	.....
Alumina and Oxide of Iron	12.81	30.10	9.40	29.60	11.11	13.83	11.07	9.38	1.74	17.28	13.95	8.29	5.49	2.96	14.75	1.03	1.11
Soluble and Insoluble Silica.......	78.77	49.73	84.25	49.43	73.93	72.64	72.35	81.86	96.43	66.51	53.30	82.02	87.11	93.97	71.04	98.02	98.36
Loss on Ignition ...	4.21	8.89	3.41	7.85	8.05	7.42	8.27	5.20	1.08	6.52	4.11	3.90	5.23	1.85	8.76	.74	.48
Moisture	3.03	9.10	1.15	9.80	4.29	5.68	5.00	2.49	.44	6.95	4.27	4.15	1.76	.80	5.40	.12	.02

TABLE 28—CONTINUED, PERCENTAGE COMPOSITION OF SOILS, OF ROBERTSON COUNTY

	Sanders Loam		Norfolk Fine Sandy Loam		Orangeburg Fine Sand		Miller Silt Loam		Miller Clay		Probably Norfolk fine Sand	
	818	826	819	875	821	885	932	960	979	3003	165	166
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid	.07	.04	.01	.02	.02	.03	.07	.02	.14	.06	.01	.11
Nitrogen	.07	.06	.02	.03	.02	.11	.08	.05	.11	.08	.04	.03
Potash	.15	.20	.10	.25	.17	.15	.53	.65	1.29	.12	.11	.13
Lime	.26	.26	.07	.05	.17	.13	2.08	6.85	7.88	9.33	.07	.06
Magnesia	.26	.24	.03	.24	.10	.19	3.50	1.27	2.03	1.95	.03	.04
Sulphur Trioxide	......	......	......	......	......	......	......	.13	......	.10	......	......
Alumina and	4.31	5.58	1.29	6.76	3.08	5.99	8.71	7.83	15.69	15.32	.63	1.10
Oxide of Iron	......	......	......	......	......	......	......	......	......	......	.63	.79
Soluble and Insoluble Silica	90.70	88.46	97.34	88.57	94.86	91.00	73.17	69.73	54.17	55.53	97.41	96.45
Loss on Ignition	2.54	2.73	.73	2.43	.81	2.08	5.94	10.41	12.72	10.41	1.12	1.09
Moisture	1.55	2.40	.29	1.26	1.10	.53	1.74	2.75	5.02	3.93	.20	.24

TABLE 28—CONTINUED, COMPOSITION OF SOILS, OF ROBERTSON COUNTY

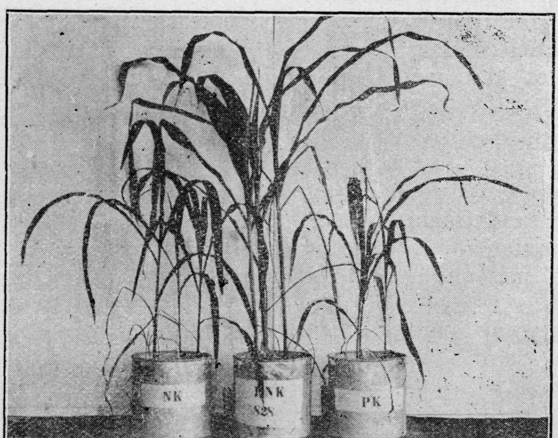
	Sanders Loam	20''-36''	Sanders Loam 0''-12''	12''-36''	Wabash Clay 0''-8''	8''-36''
	3004	3005	3006	3007	3008	3009
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid	.02	.02	.12	.07	.06	.03
Nitrogen	.07	.07	.23	.21	.13	.10
Potash	.29	.25	.53	.30	.47	.39
Lime	.10	.49	.63	.20	.54	.59
Magnesia	.25	.24	.48	.39	.62	.64
Sulphur Trioxide	.07	.07	.11	.09	.01	.14
Alumina and Oxide of Iron	4.83	4.84	12.73	8.87	10.96	14.05
Soluble and Insoluble Silica	91.13	90.28	73.87	84.20	68.57	74.58
Loss on Ignition	2.44	2.58	9.48	4.81	7.32	5.64
Moisture	.78	.81	2.49	1.23	2.87	4.12

TABLE 29—INTERPRETATION OF ANALYSES, ROBERTSON COUNTY

	Orangeburg Fine Sandy Loam	Wabash Clay	Sanders Silt Loam	Lufkin Fine Sandy Loam	Lufkin Clay	Susquehanna Fine Sandy Loam	Norfolk Fine Sand	Norfolk Fine Sandy Loam	Sanders Loam	Orangeburg Fine Sand	Miller Silt Loam	Miller Clay
Phosphoric Acid..	Fair	Low	Good	Low	Good	Low	Fair	Low	Fair	Low	Low	High
Nitrogen	Fair	Good	Good	Low	Fair	Low	Low	Low	Fair	Low	....	Good
Potash	Good	Good	Good	Fair	High	Fair	Fair	Fair	Good	Good	Good	High
Lime	Fair	Fair	Good	Fair	High	Fair	Low	Low	Fair	Good	High	High
Depth of soil	5-15"	4-8"	12"	8-15"	....	10"	6-10"	6"	12-24"	18-36"	18"	5-10"
Yield of cotton bale	1-2to1	1?	....	1-2?	....	1-3to1-2	1-4to1-2	1-4to2-3	....	....	1-2to1	1-2to1
Yield of corn, bu..	20-40	30-75	45-75			10-20	....	15-30	40-75	....	25	20-40

TABLE 30—POT EXPERIMENTS, ROBERTSON AREA

Laboratory Number		Crops and Year	Application to Soil			
			KN	PNK	PN	PK
			Grams Crop Per Pot			
818	Sanders loam (10)...........	Corn '08	34.2	43.9	43.3	39.2
		Corn '08	......	6.6	4.1	2.7
819	Norfolk fine sandy loam (2).	Corn spring '07	1.7	18.2	3.0	4.8
		Corn '08	6.6	21.1	......	2.7
820	Susquehanna fine sandy loam (11)	Corn '07	1.0	12.5	6.8	3.7
821	Orangeburg fine sand (3)....	Corn '07	2.3	10.8	18.2	2.5
		Corn, fall'7	.4	5.0	1.4	.3
		Corn '08	3.9	7.2	2.9	2.9
822	Lufkin fine sandy loam (6)..	Corn '07	2.5	20.6	21.2	21.0
828	Norfolk fine sand (1)........	Corn '07	4.5	19.2	17.5	3.3
832	Orangeburg clay (5)........	Corn '07	1.8	26.2	16.8	20.2
		Corn '08	......	1.4	2.1	.7
834	Orangeburg fine sandy loam (4)	Corn '08	3.2	24.6	27.7	4.1
843	Wabash heavy clay..........	Corn '07	5.6	16.1	......	16.3
		Wheat '08	1.4	3.7	......	3.1
		Corn '08	31.4	4.61	......	19.5
935	Lufkin clay (7).............	Grass '08	.3	2.9	......	4.9
845	Wabash silt loam (8).......	Corn '08	29.2	29.2	27.2	30.0
		Corn '08	11.5	8.0	......	8.2
		Grass '08	7.5	9.9	......	4.6
932	Miller silt loam ((9)........	Corn '07	5.4	6.2	2.1	4.0
		Grass '08	2.3	6.7	3.6	3.8



Pot Experiment—No. 828, Norfolk Fine Sand.

Pot Experiments—No. 834, Orangeburg Fine Sandy Loam; No. 821, Norfolk Fine Sand.

DISCUSSION OF RESULTS.

A large number of analyses were made of soils of this area, and the interpretation of the analyses is given in the table, and requires little comment.

A number of pot experiments were also made, and the results are presented in the table. In order to make this matter clear, we give below the deficiencies as shown by the pot experiments. In the table, DD means very deficient, D, deficient, and S, not deficient.

Table 31.—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Sanders loam	D	D	S
Norfolk fine sandy loam	DD	D	D
Susquehanna fine sandy loam	DD	D	DD
Orangeburg fine sand	DD	DD	S (Later D)
Lufkin fine sandy loam	DD	S	S
Norfolk fine sand	DD	DD	S
Orangeburg clay	DD	D	D
Orangeburg fine sandy loam	DD	DD	S
Wabash heavy clay	DD	DD	..
Lufkin clay	DD	S	..
Wabash silt loam	S	S	S
Miller silt loam	D	D	D

SOILS OF HENDERSON AREA.

(Rusk County.)

This area includes the northern part of Rusk County, covering about 580 square miles. Nine types of soil are mapped. Five are here described, and analyses made.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Henderson Area, Texas," by Charles W. Ely and A. E. Kocher. (Advance sheets—Field Operations of the Bureau of Soils, 1906.)

DESCRIPTION OF SOILS.

Norfolk Fine Sandy Loam. This is a fine sand or fine sandy loam, 14 to 30 inches deep. The soil to a depth of 4 to 6 inches is gray, below which to 14 or 30 inches, it is yellow. Subsoil is a lemon yellow sandy clay. In places the soil contains 5 to 10 per cent iron concretions. The soil is easily cultivated and holds moisture and fertilizers well. It can be kept in good condition without difficulty. The sandy clay subsoil provides fair under-drainage, except where the soil is very low and flat. It is adapted to a wide range of crops and is the best Bermuda grass land in the area. Cotton and corn are chief crops.

Norfolk Fine Sand. This is the most sandy soil in the area. It consists of a fine gray sand 4 to 6 inches deep, underlaid by a yellow sand of the same texture from 3 to 30 feet deep. The only difference between the soil and subsoil is the greater organic matter content of the soil. The texture is so loose that the soil is blown by the wind.

Fair crops are grown the first year or two after the land is cleared, but the productiveness rapidly decreases. This soil is leachy and will not hold fertilizers well. Cotton and corn are the chief crops.

Susquehanna Fine Sandy Loam. This is a gray or slightly reddish fine sandy or sand loam, containing a few iron concretions, 6 to 12 inches deep, with an average depth of about 9 inches. The subsoil is a heavy plastic red or mottled red gray clay sometimes containing sand. It is generally red at a slight depth, becomes mottled at 30 inches and is a gray clay at 3 feet. This is considered an easy soil to cultivate, but it is not very productive and will not stand exhaustive cropping without manures. The surface drainage is good but underground drainage very poor. The better drained, higher areas will grow fair peaches and small fruits. Cotton and corn are the chief crops.

Orangeburg Fine Sand. This is a gray or reddish gray fine sand from 15 to 30 inches deep with an average depth of about 2 feet The subsoil is a brownish red sandy clay of moderately open structure, resting on a compact clay of the same color and having a thickness of 3 to 4 feet. The soil is loose and porous, having excellent drainage and is easily cultivated at all times, but the clay subsoil is very retentive of moisture. Irish potatoes, peaches, strawberries, and truck crops do well. Cotton and corn are chief crops. For general farming the Orangeburg fine sand is the best type in this area.

DESCRIPTION OF SAMPLES.

No. 340—Susquehanna fine sandy loam, 14 miles north of Henderson, Texas. An old field plowed up 4 or 5 years ago.

No. 341—Susquehanna fine sandy loam, subsoil of 340.

No. 342—Orangeburg fine sand, 2 miles southwest of Motley, Texas; farm of Dr. A. E. Smith, cultivated 40 years.

No. 343—Orangeburg fine sand, subsoil of 342.

No. 344—Orangeburg fine sandy loam; one-half mile south of Motley; farm of S. Williams, cultivated 40 years.

No. 345—Orangeburg fine sandy loam, subsoil of 344.

No. 346—Norfolk fine sandy loam; 4 miles south of Craig, Texas.

No. 347—Norfolk fine sandy loam, subsoil of 346.

No. 348—Norfolk fine sand; 2 1-2 miles north of Henderson; farm of W. E. McCorkle.

No. 349—Norfolk fine sand, subsoil of 348.

TABLE 32—PERCENTAGE COMPOSITION OF SOILS OF RUSK CO.

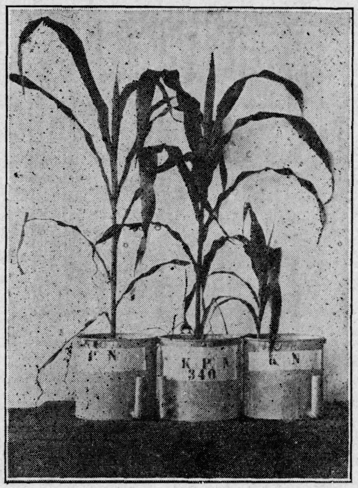
	Susquehanna Fine Sandy Loam		Orangeburg Fine Sand		Orangeburg Fine Sandy Loam		Norfolk Fine Sandy Loam		Norfolk Fine Sand
	340	341	342	343	344	345	346	347	348
	Surface	Sub-soil	Su face	Sub-soil	Surface	Sub-soil	Surface		Surface
Phosphoric Acid ...	.03	.10	.01	.02	.10	.05	.02	.02	.02
Nitrogen	.05	.04	.06	.06	.05	.03	.04	.04	.02
Potash	.12	.15	.10	.09	.54	.14	.11	.09	.03
Lime	.06	.07	.12	.07	.03	.01	.11	......	.09
Magnesia	.11	.18	.05	.15	.06	.08	.06	......	.14
Carbon Dioxide ...	.04	5.37	.06	.34	.56	.51	.16	.....	.08
Sulphur Trioxide ..	Tr.	Tr.	......	......	Tr.	Tr.	......	......	Tr.
Alumina and Oxide of Iron	2.08	16.56	1.95	2.34	13.74	13.14	1.37	......	1.13
Soluble and Insoluble Silica	95.24	71.47	96.05	95.28	82.55	83.58	96.36	......	97.88
Loss on Ignition	1.47	5.55	1.43	1.05	2.19	2.36	1.38	......	.76
Moisture	.38	5.37	.06	.34	.56	.51	.16	......	.08

TABLE 33—INTERPRETATION OF SOIL ANALYSES, HENDERSON COUNTY.

	Susquehanna Fine Sandy Loam	Orangeburg Fine Sand	Norfolk Fine Sandy Loam	Norfolk Fine Sand
Phosphoric Acid	Low	Low	Low	Low
Nitrogen	Low	Low	Low	Low
Potash	Fair	Fair	Fair	Low
Lime	Low	Fair	Fair	Fair
Depth of soil	6-12"	15-30"	14-30"	4-6"
Yield of cotton, bales	1-4to1-2	1-4to3-4	1-4to3-4	1-8to1-2
Yield of corn, bu.	15-20	15-30	15-20	8-14
Local opinion	Poor	Good	Low	Low

TABLE 34—POT EXPERIMENT, RUSK COUNTY SOIL

Laboratory Nnmber			Application NK	PNK	PN	PK
			Grams of Crop			
340	Susquehanna fine sanay loam —Henderson Co.	Oats, 1906	3.0	12.0	7.1	7.0
		Grass, 1908	2.0	4.0	6.0	3 0
342	Orangeburg fine sand	Oats, 1907	6.5	10.5	12.0	12.0
344	Orangeburg fine sandy loam —Rusk Co.	Oats, 1906	1.0	4.0	5.5	3.0
346	Norfolk fine sandy loam	Corn, 1906	2.2	2.8	2.0	......
		Oats, 1907	2.0	6.0	5.0	......
348	Norfolk fine sand	Corn, 1906	11.9	12.5	10.1	......



Pot Experiment—No. 340, Susquehanna Fine Sandy Loam.

DISCUSSION OF RESULTS.

These soils appear to be generally deficient in phosphoric acid and nitrogen.

The interpretation of the pot experiments is as follows: DD, is very deficient; D, deficient; S, sufficient.

Table 35.—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Susquehanna fine sandy loam	DD	D	D
Orangeburg fine sand	D	S	S
Orangeburg fine sandy loam	DD	S	S
Norfolk fine sandy loam	D	..	S
Norfolk fine sand	S	..	D

SOILS OF WEBB COUNTY.
(Laredo Area.)

This area embraces about 156 square miles in the southwestern portion of Webb County. Seven types of soil are mapped, and five of these are here described and analyzed.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of the Laredo Area, Texas," by A. W. Mangum and Ora Lee. (Advance sheets—Field Operations of the Bureau of Soils, 1906.)

Webb Fine Sand. To a depth of 12 inches this consists of a fine loamy sand of red to reddish brown color. The upper inch or two is usually a loose incoherent fine sand, but the structure of the soil as a whole is very compact. The surface soil grades into the subsoil, which is similar in color and texture but becomes more loamy in the lower part of the profile and at a depth of 20 to 36 inches is a very light sandy loam of red or reddish brown color.

The Webb fine sand is derived mainly from the weathering of the underlying fine grained sandstone, and its red color is due to the iron contained in this formation. The native vegetation consists mainly of cactus and mesquite, and the growth is heavier than is found on the gravelly hills and ridges. The soil also supports a heavy growth of native grass and is among the best pasture lands of the area. At present none of the type of soil is under cultivation, being used exclusively for grazing.

Laredo Silt Loam. This consists of a gray to a very light brown silt loam, which usually contain a considerable amount of fine and very fine sand in the upper 6 to 10 inches. The subsoil from 12 to 36 inches is composed of the same material as the soil, but contains less fine sand and is lighter in color. The soil is easy to cultivate and the areas used for agricultural purposes are friable and loamy, but the unimproved areas are dry and compact and have the appearance of a soil of heavier texture.

The topography is almost level, and as the soil occupies a strip along the Rio Grande, it may be easily irrigated. It is one of the most valuable soils of the area. Small amounts of alkali are sometimes encountered on the surface of this soil, but do not occur in sufficient amounts to be harmful to the crop.

A large percentage of this type is under cultivation. A great portion of the cultivated area is under irrigation, and where irrigated it produces profitable yields of all the crops grown; but on the unirrigated areas the yields are light, and the crops are often a total failure. This type is well adapted to the production of onions and a large part of the cultivated land is used for this crop. It produces 18,000 to 20,000 pounds per acre and during favorable seasons, 25,000 pounds per acre. Sweet potatoes yield from 150 to 200 bushels per acre; corn yields about 40 bushels to the acre on irrigated land. Cabbage yields about 13,000 pounds per acre. Alfalfa has been grown but does not do well for more than one season. Cowpeas do well both on irrigated and non-irrigated land.

Webb Gravelly Sandy Loam. This soil consists of a light brown to reddish brown fine sandy loam, carrying a large amount of waterworn gravel. It supports a heavy growth of mesquite and cactus and a fair growth of native grasses.

It is not adapted to agricultural purposes because irrigation is not practicable. None of the soil is under cultivation, but is used as pasture.

Laredo Clay Loam. The surface soil of this type to the average depth of 10 to 12 inches consists of a heavy light brown silty loam, which contains enough clay to make it sticky and tenacious when wet and cause it to bake and sun-crack on drying. The subsoil is a stiff, compact, silty clay. It occupies strips in the Rio Grande valley.

This soil is of limited extent, but is considered one of the best soils in the area surveyed. The surface soil when properly cultivated assumes a loamy friable condition, the heavy subsoil is retentive of moisture and the effects of fertilizers are lasting. A small amount of alkali is found, but does not occur in amounts sufficient to injure the crop grown.

The soil is well adapted to the cultivation of onions, the average yield being 20,000 pounds per acre, but if heavy rains occur about harvest time, the crop is likely to be damaged by the water collecting in shallow depressions. Alfalfa has been grown, but does not do well after the first year. Cabbage and beets have been grown. Irish potatoes do not do well. Sweet potatoes yield about 150 bushels per acre.

Webb Fine Sandy Loam. This is a light brown to reddish brown fine sandy loam with an average depth of 10 to 12 inches. The subsoil consists of a sandy clay, the upper part of which has the characteristics of a very heavy, sticky, sandy loam, but at 18 to 30 inches it is a compact sandy clay.

This soil supports a very heavy growth of cactus and mesquite. When cleared the soil is easy to cultivate, and the heavier subsoil enables it to conserve more moisture than the light silty soils along the river.

The irrigated land is used mainly for onions and seems to be well adapted to this crop, the yield being about 20,000 pounds per acre. Cabbage, beets, and turnips have been grown to a limited extent. Cowpeas do well on irrigated and non-irrigated lands. Some tobacco has been successfully grown, a good quality of leaf being produced; the soil seems well adapted to this crop. A very large percentage of this type is still undeveloped agriculturally and is used as pasture land for cattle and goats.

DESCRIPTION OF SAMPLES.

No. 816—Webb fine sand (0"-12"). Red fine sand or sandy loam; 8 miles north of Laredo, Texas.

No. 827—Laredo silt loam (0-12"). A gray, light silty loam, nearly compact when dry, more mellow while wet.

No. 830—Webb gravelly loam (0"-10"). Compact sandy loam with much coarse gravel on surface; 5 miles north of Laredo, Texas.

No. 831—Laredo clay loam (0-12"). Black, heavy silty clay, irrigated and cultivated in onions; 3 miles north Laredo, Texas.

No. 833—Webb fine sandy loam (0-9"). Yellow compact, fine sandy loam; 3 1-2 miles north Laredo, Texas.

No. 869—Laredo clay loam 12"-36"). Subsoil of 831.

No. 870—Webb fine sandy loam (19"-36"). Subsoil of 833.

No. 871—Webb gravelly, sandy loam, subsoil of 830.

No. 872—Laredo fine sand, subsoil of 816 (12"-36").

No. 877—Laredo silt loam, subsoil of 827 (12"-26").

No. 7099—Webb fine sandy loam, subsoil (9"-36").

No. 1100—Webb fine sandy loam, subsoil (9"-36").

No. 1101—Webb fine sand (0"-12"); 8 1-2 miles north Laredo, Texas.

No. 1102—Webb fine sand, subsoil of 1101 (12"-36").

No. 1103—Laredo gravelly sandy loam (0"-12"); 5 1-2 miles northeast Laredo, Texas.

No. 1104—Laredo gravelly sandy loam (0-10"); 5 miles north Laredo, Texas.

No. 1105—Laredo clay loam (0-12"); 4 miles north Laredo, Tex.

No. 1106—Laredo clay loam, subsoil of 1105 (12"-36").

No. 1107—Webb fine sand (0-12"); 9 miles north Laredo, Texas.

No. 1108—Webb fine sand, subsoil of 1107 (12"-36").

No. 1109—Laredo clay loam (0-12"); 2 miles north of Laredo, Texas.

No. 1110—Laredo clay loam, subsoil of 1109 (12"-36").

No. 1111—Laredo silt loam (0-12"); 2 miles north of Laredo, Texas.

No. 1112—Laredo silt loam (0-12"); one mile north of Laredo, Texas.

TABLE 36—PERCENTAGE COMPOSITION OF SOILS, OF WEBB COUNTY

	Webb Fine Sand						Laredo Silt Loam				Webb Gravelly Sandy Loam				Laredo Clay Loam			
	861	872	1101	1102	1107	1108	827	877	1111	1112	830	871	1103	1104	831	869	1105	1106
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-Soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid.....	.03	.07	.04	.04	.05	.05	.07	.06	.07	.18	.04	.06	.05	.06	.11	.10	.11	.10
Nitrogen	.05	.07	.06	.08	.06	.05	.05	.04	.07	.12	.14	.07	.12	.16	.09	.08	.10	.06
Potash	.57		.46	.57	.60	.55	.07	.38	.51	.41	.59	.71	.69	.43	.95	.43	.95	.97
Lime	.43	1.15	.39	1.32	.46	1.92	4.98	4.96	6.49	4.39	.46	.50	.31	.36	3.13	5.96	3.11	6.18
Magnesia	.23	.79	.25	.48	.48	.43	.61	.60	.64	.99	.55		.45	.42	1.06		1.17	1.11
Alumina and Oxide of Iron........	7.23	8.64	6.30	8.85	6.91	8.41	5.57	5.49	6.69	5.51	7.70	9.43	8.10	6.93	10.18	10.66	10.59	10.43
Soluble and Insoluble Silica	86.91	81.43	87.76	82.41	87.40	82.01	81.46	81.28	77.21	82.76	81.66	80.22	84.98	85.23	74.18	66.87	74.16	68.96
Loss on Ignition.....	2.47	4.32	2.67	4.05	2.09	3.19	3.33	5.04	4.73	4.26	5.90	4.27	4.13	5.20	6.26	5.89	5.44	6.36
Moisture	1.88	2.30	1.53	2.56	1.34	1.85	1.10	1.11	.61	.57	3.73	3.92	1.34	1.00	2.72	5.16	3.65	3.81

TABLE 36—(Continued) PERCENTAGE COMPOSITION OF SOILS OF WEBB COUNTY.

	Laredo Clay Loam		Webb Fine Sandy Loam		Webb Fine Sandy Loam	
	1109	1110	833	870	1099	1100
	Surface	Sub-soil	Surface	Sub-soil	Sub-soil	Sub-soil
Phosphoric Acid	.10	.08	.05	.03	.04	.05
Nitrogen	.10	.08	.09	.05	.05	.06
Potash	.95	.96	.44	.57	.54	.52
Lime	3.00	5.60	.32	.54	.87	.57
Magnesia	.96	1.13	.49	.63	.63	.31
Alumina and Oxide of Iron	10.48	10.74	7.02	8.69	8.57	8.57
Insoluble and Soluble Silica	75.10	64.44	85.25	83.39	83.92	84.86
Loss on Ignition	6.14	3.37	3.20	3.35	3.71	3.51
Moisture	2.42	2.74	1.54	2.44	1.55	1.44

TABLE 37—INTERPRETATION OF ANALYSES, LAREDO AREA.

	Webb Fine Sand	Laredo Silt Loam	Webb Gravelly Sandy Loam	Laredo Clay Loam	Webb Fine Sandy Loam
Phosphoric Acid	Low	Low	Low	Fair	Low
Nitrogen	Low	Low	Good	Fair	Fair
Potash	High	Fair	High	High	Good
Lime	Good	High	Good	High	Good
Depth of soil	12"	12"	10"	10"-12"	10"-12"
Local opinion	....	Fair	....	Rich	Good
Extent cultivated	None	Nearly All	....	Much	Some

TABLE 38—POT EXPERIMENTS, WEBB COUNTY.

Laboratory Number		Crop and Year	Addition: NK	PNK	PN	PK
			Weight of Crops in Grams			
816	Webb fine sand	Corn, 1907	3.9	16.2	22.2	12.5
		Corn, 1907	3.2	3.4	6.4	4.0
		Grass, 1908	2.8	6.2	5.9	3.0
827	Laredo silt loam	Corn, 1907	4.3	15.5	20.5	9.8
		Grass, 1908	2.1	3.5	4.5	2.9
830	Webb gravelly sandy loam	Corn, 1908	4.5	......	17.5	17.2
831	Laredo clay loam	Corn, 1907	53.3	60.0	......	26.3
		Wheat, '08	1.1	1.9	......	1.8
		Corn, 1908	48.9	46.9	......	1.4
833	Webb fine sandy loam	Corn, 1907	13.0	2.90	24.8	22.5
		Grass, 1908	5.7	5.9	5.7	2.8

Pot Experiment—No. 831, Laredo Silly Clay.

DISCUSSION OF RESULTS.

The interpretation of the analyses is presented in Table 37. The interpretation of the pot experiments follows:

Table 39.—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Webb fine sand	DD	D	S
Laredo silt loam	DD	D	S
Webb gravelly loam	DD	..	..
Laredo clay loam	D	DD	..
Webb fine sandy loam	DD	D	D

SOILS OF WILSON COUNTY.
(Wilson Area.)

This area includes all of Wilson County, an area of about 783 square miles. Twelve types of soil were mapped, and eight of them are described in this bulletin.

A full description and a map of this area is published by the Bureau of Soils of the U. S. Department of Agriculture as "Soil Survey of Wilson County, Texas," by W. S. Lyman and Frank C. Schraeder. (Advance sheets—Field Operations of the Bureau of Soils, 1907.)

DESCRIPTION OF SOILS.

Orangeburg fine sandy loam. This soil is locally known as post oak land. It is a fine sandy loam, reddish brown to gray in color and from 6 to 15 inches deep. Iron concretions are found in both soil and subsoil.

The greater part is found in central and northeastern part of the county. The surface is for the most part rolling and with the exception of a few small stony areas on crests of hills and erosions along streams, it is all arable land. This soil has good surface drainage. The underdrainage, however, is not as good as the surface drainage, and during a very wet year there is a tendency for the soil to run together, a condition caused by the close impervious subsoil, which does not take up water readily but retains it in the fine sandy surface soil. This keeps the soil in a wet soggy condition, which is unfavorable to the healthy growth of crops.

The Orangeburg fine sandy loam is one of the most extensively cultivated soils in the county. The early settlers preferred this soil, because it was thought to be more resistant to drought and to produce larger average yields. The general opinion has changed and the heavier soils are preferred, but during a dry year, and with the methods now in general use, larger yields are secured from this soil than from the heavier soils.

In ordinary seasons this soil is not so well adapted to the staple crops as the heavier soils, but is adapted to a greater variety of crops, and fair yields of the staple crops are secured. It is an excellent peach and good truck soil and would in all probability produce good tobacco. Melons, plums, pears, Irish and sweet potatoes, beans, peas, and peanuts do well on this soil.

Cotton averages about half a bale to the acre and corn 20 to 25 bushels.

Orangeburg Fine Sand. This is a reddish gray sand varying in depth from 13 to 36 inches. The subsoil is red or mottled red and light gray, and occasionally a dark gray, always containing a considerable proportion of sand.

It occurs between the Norfolk fine sand and Orangeburg fine sandy loam or in a few instances between the Norfolk fine sand and Webb fine sandy loam. The surface is gently rolling or undulating, and naturally well drained.

The crops grown on this soil are cotton, some peanuts, and a very little corn, the latter being an uncertain crop. Cotton averages three-eighths to one-half bale. This soil is adapted to melons, sweet potatoes, grapes, and peanuts.

Wilson Clay Loam. This is a dark brown or black clay or clay loam, sometimes streaked with a yellowish tinge. It is quite sticky when wet, but friable and loamy when dry and in a well cultivated condition. Its physical properties give it great water holding capacity, a valuable feature in this region. In its virgin state the surface becomes hard, baked, and sun-cracked.

The soil at about 10 inches grades into a dark brown and black clay, which becomes heavier in texture and lighter in color as the depth increases. At 36 inches it is a stiff compact clay often tinged with yellow.

The topography is gently rolling, and the slopes are gradual with wide shallow valleys between them. The surface affords good natural drainage and only a few areas need to be artificially drained. It is the strongest upland soil in the county for staple crops. Cotton averages five-eights to three-fourths bale per acre, and when especially well cultivated in favorable seasons much larger yields are obtained.

Corn produces on the average from 30 to 40 bushels per acre, but varies with the seasons, much larger yields being obtained in wet seasons. Sorghum cane, while not extensively grown, yields from 2 to 3 tons per acre, from which 1 to 3 cuttings are made each year. When properly cultivated this soil has strong drought resisting qualities, and much of the fluctuations in yield now experienced by farmers can be obviated by putting into practice some system of culture designed to conserve the soil moisture.

Wilson Loam. The surface of the Wilson loam consists of 10 inches of dark gray, sometimes a dark brownish gray loam, containing a considerable quantity of sand, which renders the surface friable and easily worked. The subsoil is a drab silty clay or heavy loam, containing a very small quantity of fine sand. It becomes lighter in color and heavier in texture as the depth increases and at 40 inches is a stiff tenacious silty clay often tinged with yellow.

The topography of the Wilson loam is slightly rolling and the surface sloping enough to give good natural drainage. Along a few of the larger streams there is a tendency to wash, but erosion has seldom taken place to such an extent as to interfere with the use of machinery.

This type is not extensively cultivated, but is largely cleared of the heavy mesquite growth and used for pasture. The few fields under cultivation are devoted solely to the production of corn, cotton, etc., but the soil is better adapted to early maturing crops on account of its droughty nature.

Although this soil has a great water-holding capacity, its texture allows the water to evaporate rapidly, and unless such methods of cultivation are used that conserve soil moisture, the crops suffer quickly during dry spells.

With the methods now in general use and in ordinary seasons, cotton yields from one-half to five-eighths bale per acre and corn 25 to 30 bushels.

Norfolk Fine Sand. This soil consists of a very light gray, loose and somewhat fine sand more than three feet deep. There is little or no difference between the soil and subsoil, except that the surface two or three inches is usually slightly darker in color, owing to the accumulation of a small amount of organic matter.

The topography is for the most part rolling, and the depth of the sand and its topography insure perfect drainage. This soil is regarded as of little agricultural value in this county and is used almost entirely for pasture. Only now and then are there small cultivated fields to be found, and they are situated chiefly near the line of contact with adjoining soils. Cotton, peanuts, and sweet potatoes are about the only crops grown. Corn does not produce well. Cotton averages from one-fourth to one-third bale per acre. Peanuts do well. Peaches, if properly cultivated, should do well and excellent yields of melons and grapes might be produced. Though held in low esteem under present conditions in Wilson County, this is a valuable type of soil for trucking and small fruit growing.

This soil is not as droughty as might be supposed, for the fine sand of which it is composed allows a fair movement of moisture and the surface soil when dry acts as a natural mulch, thus reducing evaporation to a minimum. The deficiency of organic matter in the soil could be overcome by green manuring, and such treatment would also increase the water-holding power of the soil.

Austin Fine Sandy Loam. This soil is a fine sandy loam of yellowish gray color. There is no marked difference between soil and subsoil. Along the river banks the same material is seen to extend to a depth of 10 or 12 feet without change and then suddenly becomes a very dark gray to dark silty clay. The soil contains many shells which give rise to the local name "shelly land." The topography is flat, but the surface is elevated 20 or 30 feet above the present level of the streams, and the soil is well drained, with the exception of a few low spots.

Attempts to irrigate this soil have been unsuccessful for the reason that the water flows only a short distance before sinking into the soil. Corn and cotton are the crops usually grown. Cotton produces one-half to five-eighths bale and corn about 25 bushels per acre. It is quite probable that certain crops such as tomatoes, cucumbers, cabbage, and cauliflowers could be successfully grown. Irish potatoes would do well.

Care must be taken to keep this soil well mulched, for its fine texture and tilth allow rapid loss of moisture by evaporation, and a few days of neglect during hot windy weather may so reduce the water supply as to injure the crop.

Wabash Clay. The Wabash clay consists of a very dark gray or black clay or clay loam 10 inches deep, grading into a stiff tenacious clay subsoil slightly lighter in color than the soil and becoming heavier in texture and lighter in color as the depth increases.

The soil is very stiff and tenacious when wet, and on drying it bakes very hard and cracks. Many of the cracks are 3 and 4 inches wide and 2 feet or more deep. A few areas occur which are slightly lighter in color and texture than the original soil. This condition is due to the admixture of sandy material brought down from the uplands.

The surface of the Wabash clay is practically level and shows the peculiar feature known as "hog wallows." These are depressions 6 to 12 inches deep and three or four feet broad, scattered irregularly through the area. The surface is also rendered uneven by the courses of intermittent streams from the adjacent highlands.

This is one of the strongest and most productive soils in the Wilson County area. It is an excellent cotton soil, and corn, sorghum, and millet do well. In an average season cotton produces three-fourths to five-eighths bale, and corn 30 to 40 bushels per acre. In a few instances, small areas of onions have been grown under irrigation on this type, and it is possible that onion growing on a large scale could be made a paying industry here.

The Wabash clay is often desired because of its location near the river, where water for stock is easily obtained. The cost of clearing the land for cultivation is usually somewhat greater than the case of other soils in the area because of the heavy growth of mesquite and chaparral.

Webb Fine Sandy Loam: This is a dark brown or reddish loam, light sandy loam, about 10 inches deep, with a subsoil of a dark brown, reddish or yellowish brown mottled clay. It occupies gently rolling areas and has good surface drainage. But in wet weather the crops suffer from poor under-drainage. It is known locally as "red sandy mesquite land."

This is one of the strongest sandy soils in the area. Cotton, corn, Irish and sweet potatoes, peanuts, sorghum, pears, melons, and some other garden vegetables are grown.

DESCRIPTION OF SAMPLES.

No. 850—Webb fine sandy loam (0-12"). Brown fine sandy loam; one mile northeast of Path; farm of Richard Voges.

No. 851—Wilson clay loam (0-10"). Derived from coastal plain deposits. Black silty clay, friable when dry, but waxy and tenacious while wet; 5 miles southeast Stockdale; farm of I. R. Culpepper.

No. 856—Orangeburg fine sand (24"-40").

No. 857—Orangeburg fine sandy loam (12"-13").

No. 859—Norfolk fine sand (0-36"). Gray, loose incoherent fine sand; 3 miles west of Sutherland Springs, Texas.

No. 860—Orangeburg fine sand (0-24"). Reddish gray fine sand; 1 1-2 miles west of Sutherland Springs, Texas.

No. 876—Wilson clay loam, subsoil (10"-36"). Five miles southeast Stockdale, Texas.

No. 879—Webb fine sandy loam, subsoil (10"-36").

No. 880—Austin fine sandy loam, subsoil (12"-36").

No. 882—Wabash clay, subsoil (10"-36").

No. 883—Wilson loam, subsoil (10"-36").

No. 934—Wabash clay (0-10"). Two and one-half miles west of Stockdale, Texas. W. L. Lawrence's farm.

No. 937—Orangeburg fine sandy loam (0-12"); three-fourths mile north of Stockdale, Texas.

No. 938—Austin fine sandy loam (0-12"); three-fourths mile west of Floresville, Texas.

No. 940—Wilson loam (0-10"); 6 1-2 miles southeast of Stockdale, Texas.

No. 1295—Wabash clay (0-8"). Black clay loam; 3 1-2 miles northeast Dewees.

No. 1296—Wabash clay, subsoil to 1295 (8"-36"). Dark gray clay.

No. 1297—Wilson clay loam (0-8"). Black clay loam; 2 miles north of Path.

No. 1298—Wilson clay loam, subsoil to 1297 (8"-36").

No. 1299—Wilson loam (0-10"). Brownish gray loam considerable silt; one mile northwest of Path, Texas.

No. 1300—Wilson loam, subsoil to 1299 (10"-36"). Drab silt clay; contains fine sand.

No. 1301—Orangeburg fine sandy loam (0-13"). Red gray clay; one mile south of Union, Texas.

No. 1302—Orangeburg fine sandy loam, subsoil to 1301 (13"-36"). Red clay; containing fine sand.

No. 1303—Austin fine sandy loam (0-12"). Yellowish gray, considerable silt; 3 miles southwest of Saspanico, Texas.

No. 1304—Austin fine sandy loam, subsoil to 1303 (12"-36").

No. 1307—Norfolk fine sand (0-36"). Gray fine sand.

TABLE 40—PERCENTAGE COMPOSITION OF SOILS, OF WILSON COUNTY

	Webb Fine Sandy Loam		Orangeburg Fine Sandy Loam		Orangeburg Fine Sandy Loan		Orangeburg Fine Sand		Wilson Clay Loam				Wilson Loam				Norfolk Fine Sand	
	850	879	937	857	1301	1302	860	856	851	876	1297	1298	940	883	1299	1300	859	1307
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-Soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid.....	.02	.02	.01	.04	.02	.02	.01	.02	.04	.07	.04	.02	.02	.03	.04	.02	.01	.01
Nitrogen	.05	.04	.03	.05	.05	.09	.02	.04	.16	.10	.12	.14	.10	.07	.09	.06	.02	.02
Potash	.15	.19	.56	.51	.09	.58	.07	.42	.38	.40	.76	.78	.84	.45	.59	.19	.04	.04
Lime	.08	.28	.12	.30	.29	.26	.08	.14	1.16	.41	.86	.87	.81	.59	.38	1.12	.06	.05
Magnesia	.18	.59	.10	.55	.11	.34	.04	.24	.64	1.89	.71	.97	.53	.80	.34	.91	.06	.07
Sulphur Trioxide ...					.04	.07		Tr			.04	.08			.12	.07		.03
Alumina and Oxide of Iron........	3.37	10.37	1.61	14.33	1.52	15.49	1.06	10.33	10.20	18.88	8.28	9.51	7.20	11.90	6.08	10.22	.01	.46
Soluble and Insoluble Silica	92.89	80.15	95.40	74.05	96.49	74.33	98.08	82.56	75.06	63.49	79.62	77.72	82.30	74.22	87.38	79.71	98.81	98.94
Loss on Ignition.....	1.90	4.15	1.00	4.25	.51	4.65	.57	3.03	7.54	8.87	6.04	5.20	4.76	5.71	3.81	4.43	.68	
Moisture	.88	2.94	.17	5.05	.90	3.69	.06	3.28	4.33	5.18	3.81	5.54	3.22	5.08	1.62	3.82	.06	

TABLE 40—(Continued) PERCENTAGE COMPOSITION OF SOILS, OF WILSON COUNTY

	Austin Sandy	Fine Loam			Wabash Clay			
	938	880	1303	1304	934	882	1295	1296
	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil	Surface	Sub-soil
Phosphoric Acid	.18	.09	.16	.07	.11	.10	.10	.09
Nitrogen	.10	.04	.11	.04	.12	.18	.11	.07
Potash	.36	.37	.33	.34	1.07	.34	1.12	1.02
Lime	11.76	15.39	17.27	18.83	2.74	15.96	2.51	15.87
Magnesia	5.05	6.58	.51	4.20	.92	1.25	.82	1.53
Sulphur Trioxide	......	......	.11	.18	......	......	.08	.26
Alumina and .... Oxide of Iron	2.64	4.65	3.34	4.99	10.25	11.87	9.75	11.73
Soluble and Insoluble Silica......	58.34	47.10	58.56	57.57	73.33	45.28	73.03	45.99
Loss on Ignition	10.13	10.22	7.08	6.35	6.52	9.09	7.12	12.32
Moisture	.65	1.55	4.26	1.20	2.86	5.24	3.82	4.41

TABLE 41—INTERPRETATION OF SOIL ANALYSES, WILSON COUNTY

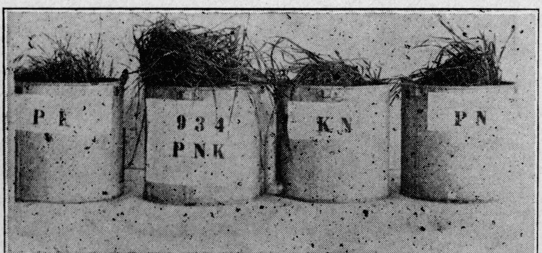
	Webb Fine Sandy Loam	Orangeburg Fine Sandy Loam	Orangeburg Fine Sand	Wilson Clay Loam	Wilson Loam	Norfolk Fine Sand	Austin Fine Sand Loam	Wabash Clay
Phosphoric Acid	Low	Low	Low	Low	Low	Low	High	Good
Nitrogen	Fair	Low	Low	Good	Good	Low	Good	Good
Potash	Good	Good	Fair	Good	Fair	Low	Good	High
Lime	Low	Good	Low	High	Good	Low	High	High
Depth of soil	10"	6-15"	15-36"	10"	10"	36"	36"	10"
Yield of cotton, bales	1-2to5-8	1-2	3-8to1-2	5-8to3-4	1-2to5-8	1-4to1-3	1-2to5-8	3-4to5-8
Yield of corn, bu.	25	20-25	....	30-40	25-30	....	25	30-40

TABLE 42—CROP PRODUCED IN POT EXPERIMENTS

Laboratory Number		Crop and Year	Addition			
			NK	PNK	PN	PK
			Grams Crop Per Pot			
850	Webb fine sandy loam (surface)	Corn, 1908	1.2	18.0	17.5	2.0
837	Orangeburg fine sandy loam..	Corn, 1907	5.2	8.4	6.9	6.4
		Grass, 1908	3.5	.....	6.0	2.2
860	Orangeburg fine sand (surface)	Corn, 1907	1.8	36.1	25.0	5.8
		Corn, 1908	1.9	2.5	.5	.4
851	Wilson clay loam (surface)..	Corn, 1907	16.8	23.4	19.2	20.8
		Grass, 1908	2.9	4.5	3.4	4.2
940	Wilson loam (surface).......	Corn, 1907	7.3	6.7	10.0	9.8
		Grass, 1908	7.0	5.0	5.5	3.8
859	Norfolk fine sand (surface)...	Corn, 1908	6.8	29.8	17.5	6.6
938	Austin fine sandy loam	Corn, 1907	2.3	8.8	6.3	4.5
		Wheat, '08,	.9	3.0	1.1	3.2
		Corn 1908	37.7	40.4	48.5	15.1
934	Wabash clay (surface)	orn, fall'07	6.7	5.6	4.1	.....
		Grass, 1908	3.4	5.6	2.5	2.7

Table 43—Interpretation of Pot Experiments.

	Phosphoric Acid.	Nitrogen.	Potash.
Webb sandy loam	DD	DD	S
Orangeburg fine sandy land	D	D	D
Orangeburg fine sand	DD	DD	D
Wilson clay loam	D	D	D
Wilson loam	S	S	S
Norfolk fine sand	DD	DD	D
Austin fine sandy loam	DD	D	D
Wabash clay	D	D	D



DISCUSSION OF RESULTS.

It is hardly necessary to add more to the facts presented in the tables. Some of these soils are strong soils, well supplied with plant food.

ACKNOWLEDGEMENT.

The descriptions of thhe types of soils given in this bulletin are condensed from the descriptions given by the Bureau of Soils in the publications cited.

The analytical work reported in this bulletin was done by all the members of the laboratory staff. Special mention should be made of the services of Mr. E. C. Carlyle.

SUMMARY AND CONCLUSIONS.

1. Chemical analyses and pot experiments are reported for a number of typical Texas soils. Interpretation of the analyses is given.
2. Plant food is only one of the essentials to the production of crops.
3. Chemical deficiencies of soils may be due to acidity, alkali, lack of organic matter, or too small a supply of phosphoric acid, potash or nitrogen.
4. In conserving soil fertility, waste of plant food or soil should be prevented, nitrogen should secured from the air, the soil stocked with organic matter, and such additional plant food added as is needed.
5. Chemical analysis shows the strength of the soil, its chemical deficiencies, its probable need of plant food.
6. Chemical analyis does not show the kind of crops for which the soil is suited, or the exact kind or amount of fertilizer required by various crops.
7. Pot experiments show the immediate needs of the soil for plant food, under favorable conditions.
8. The chemical characteristics of types of soil found extensively in Texas are discussed.
9. The soils of the different areas which were subjected to analysis are described, the analyses and pot experiments given, and the results of the work interpreted.

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