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TEXAS AGRICULTURAL EXPERIMENT STATION

A. B. CONNER, DIRECTOR
COLLEGE STATION, BRAZOS COUNTY, TEXAS

BULLETIN NO. 430 JULY, 1931

DIVISION OF CHEMISTRY

Chemical Composition of Soils of Cameron, Coleman, Dallas, Erath, Harris, Reeves, Rockwall, and Tarrant Counties

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**In cooperation with U. S. Department of Agriculture.
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This Bulletin contains detailed analyses of the various types of soils found in Cameron, Coleman, Dallas, Erath, Harris, Reeves, Rockwall, and Tarrant counties. Tables interpreting the analyses are also given, as well as the results of pot experiments designed to test the fertility of the soil. The Bulletin outlines methods for the maintenance of soil fertility, explains the terms used, and interprets the results. The results show the fundamental basis of the soil fertility of the various soil types, indicates their weakness or strength, and their probable needs for increasing or maintaining fertility. The black prairie soils are found to be richest in plant food and well supplied with lime, while the forested upland soils on an average are lowest in phosphoric acid, nitrogen, potash, and lime, and in some cases are slightly acid. The first-bottom soils are usually well supplied with plant food and with lime.

The Black Prairie soils of Tarrant county and the first-bottom soils of Dallas county run highest in nitrogen. The alluvial soils of Cameron county and the upland soils of Dallas and Cameron counties are highest in phosphoric acid. The upland soils of Cameron county are highest in active potash.

For each county, tables are given showing the analyses of the various types of soils, the pot experiments, and the interpretation of the analyses, for each individual soil type. Some tables also contain the results of analyses of the salts found in salt spots or salty areas in some of the counties.

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BULLETIN NO. 430 JULY, 1931

THE CHEMICAL COMPOSITION OF SOILS OF CAMERON, COLEMAN, DALLAS, ERATH, HARRIS, REEVES, ROCKWALL AND TARRANT COUNTIES

G. S. FRAPS

This Bulletin deals with the composition and fertility of samples of soils collected from eight counties in Texas. It is the twelfth in a series dealing with the chemical composition of typical Texas soils.

Most of the samples were collected by field agents of the Bureau of Chemistry and Soils of the United States Department of Agriculture in cooperation with the Texas Agricultural Experiment Station. Detailed reports of these surveys with maps showing the location of the different soil types have been published by the Bureau of Chemistry and Soils of the United States Department of Agriculture. Descriptions of soils given in this Bulletin have been condensed from these reports. The soil surveys referred to are as follows:

Soil Survey of Cameron County, Texas, by M. W. Beck and B. H. Hendrickson.

Soil Survey of Coleman County, Texas, by H. W. Hawker, William T. Carter, M. W. Beck, and R. E. Devereux.

Soil Survey of Dallas County, Texas, by William T. Carter, Jr., A. H. Bauer, T. M. Bushnell, et al.

Soil Survey of Erath County, Texas, by T. M. Bushnell, H. W. Hawker, and D. B. Pratapas.

Soil Survey of Harris County, Texas, by H. V. Geib, T. M. Bushnell, and A. H. Bauer.

Soil Survey of Reeves County, Texas, by M. W. Beck and W. W. Strike.

Soil Survey of Rockwall County, Texas, by H. V. Geib.

Soil Survey of Tarrant County, Texas, by H. W. Hawker, Neal Gearreald, and M. W. Beck.

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

MAINTENANCE OF FERTILITY

The following are some of the essentials to the maintenance or improvement of soil fertility:

(1) The supply of nitrogen and humus in the soil should be maintained. Growing legumes in a proper rotation, and turning these under or grazing them off is usually to be advised. The nitrogen in the soil may be supplemented by the use of nitrogenous fertilizers.

(2) Deficiency of phosphoric acid in the soil should be corrected by the use of phosphates as a fertilizer.

(3) Any acidity sufficient to be injurious to the crops being grown, if present, should be corrected by use of ground limestone or lime. Lime and limestone are also used for the improvement of the physical character of the heavy soils poor in lime or for supplying lime for crops which need a quantity of lime. Lime should be used chiefly in connection with a systematic legume rotation.

(4) Any deficiency of potash in the soil should be corrected by the use of fertilizers containing potash.

(5) Erosion or washing away of the more fertile surface soil should be prevented.

Maintenance of Humus and Nitrogen

The maintenance of the humus, or partly decayed vegetable matter, in the soil aids materially in maintenance of fertility. Partly decayed vegetable matter, sometimes termed humus, in sufficient quantity, improves the capacity of soils to hold a favorable amount of water, so as better to resist drouth. It aids in giving a fine crumbly structure to clay soils and enables them to break up into a good condition of tilth under the action of cultivating implements. It checks the rapidity of the percolation of water through sandy soils, thus decreasing loss of plant food. Humus also contains most of the nitrogen of the soil. Nitrogen in humus is in an insoluble form and cannot be taken up by crops or washed out of the soil. Nitrogen in humus is slowly changed by soil organisms to nitrates or ammonia, in which forms the nitrogen may be taken up by plants. Nitrates may be also washed from the soil. The storing of nitrogen in the insoluble humus compounds protects the soil from rapid depletion in fertility as regards nitrogen, either by cropping or by percolating water.

Some soils produce good crops for a long time without additions of vegetable matter, but for permanent productiveness on most soils, vegetable matter must be added sooner or later. Vegetable matter may be supplied in barnyard manure, which is excellent when sufficient quantities can be secured, but barnyard manure cannot always be secured in large enough quantities. Legume crops, which have power to take nitrogen from the air, may be grown in rotation with other crops, and either turned under or grazed off. If the crop is heavy, it is best to allow it to become nearly mature before turning it under. To graze off the crop is better than to turn it under, as some of its feeding value is secured when the crop is grazed, while the droppings from the animals, together with the liquid excrement, return to the soil the bulk of the plant food taken up by the crop. To make the crop into hay, and save the manure from the hay, is not as good for the soil as grazing off the crop, since a large part of the plant food in the hay is lost. When the legume is made into hay to be sold, the land probably gains little nitrogen and actually loses phosphoric acid and potash. Crops other than legumes add vegetable matter to the soil when plowed under or grazed off. They are suitable for cover crops to reduce losses from leaching or washing when the land would otherwise be bare, but legumes are the only plants which can fix the nitrogen of the air and place it into the soil in forms suitable for the use of other crops. For this reason it is best to grow legumes for hay, forage, or soil-improving crops whenever possible.

The maintenance of the nitrogen content of the soil is more important than the maintenance of the humus contest. Nitrogen may be purchased as a fertilizer, but it is expensive when bought in this way, and ordinarily a farmer cannot afford to buy enough of it to keep the nitrogen content of his land from decreasing. The only practical way to maintain the nitrogen content of the soil when ordinary farm crops are grown is to secure part of the nitrogen from the air by growing legumes. The nitrogen fixed by legumes can then be utilized for cotton, corn, kafir, or similar crops. The kind of legume best to grow depends upon the climate and other conditions, which vary with different sections of the state and with different conditions of farming.

Phosphoric Acid

Texas soils are frequently deficient in phosphoric acid. This Bulletin contains information regarding the probable deficiencies in phosphoric acid of the various soils of the counties described. Deficiency of phosphoric acid may be easily and profitably corrected by the use of superphosphate as a fertilizer.

Potash

While many of the soils of Texas are rich in potash, there is some variation and some soils need potash as a fertilizer. In general, potash is the least often needed of the three plant foods. Plants can take up more potash than they need.

The needs for potash of the various types of soils here studied are indicated by the tables of analyses and of interpretation of results given later. Some of the soils described are low in active potash compared with other soils of the state, though they are much better supplied with potash than with phosphoric acid or nitrogen.

Acidity

Some soils contain organic or inorganic acids. Some crops, such as clover, alfalfa, barley, and rye do not grow well on acid soils. There are other crops, such as cowpeas, and watermelons, which do well on acid soils. Acidity may be corrected by the use of ground limestone, ground oyster shells, air-slaked lime, or hydrated lime. Few acid soils are found to occur in the counties described in this Bulletin. Legumes and the clovers require more lime than other crops.

HOW TO USE THE ANALYSES

Analyses of the soils are given in connection with the descriptions of the various types of soil in each county. The interpretation of the analyses is also given so that the strength or weakness of each type can be ascertained.

If a soil well supplied with plant food does not give good yields, it is obvious that some condition other than plant food controls the yields. The physical condition may be poor, either in respect to cultivation, drainage, or otherwise. It may sometimes contain injurious substances, such as alkali or may supply insufficient amounts of water. Plant diseases may also be present.

If the soil is well supplied with total plant food, but low in active plant food, attempts may be made to increase the activity of soil agencies which make the plant food available, by means of additions of manure, of green crops plowed under, or if the soil needs lime, by additions of lime or ground limestone in connection with a legume rotation.

If the crop yields are low and the plant food is deficient, fertilizer should be used. The depth of the surface soil and the character of the subsoil, as well as the season, influence the yield of crops as much as the plant food. This can be seen by observing the variation of the yield on the same land from one year to another.

EXPLANATION OF TERMS

Total phosphoric acid is the entire quantity of phosphoric acid contained in the soil. It cannot all be taken up by plants at once, as only a small portion is immediately available. It is made slowly available by natural agencies.

Active phosphoric acid is that part of the total phosphoric acid which is more easily taken up by plants. It is that soluble in 0.2N nitric acid. The relation of the active phosphoric acid to the strength of the soil is shown in the table giving the interpretation of the analyses. As shown in Bulletins 126 and 276, there is a relation between the active phosphoric acid of the soil and the amount of phosphoric acid which crops are able to take from the soil in pot experiments. There is a closer relation between the active phosphoric acid of the soil and the needs of the soil for phosphoric acid as a fertilizer, than between the total phosphoric and the needs of the soil.

Total potash represents the entire amount of potash in the soil. A large part of this is locked up in highly insoluble silicates, and may not become available for the use of plants in centuries. The amount of total potash does not indicate how much is available for use by the immediate crop.

Acid-soluble potash is the amount of potash that is dissolved by strong hydrochloric acid. As pointed out by Hilgard, there is a relation between the amount of acid-soluble potash of the soil, and the wearing qualities of the soil (Fraps, Principles of Agricultural Chemistry, page 171). The higher the percentage of acid-soluble potash, the longer the soil can be cropped before it needs potash.

Active potash is the potash which can be readily taken up by plants, as shown by pot experiments in Bulletins 145 and 325. It is the potash that is soluble in 0.2N nitric acid. There is a close relation between the amount of active potash in the soil and the amount which can be used by crops.

Total nitrogen is the entire quantity of nitrogen present in the soil. Most of the nitrogen is present in organic matter or humus. As shown in Bulletin 151, there is a relation between the total nitrogen of the soil and the nitrogen which can be taken from it by crops in pot experiments. The total nitrogen is therefore an index to the needs of the soil for nitrogen, although the nitrogen in worn soils is not as available as that in new soils, and a number of conditions affect the quantity of nitrogen made available for the use of crops.

Acid-soluble lime is the lime which is dissolved by strong hydrochloric acid. According to Hilgard, the amount of lime found by this method is a valuable indication as to the fertility of the soil.

Basicity. The basicity represents the carbonate of lime and other basic materials in the soil. This term is here applied to the bases (chiefly lime) which neutralize the 0.2N nitric acid in the method for determining active phosphoric acid and active potash. This term is merely used as a convenient one for the determination referred to. If all the acid is neutralized, the basicity is 10 per cent, or 200,000 pounds of base (carbonate of lime) to 2,000,000 of the soil.

Acidity is represented by what is termed the pH of the soil. The pH (or hydrogen ion concentration) shows the intensity of the acidity of the soil.

A neutral soil is represented by a pH value of 7.0. The lower the number below pH 7, the more acid the soil. A soil of pH 6.0 would be ten times more acid than a soil of pH 7.0, and one with pH 5.0 would be 10 times more acid than one of pH 6.0. Numbers higher than 7.0 indicate alkalinity and the higher the number, the more alkaline the soil. In general, a certain reaction is best suited to a given kind of plant. There is much difference of opinion, but the approximate reaction is given in Table 1. In general, applications of lime should be made to acid soils to produce the favorable reaction, but soils do not all act alike in this respect, and sometimes acid soils do not respond to the use of lime in increase in yield of crops.

Corn possibility represents the average amount of plant food which is withdrawn by plants in pot experiments from soils containing similar amounts of total nitrogen, active phosphoric acid, or active potash. It is based on 2,000,000 pounds of the soil, which is approximately the weight of an acre of land to the depth of six and two-thirds inches. The corn possibility is not claimed to indicate the possible yield from the soil, as this depends upon other conditions in addition to the fertility of the soil. It is simply a convenient means of bringing out the relative deficiencies of plant food in the soil. The corn possibility is also a convenient way of comparing amounts of various plant foods in the same soil. For example, with the Lake Charles clay loam of Harris county, the corn possibility for total nitrogen is 28, for active phosphoric acid is 12, and for the active potash 50. The soil is probably deficient both in phosphoric acid and in nitrogen. This may be compared with the Victoria clay loam of Cameron county, which has a corn possibility of 38 bushels for nitrogen, 55 for phosphoric acid, and 273 for potash. Other comparisons can be made from the tables.

Table 1.—Reaction value (pH) for growth of crops

	pH for best growth	pH which gives good growth
Alfalfa	7.0	7.0 to 8.0
Barley	6.0	6.0 to 7.2
Clover	6.4	6.0 to 8.0
Corn	6.0	6.0 to 8.0
Cotton	....	5.0 to 8.0
Oats	5.6	5.0 to 8.0
Rye	6.0	5.5 to 7.5
Soy beans	6.5	5.0 to 8.0
Timothy	5.0	5.0 to 8.0
Wheat	7.0	6.0 to 8.0

The experiments on which this interpretation is based are published in Bulletins 126, 145, 151, 178, 267, and 355, and the method is discussed in Bulletins 213 and 355.

Saline Soils

Soluble salts occur in some of the soils of the counties here discussed, in sufficient quantity to be injurious to crops. Salty spots are of frequent occurrence along the Gulf Coast, and also in other parts of Texas. In some instances the soluble salts are of natural occurrence, as in soils along the sides of salty lakes, in spots or even in larger areas. In other cases, the soluble salts accumulate as a result of irrigation or seepage water coming too near the surface. If the ground water can be brought sufficiently near the surface to evaporate, the soluble salts contained in it are left behind and accumulate. Where the accumulation of soluble salts is greater than the amount washed down by rain or irrigation water, the soil increases in saltiness, until there is so much salt that crops cannot be grown. Salty spots due to subirrigated areas occur in various sections of Texas. They may also be produced in yards or gardens by frequent sprinkling with irrigation water on lawns or flowers. The formation of saline spots may be prevented by drainage so that the ground water is brought too low to rise and evaporate. Sufficient rain or irrigation water will then wash out any salt which may be present. Saline spots may be recovered by suitable drainage accompanied by sufficient applications of water to wash the salts through the soil into the country drainage; however, difficulties are met here, as the soil may be so heavy that the water does not penetrate readily. The saline salts may also cause the soil particles to deflocculate and close up the pores of the soil so as to cause water to penetrate very slowly or even prevent it from passing through.

Saline soils are frequently called *alkali* soils. The injurious salts are not alkaline as a rule, usually consisting of sodium chloride (common salt) and sodium sulphate. The salts are alkaline when sodium carbonate or bicarbonate are present, when they are called *black alkali.* Texas soils sometimes contain black alkali, but not frequently. The composition of some of the saline soils is given in connection with the discussion of the soils of some of the counties (see Tables 8, 18 and 22).

POT EXPERIMENTS

The needs for plant food of some of the soils discussed in this Bulletin were studied by growing the plants in pots containing portions of the soils, to which various forms of plant food were added. In making these experiments, 5,000 grams of soil were placed in galvanized iron pots, and to one or more pots a complete fertilizer (NPK or NDK) was added; D is the symbol used for dicalcium phosphate. To one or more pots nitrogen and potash (NK) were added, phosphoric acid being omitted. The difference between this pot and the pot with the complete fertilizer shows the need of the soil for phosphoric acid. To one or more pots, phosphoric acid and potash (PK) were added, nitrogen being omitted. The difference between this pot and that with the complete fertilizer shows the need of the soil for nitrogen. To a third set of one or more pots, nitrogen and phosphoric acid (NP) were added, potash being omitted. The difference between this pot and the pot receiving the complete fertilizer shows the need for potash.

The tables show the weights of the crops secured with the different additions, and also the amounts of phosphoric acid, potash, or nitrogen removed from the pot by the plants grown in the experiments. This is expressed in bushels of corn to the acre.

The soil in pot experiments is under favorable conditions and it is possible for the plants to make a greater growth or to take up more plant food from the same quantity of soil than would be the case under field conditions. There might be a considerable difference between the crop receiving the complete fertilizer (NPK), and the crop which had no potash (NP), in the amount of crop produced in the pot experiments, and yet the crop produced in the field without potash might be equal to the possibility of production under the climatic conditions prevailing. Thus the soil would appear deficient in the pot experiment, while for all practical purposes it would not be deficient in the field. This is the reason why the plant food withdrawn is expressed in bushels of corn to the acre. It shows the relative possibility of the soil to furnish plant food for crops in pot experiments.

RELATION OF CHEMICAL ANALYSIS TO PRODUCTION

Chemical analysis is made on samples of soil taken from the fields. The analysis for plant food represents the capacity of the soil to furnish it. The capacity of the soil to furnish plant food is only one of a group of factors which control production of crops.

The chemical analysis is related to the capacity of the soil to supply plant food, but when application is made of the results to field work, other important factors enter into play. The most important of these are perhaps (a) the kind of crop and its ability to assimilate plant food, (b) the depth of the soil and the extent to which it is occupied by roots, (c) the water provided by soil and season, (d) the temperature, and (e) the possibility of crop production under the other prevailing soil and climatic conditions. It is obvious that a plant having twice the power of another to assimilate phosphoric acid will need only half the quantity in the soil; that a soil furnishing enough phosphoric acid for 30 bushels of corn may not contain enough for 50 bushels; that a soil which can be occupied by roots to a depth of 6 inches furnishes only half as much plant food as one that is occupied to a depth of 12 inches; and that a soil may contain enough plant food for 30 bushels of corn and yet not enough for a large crop of tomatoes. Different crops vary in the quantity of food necessary to produce a good yield. These are all illustrations of the factors mentioned above, which affect the ability of the plant to utilize the food offered it by the soil.

The interpretations given in this Bulletin refer entirely to the capacity of the soil. No attempt is made to allow for any of the other factors which may affect production.

AVERAGE COMPOSITION OF THE SOILS OF THE COUNTIES STUDIED

For the purpose of discussion the soils were divided into three groups: the upland soils, the second-bottom, or terrace, soils and the first-bottom, or alluvial, soils. The average composition of these groups is given in Table 2.

The upland soils include both the prairie and the forested soils. The term "forested" refers to the original condition of the soils, regardless of whether they are now forested or in cultivation. The upland forested soils are usually low in nitrogen and in active phosphoric acid. They are a little better supplied with active potash but contain less than the

Table 2.—Average composition of soils by groups

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH
Upland Surface Soils									
Cameron County (prairie)	.132	.129	673	2.19	.73	630	1.18	2.37	7.9
Coleman County	.126	.066	25	1.12	.35	324	8.35	5.56	7.3
Dallas County (Black prairie)	.192	.126	130	1.59	.83	405	5.32	5.53	7.3
Erath County	.117	.066	46	1.05	.44	277	3.76	4.44	7.2
Harris County (Flat Woods)	.056	.026	20	.39	.10	95	.15	.25	6.2
Harris County (Coastal Plain)	.091	.030	25	.54	.15	98	.31	.44	6.4
Reeves County	.045	.063	180	2.21	.45	383	6.13	5.53	7.8
Rockwall County	.099	.070	55	.78	.26	185	4.78	3.71	7.0
Tarrant County (Ft. Worth prairie)	.115	.073	22	.97	.34	139	2.03	2.23	7.1
Tarrant County (Black prairie)	.172	.149	171	1.11	.58	197	8.12	6.45	7.4
Tarrant County (East Cross timbers)	.044	.050	20	.61	.07	73	.17	.45	7.1
Tarrant County (West Cross timbers)	.023	.013	12	.61	.10	21	.16	.25	6.9
Upland Subsoils									
Cameron County (prairie)	.055	.079	242	1.98	.64	513	1.14	2.66	7.5
Coleman County	.070	.046	19	1.28	.42	238	6.19	5.38	7.3
Dallas County (Black prairie)	.083	.097	103	1.57	.81	188	23.99	5.37	7.2
Erath County	.079	.057	28	1.02	.47	187	5.34	5.44	7.4
Harris County (Flat Woods)	.024	.017	13	.41	.09	77	.12	.19	6.1
Harris County (Coastal Plain)	.052	.022	16	.54	.18	84	.62	.87	6.4
Reeves County	.039	.056	137	2.04	.42	313	7.99	7.58	8.0
Rockwall County	.071	.052	27	.73	.26	111	5.77	4.06	7.1
Tarrant County (Ft. Worth prairie)	.080	.074	9	1.02	.41	92	3.34	2.70	7.3
Tarrant County (Black prairie)	.104	.150	123	1.06	.47	81	11.47	9.57	7.5
Tarrant County (East Cross timbers)	.041	.046	6	.73	.23	63	.37	.50	6.8
Tarrant County (West Cross timbers)	.015	.014	6	.49	.11	56	.43	.49	6.3
Upland Deep Subsoils									
Cameron County (prairie)	....	.104	692	2.17	.60	297	4.71	7.93	7.7
Erath County	.065	.073	49	1.19	.38	80	14.04	7.46	7.5
Harris County (Flat Woods)	.030	.017	11	.50	.11	95	.16	.33	5.8
Harris County (Coastal Plain)	.040	.016	14	.49	.17	103	.69	.84	6.4
Reeves County	.025	.040	54	....	.49	79	14.88	9.95	....
Rockwall County	.033	.036	20	.75	.26	77	....	5.85	7.7
Tarrant County (East Cross timbers)	.043	.070	8	.64	.28	57	.29	.88	6.5
Terrace (or second bottom) Surface Soils									
Coleman County	.116	.053	75	1.21	.53	481	1.13	3.47	7.4
Dallas County (high in lime)	.161	.112	181	1.33	.77	325	4.10	4.54	7.4
Dallas County (moderate in lime)	.071	.037	35	.63	.20	114	.54	.98	6.9
Erath County	.077	.048	23	.96	.24	291	.42	1.25	7.0
Rockwall County	.096	.119	188	.93	.52	296	7.15	6.51	7.3
Tarrant County	.071	.050	36	.76	.22	116	1.12	1.97	7.3

Table 2.—Average composition of soils by groups—Continued

	Nitrogen per cent	Total Phos. Ac. per cent	Active Phos. Ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH
Terrace (or second bottom) Subsoils									
Coleman County	.087	.048	61	1.23	.55	329	2.72	4.35	7.4
Dallas County (high in lime)	.090	.169	112	1.08	.55	111	14.18	6.28	8.7
Dallas County (moderate in lime)	.040	.031	30	.77	.26	104	.88	1.33	7.2
Erath County	.079	.057	4	1.08	.78	200	.70	1.11	6.7
Rockwall County	.072	.089	99	1.01	.45	191	9.16	6.13	7.5
Tarrant County	.051	.035	15	.87	.31	102	1.54	1.94	7.2
Terrace (or second bottom) Deep Subsoils									
Coleman County	.091	.052	10	1.07	.55	174	4.27	7.93	7.5
Dallas County (moderate in lime)	.036	.036	13	.91	.32	124	.30	.44	6.2
Erath County	.021	.063	....	.41	....	....	....	....	....
Tarrant County	.042	.055	25	.89	.33	94	2.76	1.66	7.4
Alluvial (or first bottom) Surface Soils									
Cameron County	.118	.154	306	2.15	.98	404	7.44	8.42	7.7
Coleman County	.099	.088	253	1.59	.57	332	2.80	4.37	7.5
Dallas County	.174	.101	114	1.30	.70	304	8.67	9.17	7.2
Erath County	.117	.108	175	1.40	.54	512	2.61	3.58	7.3
Harris County	.101	.041	40	.72	.19	166	.80	1.30	6.4
Reeves County	.087	.131	327	2.40	.63	443	7.82	7.57	7.6
Rockwall County	.135	.131	106	.72	.45	196	10.84	7.91	7.4
Tarrant County	.086	.097	56	1.11	.34	169	3.00	4.48	7.2
Alluvial (or first bottom) Subsoils									
Cameron County	.070	.121	110	1.98	.65	234	9.88	9.63	7.9
Coleman County	.063	.075	187	1.45	.47	173	5.19	8.08	7.5
Dallas County	.108	.118	66	1.31	.61	95	9.03	8.68	7.3
Erath County	.072	.074	73	1.37	.58	237	4.32	4.41	7.4
Harris County	.043	.027	20	.76	.25	107	.53	.89	6.5
Reeves County	.049	.127	287	2.55	.76	462	8.24	8.03	7.7
Rockwall County	.098	.115	76	.65	.42	127	13.17	7.91	7.4
Tarrant County	.073	.099	38	1.31	.46	73	5.86	4.94	7.4
Alluvial (or first bottom) Deep Subsoils									
Cameron County	.030	.105	110	1.98	.30	75	9.33	9.51	8.1
Erath County	.055	.058	36	1.19	.52	210	12.75	6.87	7.6
Harris County	.046	.027	20	.67	.25	98	.63	.86	6.5
Reeves County	.037	.137	114	2.05	.84	306	11.22	10.00	7.5
Coastal Land Surface Soil—Cameron County	.052	.130	133	1.71	.87	187	11.44	9.86	7.7
Coastal Land Subsoil—Cameron County	.069	.122	44	1.47	.89	101	11.87	10.00	8.0

prairie soils. They are slightly acid in Harris county, but are neutral in the other counties. They are also low in lime. The subsoils are likewise low in plant food and they are slightly more acid than are the surface soils.

The upland prairie soils (Table 2) are much better supplied with plant food and with lime than are the forested soils. All of them are limestone soils, and none are acid. The other upland soils are well supplied with plant food and lime, with the exception of those of Harris county.

The second-bottom, or terrace, soils are located above overflow. They are somewhat better equipped with plant food than are the upland forested soils, but are not as well supplied as the prairie soils. They are limestone soils and are not acid.

Some of the first-bottom soils are subject to overflows. They are usually well supplied with plant food. All of them are well supplied with lime.

The groups of surface soils which average highest in nitrogen are the Black Prairie soils of Tarrant county and the first-bottom soils of Dallas county. Next come the alluvial soils of Rockwall county and the upland soils of Cameron county. The soils lowest in nitrogen are the upland West Cross Timber soils of Tarrant county and the upland soil of Reeves county.

The groups of surface soils which average highest in total phosphoric acid are the alluvial soils of Cameron county and the upland soils of Dallas and Cameron counties. The upland prairie soil of Cameron county is highest in active phosphoric acid, while the alluvial soils of Cameron and Reeves counties are high.

The group of surface soils highest in active potash is the upland soils of Cameron county. Those high in active potash include first-bottom soils of Cameron, Erath, and Reeves counties, second-bottom soils of Coleman county, and upland soils of Dallas county.

CROP PRODUCTION POWER OF AVERAGE SOILS

Table 3 contains the number of crops of 40 bushels of corn that could be produced by the plant food on an acre to the depth of six and two-thirds inches (two million pounds), provided all the plant food could be extracted by the plants, in the groups of soils as averaged in Table 2. The total phosphoric acid of the upland soils could produce 10 to 119 crops of 40 bushels of corn, the acid-soluble potash could produce 35 to 365 crops and the total nitrogen 8 to 64 crops. The terrace soils and the alluvial or first-bottom soils average much better, as can be seen in the table. It is seen that some of the soils have limited fertility. As these figures refer only to the top seven inches of the soil, and the plants may draw on the subsoil, the actual possibility for crops is much greater than is indicated above.

Table 3.—Number of crops of forty bushels of corn which would be produced by the plant food in two million pounds soil (an acre 7 inches deep).

Group	Nitrogen	Total phosphoric acid	Acid-soluble potash
Upland Surface Soils			
Cameron County (prairie)	44	103	365
Coleman County	42	53	175
Dallas County (Black prairie)	64	101	415
Erath County	39	53	220
Harris County (Flat Woods)	19	21	50
Harris County (Coastal Plain)	30	24	75
Reeves County	15	50	225
Rockwall County	33	56	130
Tarrant County (Fort Worth prairie)	38	58	170
Tarrant County (Black prairie)	57	119	290
Tarrant County (East Cross timbers)	15	40	35
Tarrant County (West Cross timbers)	8	10	50
Terrace (or second bottom) Surface Soils			
Coleman County	39	42	265
Dallas County (high in lime)	54	90	385
Dallas County (moderate in lime)	24	30	100
Erath County	26	38	120
Rockwall County	32	95	260
Tarrant County	24	40	110
Alluvial (or first bottom) Surface Soils			
Cameron County	39	123	490
Coleman County	33	70	285
Dallas County	58	81	350
Erath County	39	86	270
Harris County	34	33	95
Reeves County	29	105	315
Rockwall County	45	105	225
Tarrant County	29	78	170
Coastal land Surface Soil			
Cameron County	17	104	435

Table 4 contains the corn possibility of the groups, derived from Table 2. In the upland soils the corn possibility of the active phosphoric acid varies from 12 to 60 bushels, the active potash from 26 to 171, and the total nitrogen from 13 to 48 bushels. These figures show the importance of nitrogen and phosphoric acid in these soils, and that potash is less important.

FERTILIZERS FOR THE SOILS STUDIED

The soils studied may be divided into several groups with respect to their relation toward fertilizers.

The upland soils of all the counties except Cameron, Dallas, Reeves, and Tarrant (Black Prairie), on an average are somewhat low in phosphoric acid. The upland soils of Harris, Reeves, and the East and West Cross Timbers of Tarrant county are low in nitrogen. The upland soils of Harris county and the East and West Cross Timbers of Tarrant county are low in active potash. The use of fertilizers is generally advisable for field crops on these soils in the eastern part of the state. They are especially needed for truck and fruit crops. Fertilizers suggested for use are given in other publications of the Experiment Station.

Table 4.—Interpretation of average analyses of surface soils.

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Upland Surface Soils						
Cameron County (prairie	38	60	245	good	good	good
Coleman County	38	18	144	good	good	high
Dallas County (Black prairie)	53	45	180	good	good	high
Erath County	33	30	135	good	good	high
Harris County (Flat Woods)	18	12	50	low	low	fair
Harris County (Coastal Plain)	28	18	50	low	fair	good
Reeves County	18	45	171	good	good	high
Rockwall County	28	30	94	good	good	high
Tarrant County (Fort Worth prairie)	33	18	73	good	good	high
Tarrant County (Black prairie)	48	45	94	good	good	high
Tarrant County (East Cross timbers)	18	12	38	fair	low	fair
Tarrant County (West Cross timbers)	13	12	26	low	low	fair
Terrace (or second bottom) Surface Soils						
Coleman County	33	35	204	fair	good	good
Dallas County (high in lime)	48	45	144	good	good	high
Dallas County (moderate in lime)	23	24	61	good	good	good
Erath County	23	18	135	good	good	good
Rockwall County	28	45	135	good	good	high
Tarrant County	23	24	61	good	good	good
Alluvial (or first bottom) Surface Soils						
Cameron County	33	50	180	good	good	high
Coleman County	28	50	154	good	good	high
Dallas County	48	45	144	good	good	high
Erath County	33	45	211	good	good	high
Harris County	33	24	84	good	good	good
Reeves County	28	50	188	good	good	high
Rockwall County	38	45	94	good	good	high
Tarrant County	28	30	84	good	good	high
Coastal land Surface Soil						
Cameron County	18	45	94	good	good	high

In general, the light soils are likely to need more potash than the heavier soils.

The black calcareous prairie soils, especially the Houston soils, do not respond well to fertilizers, and at present we cannot recommend fertilizers to be used on them, but recommend legume rotation and manure. Climatic conditions may interfere with the profitable use of fertilizers in the western part of the state not under irrigation, and they are not recommended in the absence of favorable field experiments.

The first-bottom soils are well supplied with plant food and generally do not need fertilizers so much as the upland soils. Where they produce a heavy growth of stem and leaves but do not fruit well, applications of superphosphate may correct this condition. Where the fertility has begun to decrease, due to cultivation over a period of years, fertilizers will probably be of advantage. Fertilizers would be of advantage on vegetable crops.

USE OF LIME

Few of the soils described in this Bulletin are acid. Contrary to local opinion, lime is not needed on many of these soils. If lime is needed, it will be mentioned in the discussion of the soils of the county concerned.

The use of lime on sandy soils which are well drained, such as Norfolk, Ruston or Orangeburg soils, is not to be advised except in connection with a legume rotation, for the reason that application of lime is likely to stimulate the production of nitrates and cause loss of nitrogen of the soils during the winter months. The acidity of these surface soils is usually not high enough to be injurious to crops ordinarily grown.

SOILS OF CAMERON COUNTY

Cameron county is in the extreme southern part of Texas. Fifteen soil types belonging to 10 series have been mapped in this county. The soils of the delta region, chiefly derived from deposits made by the Rio Grande, are classed as the Laredo, Harlingen, Cameron, and Rio Grande series. The upland soils in the northern part of the county are included in the Victoria and Tiocano series. The soils along the coast belong to the Lomalto or Point Isabel series, or are classed as dune sand. Lomalto clay is the most extensive soil type, occupying 22 per cent of the area; Victoria clay comes second with 19.9 per cent, and Harlingen clay third, occupying 17.9 per cent of the area. Laredo silty clay loam, 11.8 per cent, comes fourth.

Composition of Soils. Table 5 gives the analyses of the different soil types and Table 6 an interpretation of the analyses; these analyses show the strength or weakness of the various soils. The soils of this county are well supplied with plant food. The potash and nitrogen content are high. All the soils examined were high in lime and no applications of lime are likely to be needed. Nitrogen is likely to be the plant food needed first, because it is used in large quantities by the crops and is more readily washed from the soil than other plant food.

Table 5.—Analyses of soils of Cameron County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Cameron clay	.100	.179	336	2.53	1.23	196	9.76	9.22	7.9	Surface
Cameron clay	.061	.134	147	2.20	1.11	131	10.68	9.42	8.5	Subsoil
Harlingen clay	.116	.123	238	2.17	.98	527	4.38	7.85	7.7	Surface
Harlingen clay	.151	....	230	1.89	.85	497	7.30	8.54	8.6	Subsoil
Laredo clay	.194	.209	397	2.11	.80	453	5.17	5.46	7.5	Surface
Laredo clay	.065	.142	181	1.50	.87	109	9.24	9.83	7.6	Subsoil
Laredo clay	.029	.113	223	1.74	.38	83	8.35	9.85	7.7	30–36
Laredo fine sandy loam	.090	.112	410	1.82	.36	304	4.87	5.80	7.6	0–18
Laredo fine sandy loam	.047	.107	10	2.50	.23	156	10.42	10.00	7.7	18–24
Laredo fine sandy loam	.023	.076	143	2.41	.09	71	8.98	8.47	7.9	24–36
Laredo loam	.098	.137	373	2.33	.49	471	5.82	9.60	7.7	0–15
Laredo loam	.070	.118	38	1.91	.47	210	10.26	19.80	7.7	15–24
Laredo loam	.039	.113	50	2.06	.36	107	9.24	16.80	7.7	24–36
Laredo silty clay loam	.146	.182	666	2.17	2.81	548	5.49	8.16	7.7	Surface
Laredo silty clay loam	.072	.168	126	1.67	.64	329	11.22	9.87	8.1	Subsoil
Laredo silty clay loam	.030	.117	24	1.70	.38	40	10.74	9.85	8.9	30–36
Lomalta clay	.062	.136	55	1.90	.90	153	12.73	10.00	7.8	Surface
Lomalta clay	.069	.122	44	1.47	.89	101	11.87	10.00	8.0	20–36
Point Isabel clay	.041	.123	210	1.51	.83	220	10.14	12.70	7.5	0–36
Rio Grande clay	.176	.196	248	2.41	.96	564	10.83	9.77	7.7	Surface
Rio Grande clay	.102	.156	170	2.57	.92	410	10.98	9.27	7.6	Subsoil
Rio Grande silty clay loam	.087	.127	45	2.11	.84	317	10.73	9.96	7.7	Surface
Rio Grande silty clay loam	.032	.060	46	1.67	.38	128	9.91	9.92	7.9	Subsoil
Rio Grande very fine sandy loam	.050	.119	44	1.70	.37	256	9.88	18.50	7.8	0–15
Rio Grande very fine sandy loam	.029	.085	39	1.94	.36	140	8.87	17.90	7.8	15–36
Liocano clay	.168	.206	1145	1.97	.93	886	2.74	4.93	9.5	0–36
Victoria clay loam	.138	.153	583	1.99	.91	752	.91	2.45	7.4	Surface
Victoria clay loam	.057	.131	482	2.32	.82	502	1.89	5.30	7.5	Subsoil
Victoria fine sandy loam	.097	.078	218	2.48	.47	615	.50	.98	7.4	Surface
Victoria fine sandy loam	.055	.056	126	2.48	.50	462	.37	.79	7.4	Subsoil
Victoria fine sandy loam	....	.104	692	2.17	.60	297	4.71	7.93	7.7	18–36
Victoria sandy clay loam	.123	.077	745	2.32	.60	268	.56	1.10	7.4	0–12
Victoria sandy clay loam	.052	.050	118	1.14	.59	576	1.17	1.90	7.6	12–36

Phosphoric acid is likely to be next in importance and potash last. Saline soils occur in this county and the area is likely to increase where underdrainage is not sufficient and the water table occurs too near the surface of the soil.

Pot experiments are given in Table 7. Attention is directed to the high quantities of potash furnished to the crops, and the failure of the crops to respond to applications of this element. A number of the soils responded to applications of nitrogen, and some to phosphoric acid, though the number responding to phosphoric acid is smaller than for nitrogen. The second crop frequently shows a greater need of nitrogen or phosphoric acid than the first crop.

Fertilizers. Although these soils are rich and well supplied with plant food, some of them are heavily cropped. Two or three crops may be grown a year. Truck crops are also grown, which require good supplies of readily available plant food. Fertilizers containing nitrogen and phosphoric acid are needed on some of the older soils, especially on truck crops. Potash is less likely to be needed.

The soils contain an abundance of lime and do not need liming.

Saline Soils. The soluble salts contained in some saline soils found in Cameron county are given in Table 8.

An examination of the table shows that the largest part of the salts are chlorides, especially when much salt is present. The estimation of the chlorine, which can be readily and rapidly carried out, thus offers a quick method for estimating the quantities of salts present.

Citrus trees seem to be injured by about 600 parts per million of saline salts (see analyses 30898, 33773, and 31744). This is a comparatively small amount.

Soil irrigated with salty water is converted into a salty soil. Soils 31750-1 before irrigation may be compared with soils 31744-9, inclusive, after irrigation with salty water. The salty water caused salt to accumulate in these soils.

Soils along a salty resaca may contain salt layers of subsoil, 90 feet or more from the resaca. This is shown by analyses 31756-61, inclusive. The samples were taken approximately at the level of the water of the resaca. The water of the resaca has penetrated into the soil, evaporated, and left a highly salty layer, at depths of 3 to 6 feet under the surface. This is much too salty to allow roots of trees to penetrate. Under irrigation, the salt is likely to rise to the surface, and accumulate sufficiently to destroy vegetation. The salt can be prevented from rising only if the irrigation water passes through the soil and out in the subsoil in sufficient amounts to keep the salts washed out and prevent them from accumulating.

Seepage of water from irrigation canals may produce a high water table and give rise to saline soils.

Table 6.—Interpretation of analyses of surface soils of Cameron County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Cameron clay	28	50	94	good	good	high
Harlingen clay	33	50	219	good	good	high
Laredo clay	53	50	196	good	good	high
Laredo fine sandy loam	28	55	144	good	good	high
Laredo loam	28	50	196	good	good	high
Laredo silty clay loam	43	60	219	good	good	high
Lomalta clay	23	30	84	good	good	high
Point Isabel clay	18	50	105	good	good	high
Rio Grande clay	48	50	226	good	good	high
Rio Grande silty clay loam	28	30	144	good	good	high
Rio Grande very fine sandy loam	18	30	125	good	good	high
Liocano clay		65	294	good	good	high
Victoria clay loam	38	55	273	good	good	good
Victoria fine sandy loam	28	50	239	good	good	good
Victoria sandy clay loam	38	60	125	good	good	good

Table 7.—Pot experiments on soils of Cameron County

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
982	Cameron clay—subsoil—corn, 1st crop	50.9	30.4	26.1	41.1	....	....	....
982	Cameron clay—subsoil—mustard, 2nd crop	8.1	5.1	8.1	6.8	....	....	....
982	Cameron clay—subsoil—sorghum, 3rd crop	26.5	22.7	14.8	....	....	....	....
982	Cameron clay—subsoil—corn, 4th crop	6.2	13.9	....	....	....	....	....
982	Cameron clay—subsoil—sorghum, 5th crop	21.0	13.0	....	....	....	....	....
982	Cameron clay—subsoil—corn, 6th crop	33.8	4.8	....	....	....	....	....
982	Cameron clay—subsoil—sorghum, 7th crop	26.2	6.2	....	....	....	....	....
9044	Harlingen clay—surface—corn, 1st crop	30.0	30.9	32.4	31.1	142	65	785
9044	Harlingen clay— urface—sorghum, 2nd crop	19.6	24.7	27.0	28.2	63	59	353
9045	Harlingen clay—subsoil—corn, 1st crop	9.8	....	....	13.5	....	....	288
9045	Harlingen clay—subsoil—sorghum, 2nd crop	38.2	....	....	40.2	....	....	320
9045	Harlingen clay—subsoil—corn, 3rd crop	32.2	....	....	38.4	....	....	450
9045	Harlingen clay—subsoil—sorghum, 4th crop	39.7	....	....	37.4	....	....	293
9045	Harlingen clay—subsoil—cotton, 5th crop	39.0	....	....	36.5	....	....	359
21781	Harlingen clay—surface—corn, 1st crop	30.4	24.3	28.0	25.0	47	56	451
21781	Harlingen clay—surface—sorghum, 2nd crop	26.5	7.0	28.4	29.2	27	45	299
21782	Haringen clay—subsoil—corn, 1st crop	11.5	....	3.4	....	....	8	45
21782	Harlingen clay—subsoil—sorghum, 2nd crop	1.0	....	2.9	....	....	7	....
21773	Laredo silty clay loam—surface—corn, 1st crop	27.7	19.7	21.2	33.2	62	49	695
21773	Laredo silty clay loam—surface—sorghum, 2nd crop	29.8	13.3	25.6	34.8	22	44	404
21774	Laredo silty clay loam—subsoil—corn, 1st crop	10.4	8.0	4.1	22.1	24	7	....
21774	Laredo silty clay loam—subsoil—sorghum, 2nd crop	25.7	3.3	7.8	25.7	7	14	187
21777	Rio Grande silty clay loam—surface—corn, 1st crop	20.9	18.2	20.4	27.5	45	31	463
21777	Rio Grande silty clay loam—surface—sorghum, 2nd crop	25.9	7.2	20.2	29.7	17	27	292
21778	Rio Grande silty clay loam—subsoil—corn, 1st crop	11.0	4.0	5.0	12.6	22	7	194
21778	Rio Grande silty clay loam—subsoil—sorghum, 2nd crop	11.5	4.0	7.7	10.2	10	13	70
963	Rio Grande silty clay loam—subsoil—sorn, 1st crop	22.9	21.7	....	....	....	....	....
963	Rio Grande silty clay loam—subsoil—sorghum, 2nd crop	36.7	7.0	....	....	....	....	....
963	Rio Grande silty clay loam—subsoil—corn, 3rd crop	39.2	7.5	....	....	....	....	....
963	Rio Grande silty clay loam—subsoil—sorghum, 4th crop	34.7	2.5	....	....	....	....	....
21779	Victoria clay loam—surface—corn, 1st crop	49.0	45.0	46.6	47.4	103	136	1204
21779	Victoria clay loam—surface—sorghum, 2nd crop	35.5	23.5	29.2	26.9	58	93	275
21780	Victoria clay loam—subsoil—corn, 1st crop	19.6	16.9	16.5	26.5	26	29	443
21780	Victoria clay loam—subsoil—sorghum, 2nd crop	20.5	2.0	18.9	29.7	5	27	249
25779	Victoria clay loam—surface—corn, 1st crop	26.5	11.4	24.8	29.5	19	54	635
25779	Victoria clay loam—surface—kafir, 2nd crop	34.9	6.3	34.2	33.4	13	51	440
25779	Victoria clay loam—surface—cotton, 3rd crop	22.7	21.5	21.0	13.0	31	64	304
25780	Victoria clay loam—subsoil—corn, 1st crop	25.7	10.6	9.5	26.0	17	18	35
25780	Victoria clay loam—subsoil—kafir, 2nd crop	36.5	14.3	31.0	4.4	8	25	335
25780	Victoria clay loam—subsoil—cotton, 3rd crop	18.5	....	16.4	17.5	....	41	....
25781	Victoria fine sandy loam—surface— orn, 1st crop	29.2	30.9	29.3	29.5	67	66	826
25781	Victoria fine sandy loam—surface—kafir, 2nd crop	46.5	12.0	43.5	43.0	24	60	525
25781	Victoria fine sandy loam—surface—cotton, 3rd crop	22.0	....	20.1	21.0	....	66	339
25782	Victoria fine sandy loam—subsoil—corn, 1st crop	24.3	20.1	18.7	31.2	35	30	643
25782	Victoria fine sandy loam—subsoil—kafir, 2nd crop	43.1	5.2	26.5	42.4	10	28	420
25782	Victoria fine sandy loam—subsoil—cotton, 3rd [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 8.—Composition of saline spots in soils of Cameron County, in parts per million

Analysis Number		Depth, inches	Calc. Carb.	Calc. Sulp.	Calc. Chlor.	Mag. Carb.	Mag. Sulp.	Mag. Chlor.	Sod. Carb.	Sod. Sulp.	Sod. Chlor.
12746		0–12	250	49	61			48			572
12747		0–12	241			7	98			97	85
21051	Laredo silty clay loam	0–12	169	819	2910			1046			6637
24734	Donna clay	0–12	480	138	1828			239			
24735	Hidalgo clay	0–12	320	65			95			15	371
30898	Citrus trees died	0–12	205	196	55			128			414
31733		6–12	485	192	18			111			74
31734		12–18	500	270	69			106			
31856		0–12	225			75			106	464	277
31857		12–18	252			48			117	250	178
33773	Citrus trees died	0– 7	187			67			19	195	256
33774		7–19	195			29	72			208	231
31744	Irrigated with salty water. Citrus chlorotic	0–12	270	258			138	35			650
31745	Irrigated with salty water. Citrus chlorotic	12–24	275	226			131	33			426
31746	Irrigated with salty water. Citrus chlorotic	0–12	238	352			146	7			818
31747	Irrigated with salty water. Citrus chlorotic	12–24	323			46	36			348	450
31748	Irrigated with salty water. Citrus chlorotic	0–12	350	83			128			213	574
31749	Irrigated with salty water. Citrus chlorotic	12–24	350			65			38	515	586
31750	Not irrigated	0–12	258	65	20			196			
31751		12–24	380	97	61			106			
31756	90 feet from salty resaca	36–48	235	1258			956	50			5942
31757	90 feet from salty resaca	48–60	195	1161			671	267			5405
31758	90 feet from salty resaca	60–72	185	1577			645	394			4899
31759	Near salty resaca	36–48	175	683			422	194			4960
31760		48–60	188	690			503	109			4858
31761		60–72	205	364			489			320	4455

Classification of Soils of Cameron County

Coast Plain Soils. Surface soil, ashy-brown to dark-brown. Subsoil, below 10 inches ashy-gray clay. Lomalto series.

Surface soil, ashy-brown to brownish-ashy-gray, thin layers of ashy-gray sandy clay and yellowish-brown sandy loam, but not much change to 10 feet or more. Point Isabel series.

Rio Grande Delta Soils (Alluvial Soils). Surface soil, ashy-gray color to 3 or 4 inches. Subsoil, below 4 inches dark gray plastic clay. Harlingen series.

Surface soil, brown-slightly lighter subsurface layer and below this pale brownish-yellow subsoil. Laredo series.

Surface soil, very dark-brown or nearly black. Subsoil, brownish-yellow containing whitish lime concretions. Cameron series.

Surface soil, light-brown to brown. Subsoil, layers of light-brownish-yellow, lighter textured material interstratified with heavier textured layers of heavier material. Subject to overflow. Rio Grande series.

Upland Soils. Surface soil, very dark-brown to black. Subsoil, at 12-14 inches lighter-colored and at 20-24 inches a yellowish-brown. Victoria series.

Surface soil, dark ashy-gray clay extending to 3 or 4 feet without change. Very tough when dry and plastic when wet. Tiocano series.

Condensed Description of Soils of Cameron County

Cameron clay is a nearly black clay, ashy-gray when dry, below which is a dark-brown clay, grading into yellowish-brown silty clay loam or silty clay and this into a sticky, plastic brownish-yellow or light yellowish-brown clay. It occurs in large areas south of the Arroyo Colorado. The surface has a gentle slope, with poor drainage. A very small proportion is under cultivation to cotton and corn.

Harlingen clay is ashy-gray to dark ashy-gray clay which passes into lighter ashy-gray, plastic, sticky clay. It is extensive. The surface is flat to nearly level, and the drainage is imperfect. In some places the water table is only two feet below the surface. About 20 per cent is under cultivation, chiefly to cotton and corn. Citrus fruit tried has not done well.

Laredo clay is a brown clay which passes into yellowish-brown stiff clay containing white lime material, then into yellowish-brown friable silty clay loam succeeded by yellowish-brown friable very fine sand. It occupies only small areas, the largest of which is southeast of San Benito. The surface is very gently undulating and the surface drainage and underdrainage are fair to good, where not retarded by seepage water. About 5 per cent of the soil is under cultivation, chiefly to cotton, corn, and cabbage. Under irrigation, a large acreage has become impregnated with water-soluble salts. There is also a deep phase, about 25 per cent of which is cultivated to cotton, cabbage, lettuce, corn, and citrus fruit.

Laredo fine sandy loam is a brown to dark-brown fine sandy loam, grading into lighter-brown fine sandy loam, below which is yellowish-brown fine sand or loamy fine sand. It occurs in small areas south of the Arroyo Colorado. Its surface is very gently undulating to billowy with good drainage. About 25 per cent of the soil is under cultivation to cotton, corn, and citrus fruit, with some vegetables. An excess of irrigation water sometimes accumulates in the subsoil because of inadequate drainage outlets. Owing to the open texture and structure of this soil, artificial drainage should be comparatively easy and work efficiently.

Laredo silty clay loam is of a brown heavy silty clay loam passing into slightly lighter brown silty clay, which grades into grayish-yellow or pale brownish-yellow, friable or rather chalky silty clay loam. Below this is a pale brownish-yellow very fine sand, passing into brownish-yellow silty clay loam, which is underlain by dark-brown clay. It occupies a position higher than the adjacent soils. The surface is smooth with a gentle slope and good drainage, but it is subject to "subbing" and consequent injury by accumulation of alkali salts. The principal crops are cotton, cabbage, lettuce, and citrus fruit, with a small acreage devoted to all the other crops.

Lomalto clay is of dark-brown clay, grading into brownish ashy-gray, tough plastic clay. This passes into yellowish-brown, tough, plastic clay, containing some whitish concretions. It is of wide extent on nearly all of the coastal prairie section in the eastern part of the county. The surface is flat and level, there is practically no drainage, and the soil is wet through the greater part of the year. It is utilized for pasture only.

Point Isabel clay is an ashy-gray clay with a decidedly brownish cast immediately below the surface. It occurs in the coastal prairie country as clay dunes in the eastern part of the county. The surface is ridge-like. The surface drainage is excessive but underdrainage is slow. None of it is under cultivation.

Rio Grande clay is a brown silty clay. It occurs as small areas in first bottoms of the Rio Grande. The surface is flat to slightly depressed. Drainage is good. The greater part is under cultivation to cotton and corn.

Rio Grande silty clay loam is light-brown silty clay loam, passing into light-brown to grayish-yellow very fine sand or very fine sandy loam. It is the chief type in the first bottoms of the Rio Grande. The surface is flat and nearly level. The drainage is good. The water table usually stands at about the average level of water in the river. The land is subject to overflows except where protected by levees. The greater part is under cultivation, mainly to cotton, corn, potatoes, and vegetables.

Rio Grande very fine sandy loam is yellowish-brown to grayish-yellow very fine sandy loam, underlain by pale-yellow or yellowish-gray very fine sandy loam. The area is very small. The drainage is good. It is used for potatoes, cotton, corn, and vegetables.

Tiocano clay is a dark ashy-gray to black clay. When dry the soil is extremely tough, and when wet it is very sticky and plastic. It occurs chiefly in small areas in the region occupied by the Victoria soils. The surface is flat and the drainage very poor. It is used only for pasture.

Victoria clay loam is very dark brown clay loam or heavy clay loam with an ashy-gray cast, which passes into ashy-gray or dark ashy-gray stiff clay, below which is dark yellowish-brown stiff clay. When wet the soil is almost black. This is an extensive soil, principally in the section north of the Arroyo Colorado. The surface is flat, and the surface drainage is poor. The underdrainage is good in most places. This is one of the most important agricultural soils of the region, cultivated chiefly in cotton, corn, citrus fruits, potatoes, and cabbage.

Victoria fine sandy loam is a dark grayish-brown to dark-brown fine sand or fine sandy loam below which is a yellowish-brown fine sandy clay. It occurs chiefly north of the Arroyo Colorado. The surface is very gently undulating. The drainage is good. It is considered locally to be the best citrus-fruit soil in the county. Cotton is also grown.

Victoria sandy clay loam is a dark-brown sandy clay loam below which is a yellowish-brown or cream-colored, highly calcareous clay loam to clay. It occurs almost entirely north of the Arroyo Colorado. It has a flat to gently undulating surface. The surface and internal drainage are fair to good. About 5 per cent of the type is under cultivation to cotton, corn, citrus fruit, and a small acreage of vegetables; the remainder is used for pasture.

SOILS OF COLEMAN COUNTY

Coleman county is located in the Rolling Plains, near the geographical center of Texas. Eighteen types, in nine series, are mapped in this county. The upland soils are included in the Valera, Crawford, Windthorst, and Vernon series. The Abilene, Roscoe, and Miles soils occur in smooth nearly flat to undulating areas. The first-bottom soils are in the Frio and Yahola series. The Abilene clay occupies 42.8 per cent of the area, the Valera stony loam 27.4 per cent, the Valera clay 6.4 per cent, and the Frio clay 5.5 per cent.

Composition of Soils. The chemical composition of the soils is given in Table 9 and the interpretation of the analyses in Table 10. The

Table 9.—Analyses of soils of Coleman County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Abilene clay........................	.185	.077	172	1.14	.65	771	2.30	3.70	7.5	0–6
Abilene clay........................	.160	.073	124	1.06	.61	659	3.11	5.15	7.3	6–12
Abilene clay........................	.099	.068	11	1.00	.55	130	7.85	13.80	7.6	12–33
Abilene clay loam..................	.115	.062	71	1.14	.60	448	1.09	1.88	7.3	Surface
Abilene clay loam..................	.104	.056	33	1.07	.58	320	3.75	5.69	7.3	Subsoil
Abilene clay loam..................	.081	.035	9	1.14	.54	217	.68	5.86	7.4	Deep Subsoil
Crawford clay......................	.165	.078	11	1.44	.47	750	.48	.93	6.9	0–6
Crawford clay......................	.109	.066	8	1.74	.77	460	.75	1.20	7.0	6–36
Frio clay..........................	.133	.139	459	2.54	1.03	171	1.86	3.46	7.6	0–8
Frio clay..........................	.081	.114	81	2.22	.82	166	6.54	9.80	7.4	8–36
Frio clay loam.....................	.094	.081	305	1.40	.48	434	1.84	3.05	7.4	0–12
Frio clay loam.....................	.068	.076	207	1.18	.42	222	5.84	9.10	7.7	Subsoil
Frio fine sandy loam...............	.069	.022	13	.96	.37	229	.62	1.02	7.2	0–6
Frio fine sandy loam...............	.063	.022	20	1.09	.36	86	3.02	3.80	7.3	6–30
Miles clay loam....................	.099	.045	17	1.29	.64	384	.76	1.40	7.5	Surface
Miles clay loam....................	.080	.039	18	1.58	.59	291	2.43	3.55	7.6	Subsoil
Miles fine sandy loam..............	.049	.028	18	1.46	.24	201	.29	.35	7.0	0–15
Miles fine sandy loam..............	.033	.027	19	1.39	.48	71	.36	1.10	....	15–36
Roscoe clay........................	.131	.051	95	1.04	.51	603	1.20	10.00	7.5	0–8
Roscoe clay........................	.056	.045	112	1.05	.51	306	3.97	6.25	7.6	8–
Valera clay........................	.177	.074	36	1.30	.55	438	7.97	6.48	7.3	Surface
Valera clay........................	.091	.044	18	1.43	.44	284	12.61	8.18	7.7	Subsoil
Vernon stony clay..................	.145	.090	30	1.17	.27	109	16.38	29.95	7.6	0–6
Vernon stony clay..................	.054	.056	50	1.76	.29	87	12.59	24.10	7.7	Subsoil
Windthorst fine sandy loam.........	.064	.033	35	.72	.22	253	.29	.45	7.3	0–8
Windthorst fine sandy loam.........	.056	.036	13	.99	.44	260	.40	.65	6.8	8–
Windthorst stony fine sandy loam....	.077	.055	14	.99	.25	72	16.61	31.56	7.6	0–7
Windthorst stony fine sandy loam....	.041	.026	7	.50	.14	98	4.58	7.03	7.4	Subsoil
Yahola fine sandy loam.............	.064	.080	338	1.44	.40	423	2.64	4.57	7.7	Surface
Yahola fine sandy loam.............	.038	.074	260	1.34	.37	145	5.66	9.19	7.7	Subsoil
Yahola silty clay loam.............	.136	.120	150	1.60	.58	403	7.05	13.60	7.6	0–12
Yahola silty clay loam.............	.063	.089	366	1.41	.36	248	4.91	8.50	7.6	12–36

upland soils, on an average, are low in active phosphoric acid, somewhat better supplied with nitrogen, and still better with active potash. These upland soils will probably need nitrogen and phosphoric acid first, and potash last. The terrace and first-bottom land are better supplied with plant food of all kinds than the upland soils, and should be more productive and durable. They will probably need nitrogen first, phosphoric acid second, and potash last. None of the soils of Coleman county are acid and none of them seem to need lime for legumes or other crops. There are many of them which are high in lime.

Pot Experiments. The results of some pot experiments are in Table 11. The plants respond to applications of nitrogen and phosphoric acid but not to potash.

Fertilizers. The supply of moisture is probably the controlling factor in the production of crops in this section. Fertilizers containing nitrogen and phosphoric acid may be tried, but in the absence of field experiments they cannot, at present, be recommended for general use. They would probably give results on some of the upland soils under favorable seasonal conditions.

Lime. The use of lime is not recommended, since the soils are not acid and many are high in lime.

Saline Soils. The composition of some salty soils is given in Table 12. Chlorides predominate. Comparison with the salts in a dead spot from Wise county shows that the quantity of alkali is sufficient to be dangerous.

Classification of Soil Types of Coleman County

Bottom-land Soils. Surface soil, brown to rusty black. Subsoil, brown to dark-brown color. Soil is calcareous. Frio series.

Surface soil, calcareous, purplish-red to reddish-brown. Subsoil, lighter-textured, purplish-red or light purplish-red, calcareous. Yahola series.

Upland Soils. Surface soil, brown to dark-brown. Subsoil, brown to brownish-yellow, generally calcareous. Valera series.

Surface soil, red, dark-brownish-red or reddish-brown. Subsoil, stiff red or reddish-brown clay. Crawford series.

Surface soil, sandy with grayish-brown to reddish-brown color. Subsoil, stiff red clay in some places mottled with yellow. Not calcareous. Windthorst series.

Surface soil, brown to chocolate-brown. Subsoil, brown becoming lighter in the lower part. Soil is not calcareous. Abilene series.

Surface soil, purplish-red to reddish-brown. Subsoil, of a similar color but stiffer in texture. Soil not calcareous but subsoil is generally so. Vernon series.

Table 10.—Interpretation of analyses of surface soils of Coleman County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Abilene clay	53	45	273	good	good	high
Abilene clay loam	33	35	188	good	good	good
Crawford clay	48	12	268	good	good	good
Frio clay	38	55	84	good	low	high
Frio clay loam	28	50	188	good	good	good
Frio fine sandy loam	23	12	115	low	good	good
Miles clay loam	28	12	171	good	good	good
Miles fine sandy loam	18	12	105	low	good	good
Roscoe clay	38	40	239	good	good	good
Valera clay	48	24	188	good	good	high
Vernon stony clay	43	18	61	good	good	high
Windthorst fine sandy loam	23	24	125	good	good	good
Windthorst stony fine sandy loam	23	12	38	good	good	high
Yahola fine sandy loam	23	50	180	good	good	high
Yahola silty clay loam	38	45	180	good	good	high

Table 11.—Pot experiments on soils of Coleman County

Lab. No.	Type name	Weight crops in grams				Corn possibiity of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
20196	Abilene clay loam—surface—corn, 1st crop	37.0	29.7	23.5	32.2	123	80	651
20196	Abilene clay loam—surface—sorghum, 2nd crop	31.5	19.5	20.3	25.5	37	51	279
20196	Abilene clay loam—surface—cotton, 3rd crop	27.4	....	31.4	....	....	97	....
20197	Abilene clay loam—subsoil—corn, 1st crop	19.7	18.2	9.9	14.0	50	18	279
20197	Abilene clay loam—subsoil—sorghum, 2nd crop	27.1	6.4	21.7	24.8	12	27	268
20197	Abilene clay loam—subsoil—cotton, 3rd crop	23.7	....	20.2	....	....	32	....
20198	Abilene clay loam—subsoil—corn, 1st crop	8.2	10.5	5.4	16.2	40	9	314
20198	Abilene clay loam—subsoil—sorghum, 2nd crop	22.0	4.6	10.0	25.2	9	13	206
20198	Abilene clay loam—subsoil—cotton, 3rd crop	21.1	....	7.2	....	....	9	....
20542	Frio clay—surface—corn, 1st crop	30.2	19.3	22.1	31.2	30	42	486
20542	Frio clay—surface—kafir, 2nd crop	35.0	3.1	38.9	41.7	7	46	356
20542	Frio clay—surface—cotton, 3rd crop	26.2	....	....	25.9	....	....	239
20542	Frio clay—surface—cowpeas, 4th crop	49.1	....	....	49.1	....	....	905
20543	Frio clay—subsoil—corn, 1st crop	8.9	8.4	4.5	9.9	20	7	168
20543	Frio clay—subsoil—kafir, 2nd crop	18.6	4.0	18.5	25.7	45	26	232
20543	Frio clay—subsoil—cotton, 3rd crop	15.5	....	....	15.8	....	....	169
20543	Frio clay—subsoil—cowpeas, 4th crop	20.0	....	....	19.9	....	....	358
20544	Miles fine sandy loam—surface—corn, 1st crop	38.5	12.1	13.2	41.5	18	22	334
20544	Miles fine sandy loam—surface—sorghum, 2nd crop	26.6	5.3	23.3	25.0	14	26	167

Table 12.—Composition of saline spots in soils of Coleman and Wise Counties, in parts per million

Analysis Number		Depth, inches	Calc. Carb.	Calc. Sulp.	Calc. Chlor.	Mag. Carb.	Mag. Sulp.	Mag. Chlor.	Sod. Carb.	Sod. Sulp.	Sod. Chlor.
20305	Coleman County	0–7	188	233	519	....	....	85	....	....	523
20306	....	7–19	225	262	230	....	....	85	....	....	493
20836	Wise County, dead spot	0–7	275	1030	....	....	210	....	....	285	835
20837	....	7–19	240	....	....	70	....	....	180	390	315

Surface soil, black. Subsoil, dark brown to dark-ashy-gray. Roscoe series.

Surface soil, reddish-brown to purplish-red. Subsoil, red or purplish-red. Soil not calcareous. Miles series.

Condensed Description of Soils of Coleman County

Abilene clay is a brown to dark-brown clay, which grades into lighter-brown, chocolate-brown or buff-colored clay ranging from moderately friable to fairly stiff. It occupies terrace-like areas with nearly level to undulating surface and fair to good drainage. It is a strong, productive soil, plastic when wet with a tendency to clod if plowed when too wet or too dry, but breaks up on exposure and forms a good tilth. Wheat, oats, milo, kafir, feterita, corn, cotton, Sudan grass, and Johnson grass are grown.

Abilene clay loam is a brown, dark-brown or chocolate-brown clay loam, underlain by brown or chocolate-brown clay, which becomes slightly lighter in color with depth. It occurs upon the outwash and terrace plains of the county, in small areas. It has a gently sloping to undulating surface, with slightly excessive drainage. About one-half of the type is under cultivation to wheat, oats, grain sorghums, corn, cotton, and Sudan grass.

Crawford clay is reddish-brown or brownish-red clay, passing into stiff, red clay, underlain usually by limestone at about 15 to 36 inches. It occurs on the upland in small areas. Most of the type is under cultivation to wheat, oats, and cotton.

Crawford stony clay is reddish-brown or brownish-red clay underlain by rock at a very shallow depth and with limestone fragments strewn abundantly over the surface. The acreage is small. It is valuable only for pasture.

Frio clay is brown to dark-brown, rather silty clay, which passes into somewhat stiffer clay of light-brown to yellowish-brown color. It is highly calcareous. It is an important soil. It occurs in the first bottoms of the larger streams and is subject to overflow. The surface is flat but fairly well drained. A large part is under cultivation to corn and cotton, Johnson grass, Sudan grass, and the sorghums. It is adapted to pecans.

Frio clay loam is a brown to dark-brown clay loam, ranging to a silty clay loam, passing into brown or light-brown clay loam or clay. The total area is not large; chiefly along Jim New and Hords Creeks. In first-bottom positions subject to overflow the surface is nearly level but the drainage is good. About 50 per cent is under cultivation. It is adapted to the same crops as the Frio clay.

Frio fine sandy loam is grayish-brown, brown or dark-brown, heavy fine sandy loam to fine sandy loam, overlying grayish-brown, brown or light-brown clay loam to clay. It occupies narrow strips in the first bottoms of drainage ways and is subject to overflow. Some of the type is under cultivation, chiefly to cotton and corn.

Miles clay loam is reddish-brown clay loam, grading into reddish-brown, fairly stiff clay or clay loam. The surface ranges from nearly level to slightly sloping or undulating with good drainage. It is found in many parts of the county, and the total area is considerable. The greater part is under cultivation to oats, wheat, grain sorghums, corn, and cotton.

Miles fine sandy loam is light-brown, grayish-brown, or reddish-brown loamy fine sand to fine sandy loam, underlain by a thin layer of red clay loam or fine sandy clay loam, before passing into the subsoil proper, which consists of red to dull-red, or sometimes dark-red clay loam to clay, generally fairly stiff. It has a nearly level to gently undulating surface with good drainage. The greater part occurs in the northern half of the county. Most of it is under cultivation to milo, kafir, corn, cotton, oats, peanuts, watermelons, and cantaloupes. The soil is well adapted to the growing of peaches and of vegetables; pears, apples, blackberries and dewberries appear to do well.

Miles sandy loam is a reddish-brown to brownish-red or light purplish-red, slightly loamy sand to light sandy loam, which grades into red or purplish-red friable sandy clay loam to sandy clay, passing quickly into clay loam. It occupies a small area on a high terrace of the Colorado River. The topography is undulating to gently rolling. Drainage is good. It is adapted to the same general crops as the Miles fine sandy loam. The soil drifts somewhat during dry spells.

Roscoe clay is very dark-brown to dark-gray or black clay, which in places extends without change to depths of 36 inches; usually slightly lighter in color in the lower portions. It occupies smooth, nearly flat areas. Drainage is restricted by the flat surface and the heavy subsoil. The total area is not large. It occurs mainly about the heads of streams and along the channels of sluggish drainage ways. Small grains are inclined to lodge, especially in wet seasons. Corn, cotton, and the grain sorghums do well.

Valera clay is brown, chocolate-brown, or dark-brown clay, grading into brown, light-brown, or chocolate-brown, rather stiff clay. When wet the soil is sticky and plastic, but on drying out it assumes a friable, crumbly character. It occurs on the true uplands. The chief areas lie southwest of Coleman. The surface varies from nearly level to gently undulating. The drainage is fair to good. While it is of small extent, it is an important agricultural soil, and the major part is under cultivation to the small grains, corn, the grain sorghums, and cotton.

Valera stony clay is the same as Valera clay except that large and small fragments of hard and soft limestone and chert are on the surface to such extent to make agricultural utilization impossible. This is an upland soil of large extent.

Vernon stony clay is chocolate-reddish-brown to dark-brownish-red clay, underlain by purplish-red clay, containing stones. The greater part is in the vicinity of Red Bank School. It is used only for grazing.

Windthorst fine sandy loam is grayish to reddish-brown fine sandy loam to loamy fine sand, underlain by red, stiff clay, with some yellow mottling. The surface is nearly level to gently rolling. Drainage is good. This type is scattered in small areas over the eastern part of the county. Cotton, corn, and peanuts are the leading crops grown.

Windthorst stony fine sandy loam is a grayish-brown to reddish-brown fine sandy loam to loamy fine sand, heavily covered with small, large and even massive, fragments of reddish sandstone. This passes into a thin layer of red clay loam, and this into red, stiff clay, which rests upon rock at a depth of less than three feet. The surface is rolling to hilly, and drainage is good to excessive. The type has no value for farm crops, its chief value being for grazing.

Yahola fine sandy loam is a purplish-red to dark reddish-brown fine sandy loam, grading into light-reddish-brown or light-purplish-red fine sandy loam, which passes into a light-reddish-brown to purplish-red loamy fine sand. It occupies first bottoms in the Colorado River and is liable to overflow. The surface is nearly level to gently sloping, and the drainage is good. The type retains moisture for a long time after the heavier types have become drouthy. At least half of it is under cultivation to cotton, chiefly, but also corn, and the grain sorghums.

Yahola silty clay loam is reddish-brown to chocolate-brownish-red silty clay loam, underlain by purplish-red or light-purplish-red fine sandy loam or very fine sandy loam. It occurs in narrow strips in the bottoms of the Colorado River and is subject to frequent overflow. It is used for pasture.

SOILS OF DALLAS COUNTY

Nineteen types of soil were mapped in Dallas county, grouped in 13 series. The upland soils are classed as the Houston and Ellis series. The terrace soils include the Bell and Lewisville series, which are high in lime, and the Cahaba, Amite, Kalmia, Leaf, and Irving series, which are low in lime. The alluvial or first-bottom soils include the Trinity, Catalpa, Frio, and Ochlockonee series. The Houston black clay is the most extensive soil and occupies 24.5 per cent of the county. The Houston clay covers 16.2 per cent, the Trinity clay 15.3 per cent, the Bell clay 9.3 per cent, and the Cahaba fine sandy loam 4.6 per cent of the county.

Table 13.—Analyses of soils of Dallas County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Bell clay	.137	.094	210	1.04	.62	297	3.17	5.19	7.3	Surface
Bell clay	.088	.088	129	.82	.56	125	5.33	7.48	7.7	Subsoil
Cahaba fine sandy loam	.035	.038	39	.63	.12	83	.18	.27	7.1	Surface
Cahaba fine sandy loam	.027	.033	52	.68	.21	116	1.53	.33	7.2	Subsoil
Cahaba fine sandy loam	.039	.047	14	1.00	.31	128	.27	.37	6.7	Deep Subsoil
Catalpa clay	.157	.130	90	1.38	.64	200	8.31	14.70	7.4	0–12
Catalpa clay	.105	.115	92	1.41	.56	49	9.48	16.70	7.4	12–36
Ellis clay	.157	.086	13	2.28	1.14	406	1.14	5.89	6.6	0–8
Ellis clay	.081	.088	102	2.26	1.14	256	....	4.00	7.1	Subsoil
Frio clay	.215	.158	157	1.43	.72	344	8.47	15.00	7.1	0–12
Frio clay	.120	.122	31	1.23	.65	114	7.20	9.59	7.3	12–36
Houston clay	.299	.183	280	1.74	.85	514	4.65	5.46	7.9	0–8
Houston black clay	.120	.109	98	.75	.49	295	10.18	5.23	7.3	Surface
Houston black clay	.084	.106	104	.88	.47	119	23.99	6.74	7.2	Subsoil
Irving clay	.120	.041	28	.84	.27	206	.94	1.41	7.0	0–12
Irving clay	.053	.029	21	.80	.21	129	.81	.92	7.1	12–36
Irving silt loam	.057	.029	28	.56	.19	121	.31	1.68	6.2	0–8
Irving silt loam	.033	.023	13	.76	.32	71	.62	2.90	....	8–24
Irving clay	.082	.045	54	....	.33	102	1.03	1.12	7.1	0–12
Irving clay	.054	.039	53	1.09	.32	79	1.03	1.82	7.3	12–36
Leaf fine sandy loam	.059	.033	24	.48	.09	57	.26	.40	7.1	Surface
Leaf fine sandy loam	.033	.033	9	.54	.24	125	.41	.68	7.0	8–19
Leaf fine sandy loam	.033	.024	11	.81	.32	119	.32	.50	5.7	Deep Subsoil
Lewisville clay	.185	.130	151	1.62	.92	352	5.03	3.89	7.4	Surface
Lewisville clay	.091	.250	94	1.33	.54	96	23.02	5.08	7.6	Subsoil
Trinity clay	.150	.132	94	1.10	.74	369	9.23	8.50	7.2	Surface
Trinity clay	.099	.116	74	1.28	.62	123	10.41	7.04	7.3	Subsoil

Composition of Soils. The analyses of the various soil types are given in Table 13 and the interpretation of the analyses in Table 14. The soils of Dallas county are in general well supplied in plant food with the exception of some of the terrace soils low in lime, which are low in phosphoric acid and nitrogen. These include the Cahaba fine sandy loam, the Irving clay, Irving silt loam, and the Leaf fine sandy loam. The Houston black clay, which is the typical black prairie soil, is well supplied with plant food. None of the soils are acid and many of them are high in lime.

Pot Experiments. Pot experiments with soils of Dallas county are given in Table 15. Responses in plant growth to additions of phosphoric acid and of nitrogen are made by a number of the samples of soils, including the Bell clay, Cahaba fine sandy loam, Houston black clay, and Irving clay. These experiments indicate that the soils would respond to these fertilizers in the field if other conditions (such as moisture) did not limit the growth to less than the amount which can be produced by the plant food in the soil. If these limiting conditions could be removed, the Houston black clay, to judge from the pot experiments, would respond to fertilizers. As previously pointed out, the plants grown in the pot experiments may show deficiencies in the soil which are not so apparent in the field, on account of the more favorable conditions for plant growth in the pot experiments.

Fertilizers. Commercial fertilizers are probably needed by the Cahaba fine sandy loam, the Irving clay, Irving silt loam, and Leaf fine sandy loam. The other soils may not respond well to fertilizer until they have been under cultivation for some time. The Houston black clay usually does not respond to fertilizers, even when cultivated so long that yields are low, probably on account of other limiting conditions.

Lime. The soils are not acid and there seems to be no need for lime at the present time. Many of the soils contain large percentages of lime, but some of the terrace soils contain only moderate amounts.

Classification of the Soil Series

Bottom-land Soils. Surface soil, dark-brown to black. Subsoil, is similar in color and texture. Soil is calcareous. Trinity series.

Surface soil, brown. Subsoil, a little lighter in color. Soils calcareous. Catalpa series.

Surface soil, grayish-brown or brown. Subsoil, lighter in color. Soil strongly calcareous. Frio series.

Surface soil, grayish-brown to brown. Subsoil, brown to yellow. Soil not calcareous. Ochlockonee series.

Upland Soils. Surface soil, grayish to brownish; subsurface soil, brown to yellow; Subsoil, red. Cahaba series.

Table 14—Interpretation of analyses of surface soils of Dallas County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Bell clay	38	50	135	good	good	high
Cahaba fine sandy loam	13	24	50	fair	fair	fair
Catalpa clay	43	40	94	good	good	high
Ellis clay	43	12	180	good	good	good
Frio clay	58	45	154	good	good	high
Houston clay	63	50	211	good	good	high
Houston black clay	33	40	135	good	good	high
Irving clay	33	18	105	good	good	good
Irving silt loam	18	18	61	low	good	good
Irving clay	28	30	61	good	good	good
Leaf fine sandy loam	18	18	38	good	low	good
Lewisville clay	53	45	163	good	good	high
Trinity clay	43	40	163	good	good	high

Table 15.—Pot experiments on soils of Dallas County

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
18222	Bell clay—surface—corn, 1st crop	22.8	12.7	14.7	23.3	34	...	392
18222	Bell clay—surface—sorghum, 2nd crop	32.7	26.5	26.0	28.5	76	...	226
18223	Bell clay—surface—corn, 1st crop	18.6	12.9	7.5	18.9	31	...	200
18223	Bell clay—surface—sorghum, 2nd crop	25.0	27.5	15.3	22.0	67	...	143
18216	Cahaba fine sandy loam—surface—corn, 1st crop	37.8	6.9	27.3	22.9	12	44	145
18216	Cahaba fine sandy loam—surface—sorghum, 2nd crop	33.4	5.5	31.8	37.5	11	33	75
18216	Cahaba fine sandy loam—surface—cowpeas, 3rd crop	43.8	...	...	43.8	...	...	203
18217	Cahaba fine sandy loam—subsoil—corn, 1st crop	34.2	...	...	25.5	...	...	200
18217	Cahaba fine sandy loam—subsoil—sorghum, 2nd crop	42.0	...	...	29.2	...	...	133
18217	Cahaba fine sandy loam—subsoil—cowpeas, 3rd crop	36.3	...	...	26.0	...	...	120
18217	Cahaba fine sandy loam—subsoil—cotton, 4th crop	33.5	...	...	33.4	...	...	208
7181	Houston black clay—surface—corn, 1st crop	30.2	...	15.9	...	...	23	...
7181	Houston black clay—surface—sorghum, 2nd crop	17.2	...	11.2	...	...	14	...
7181	Houston black clay—surface—corn, 3rd crop	26.7	...	8.1	...	...	13	...
7181	*Houston black clay*—surface—sorghum, 4th crop	18.2	...	8.2	...	...	9	...
7182	Houston black clay—subsoil—corn, 1st crop	10.0	16.5	...	...	33	...	...
7182	Houston black clay—subsoil—sorghum, 2nd crop	10.3	5.5	...	...	26	...	...
7182	Houston black clay—subsoil—corn, 3rd crop	25.0	7.8	...	...	10	...	...
7182	Houston black clay—subsoil—sorghum, 4th crop	18.0	3.2	...	...	6	...	...
18218	Houston black clay—surface—corn, 1st crop	41.9	25.1	44.0	43.0	50	112	752
18218	Houston black clay—surface—sorghum, 2nd crop	42.2	13.6	42.0	38.5	24	83	316
18219	Houston black clay—subsoil—corn, 1st crop	35.7	...	...	32.9	...	...	232
18219	Houston black clay—subsoil—sorghum, 2nd crop	33.1	...	...	24.0	...	...	114
18219	Houston black clay—subsoil—rice, 3rd crop	29.4	...	...	25.7	...	...	233
23094	Houston black clay—surface—cotton, 1st crop	30.9	23.6	28.7	...	57	196	314
23096	Houston black clay—surface—cotton, 1st crop	23.2	15.9	22.1	...	49	37	...
18224	Irving clay—surface—corn, 1st crop	27.9	13.1	9.1	29.3	24	...	152
18224	Irving clay—surface—sorghum, 2nd crop	33.0	30.0	6.8	32.0	66	...	107
18225	Irving clay—subsoil—corn, 1st crop	28.7	11.0	10.3	23.0	23	...	109
18225	Irving clay—subsoil—sorghum, 2nd crop	16.4	21.0	9.9	21.0	51	...	71
18220	Trinity clay—surface—corn, 1st crop	53.0	31.3	47.3	46.8	56	97	605
18220	Trinity clay—surface—sorghum, 2nd crop	41.3	9.6	35.6	49.3	19	68	454
18221	Trinity clay—subsoil—corn, 1st crop	34.4	...	...	29.4	...	...	256
18221	Trinity clay—subsoil—sorghum, 2nd crop	34.3	...	...	30.1	...	...	148
18221	Trinity clay—subsoil—rice, 3rd crop	37.7	...	...	40.6	...	...	339

Surface soil, brown to reddish-brown or red. Subsoil, red. Amite series.

Surface soil, grayish or brownish. Subsoil yellow. Kalmia series.

Surface soil, grayish-brown or brown; subsurface yellow; gray subsoil. Leaf series.

Surface soil, ashy-gray to black. Subsoil, ashy-gray, dark-gray, or black stiff plastic clay. Irving series.

Surface soil, black subsoil, black or bluish-gray soil and subsoil. Calcareous. Bell series.

Surface soil, brown to dark-brown. Subsoil, light-brown to yellowish-brown. Lewisville series.

Surface soil, black or brown. Subsoil, brown, yellow, grayish or dark-bluish-gray. Soil and subsoil calcareous. Houston series.

Surface soil, brown to greenish-brown. Subsoil, greenish-brown to olive-dusk. Ellis series.

Condensed Description of Soils of Dallas County

Bell clay is black or dark-ashy-gray clay, which either shows but little change in the 3-foot section or passes into ashy-black or dark-ashy-gray clay having a faint bluish cast. It is very sticky when wet, but easily cultivated at the proper time. It is of extensive occurrence in all parts of the county, on old stream terraces high above the stream bottoms. The surface is almost level with poor surface drainage. Nearly all is cultivated.

Cahaba fine sand is a grayish-brown to brownish-gray loamy fine sand grading into yellow loamy fine sand. It occurs in small areas on the low terraces of the Trinity River, West Fork, and Elm Fork bottoms. Nearly all is in cultivation. Cotton, corn, and sorghum are grown but the soil is too light for them. It is well suited to vegetables, peanuts, sweet potatoes, watermelons, and fruit, such as peaches, grapes, plums, and other small fruits.

Cahaba fine sandy loam is a brown, grayish-brown, yellowish-brown, or pale-yellow friable fine sand to loamy fine sand below which is a red to reddish-yellow friable fine sandy clay. It occurs in several areas of more than a square mile in extent around Irving, in the western part of the county. The surface is gently rolling with good drainage. The soil holds moisture well in dry seasons. Most of this soil is in cultivation to cotton, corn, and vegetables.

Catalpa clay is a brown clay passing into light-brown to yellowish-brown or grayish clay. It occurs as bottoms along Mountain Creek and some of its tributaries. The surface is nearly level and the drainage is imperfect. Cotton and corn, with some sorghum, are the main crops.

Chalk represents areas where the chalk—"white rock"—comes to the surface or is covered by not more than 2 or 3 inches of grayish soil. None of this is in cultivation, but is in pasture.

Ellis clay is a brown or slightly greenish-brown, waxy, heavy clay, underlain by greenish-yellow or light-greenish-brown, plastic, sticky (when wet), heavy clay. The surface is very rolling to hilly, and many of the slopes are very steep, and subjected to severe erosion. The soil is mainly used for pasturage.

Frio clay is a brown or grayish-brown silty clay with a subsoil lighter in color. The surface soil crumbles on drying and becomes very mellow and loose with cultivation. The area is small. This is a first-bottom soil. Most of it is cultivated to cotton and corn.

Frio loam is a grayish-brown loam below which is a brown, yellowish-brown, or yellow loam or fine sandy loam or in some places silty clay. It occurs in a few small areas in the western part of the county along the West Fork of the Trinity River and along Denton Creek. The surface is flat and is covered by overflows occasionally, but the drainage is fair. Most of it is under cultivation.

Houston black clay is a very dark-bluish-gray to black clay with dark-bluish-gray or black clay subsoil. It is the most extensive soil type, occurring in large bodies throughout the northern, northeastern, and southern parts of the county. The surface is gently rolling to rolling. The soil holds water well in dry weather. Practically all is in cultivation to cotton, corn, and grain.

Houston clay is a brown or grayish-brown to dark-brown or dark-grayish-brown clay, which grades into lighter-colored grayish-brown or brown clay which abruptly passes into grayish-yellow clay containing whitish lime material. It occurs in a large number of small areas principally in the southern and northeastern parts of the county. The surface is rolling, with many rather steep slopes. Most of it is in cultivation.

Irving clay is a dark-ashy-gray to ashy-black or very dark-ashy-brown clay, underlain by very tough, dark-gray, black, or bluish-gray clay. It is not a very extensive soil. The surface is nearly level, with slow drainage, though usually sufficient for crops. Most of it is in cultivation, chiefly to cotton, corn, oats, sorghum, and some wheat.

Irving fine sandy loam is a dark-gray or ashy-gray to brownish-gray, heavy fine sandy loam, below which is a dark-gray, heavy clay. It occurs in numerous small flat areas, with poor surface drainage. Most of it is in cultivation to cotton and corn.

Irving silt loam is a gray or ashy-gray silt loam passing abruptly into an ashy-gray, sticky, plastic clay. It occurs on old terraces. The area is small but most of it is in cultivation to corn, cotton, oats, and sorghum.

Kalmia fine sand is a gray or brownish-gray, loose, fine sand, underlain by pale-yellow, loose, fine sand. It is nearly level and has good drainage, water passing downward through the loose subsoil. Most of it is cultivated to early vegetables, grapes, and berries. The soil drifts badly where unprotected.

Leaf fine sandy loam is a brown fine sandy loam grading into a yellowish-brown, brownish-yellow, or pale-yellow fine sand or fine sandy loam below which is a yellowish-brown sandy clay loam, which passes into heavy, stiff, plastic clay, mottled red, yellowish-brown, and gray. It is extensive. The topography is flat to gently rolling. Most of it is cultivated to cotton, corn, and sorghum. The better drained areas are well suited to vegetables and fruits.

Leaf gravelly sandy loam is a brown to dark-brown sandy loam, below which is a stiff, plastic red clay or a mottled red and yellow or red and yellowish-brown, stiff, plastic clay. It is of slight extent. Nearly all of it is cultivated to cotton, corn, wheat, and oats.

Lewisville clay is a brown to rather dark-brown clay, light-brown to yellowish-brown clay subsoil. It occurs in nearly all sections of the county. The topography is mainly gently rolling, with good surface drainage. Most of it is in cultivation. It is considered to be a productive soil. It has good internal drainage and dries out and warms up early in the spring.

Ochlockonee clay loam is a brown or dark-brown clay loam or sandy clay loam, underlain by yellow or brownish-yellow sandy clay loam or clay. It occurs in two small areas in the bottoms along Bear Creek and Delaware Branch in the western part of the county. Although nearly level, it has fair surface drainage. Part of it is utilized for pasture and part in growing cotton, corn, and sorghum.

Trinity clay is a very dark-brown to black clay, which grades into light-brown, brown, or black clay. It is an extensive type and occupies the bottom lands along most of the rivers and smaller streams. The surface is flat. It is subject to overflows that destroy crops. Most of it is in cotton and corn. It is a very rich and productive soil, and is comparatively easy to cultivate when the moisture conditions are right.

SOILS OF ERATH COUNTY

Twenty types of soil were mapped in Erath county, included in 13 series. The residual upland soils are classed in the Windthorst, Nimrod, Denton, Erath, San Saba, and Brackett series. The alluvial terrace soils or the second bottoms are classed as Lewisville and Bastrop series. The first-bottom soils are included in the Frio and Trinity series. The Windthorst and Nimrod are classed as non-calcareous, while the Denton, Erath, San Saba, and Brackett are calcareous. The alluvial soils are all calcareous, though the Bastrop soils are not calcareous in the upper part. The Windthorst fine sandy loam is the most extensive type occupying 29.5 per cent of the area and is also extensively cultivated.

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Bastrop fine sandy loam	.077	.048	23	.96	.24	291	.42	1.25	7.0	0–6
Bastrop fine sandy loam	.079	.057	4	1.08	.78	200	.70	1.11	6.7	6–24
Bastrop fine sandy loam	.021	.063	....	.41	....	....	....	....	....	24–36
Brackett gravelly loam	.095	.051	32	.79	.22	106	9.87	8.48	7.5	0–7
Brackett gravelly loam	.038	.026	32	.75	.24	34	15.05	29.10	7.8	7–36
Brackett silty clay loam	.133	.079	53	1.41	.75	645	9.44	5.75	7.3	Surface
Brackett silty clay loam	.091	.056	48	1.99	.68	219	5.81	6.61	7.6	Subsoil
Brackett silty clay loam	.065	.114	221	2.45	.28	75	5.39	8.90	7.8	15–36
Denton clay	.178	.089	92	1.18	.39	267	5.92	5.66	7.3	Surface
Denton clay	.097	.058	17	.76	.40	62	12.46	8.59	7.6	Subsoil
Denton clay	.063	.047	2	.92	.33	53	12.29	10.00	7.6	Deep Subsoil
Denton clay loam	.154	.072	44	1.32	.69	420	.72	1.64	7.0	0–9
Denton clay loam	.117	.059	18	.85	.85	250	.94	.44	7.1	9–13
Denton clay loam	.072	.063	8	1.19	.54	85	11.98	4.34	7.5	13–36
Denton fine sandy loam	.123	.089	14	.90	.33	157	7.47	5.58	7.3	Surface
Denton fine sandy loam	.106	.096	35	.94	.37	182	15.41	9.60	7.5	Subsoil
Denton fine sandy loam	.092	.096	2	.80	.32	136	22.41	10.00	7.3	12–36
Denton loam	.118	.067	58	1.17	.47	276	.76	1.26	7.1	0–8
Denton loam	.098	.086	43	1.23	.45	550	6.05	3.85	7.5	8–24
Denton loam	.066	.080	36	.79	.36	10	29.26	10.00	7.7	24–36
Erath clay	.142	.074	95	1.17	.57	324	1.56	7.70	7.2	0–15
Erath clay	.059	.037	34	.84	.42	....	9.42	10.00	7.5	15–36
Frio fine sandy loam	.052	.044	75	.92	.22	202	.37	.93	7.3	Surface
Frio fine sandy loam	.047	.051	47	1.13	.32	170	.57	1.00	7.3	Subsoil
Frio fine sandy loam	.045	.050	52	1.31	.48	235	1.43	2.20	7.5	Deep Subsoil
Frio loam	.112	.084	196	1.40	.40	441	6.36	7.40	7.3	0–9
Frio loam	.065	.075	5	1.14	.33	73	14.76	26.80	7.6	9–16
Frio loam	.049	.060	4	.94	.28	59	17.34	30.50	7.6	16–36
Frio silty clay loam	.120	.090	183	1.72	.71	503	3.61	5.07	7.5	Surface
Frio silty clay loam	.100	.091	63	1.65	.70	152	4.59	9.56	7.3	Subsoil
Frio silty clay loam	.062	.061	24	1.43	.67	74	13.82	9.12	7.5	Deep Subsoil
Frio very fine sandy loam	.140	.189	237	1.21	.34	430	1.97	3.05	7.2	Surface
Frio very fine sandy loam	.054	.092	240	1.21	.43	554	.73	1.22	7.4	Subsoil
Frio very fine sandy loam	.035	.053	63	.99	.28	473	11.17	6.14	7.8	Deep Subsoil
Nimrod fine sand	.052	.027	26	.50	.15	143	.33	1.41	7.0	Surface
Nimrod fine sand	.082	.020	11	.41	.41	152	.15	.20	6.7	Subsoil
San Saba clay	.119	.074	63	.87	.58	138	4.21	8.52	7.2	Surface
San Saba clay	.064	.070	51	.81	.53	63	6.65	8.09	7.5	Subsoil
Trinity clay	.159	.131	182	1.74	1.03	983	.76	1.46	7.0	0–8
Trinity clay	.095	.060	9	1.72	1.11	....	.93	.25	7.3	8–18
Trinity clay	.084	.065	....	1.30	.87	....	19.97	....	7.5	18–22
Windthorst clay loam	.121	.072	16	1.40	.54	429	.83	1.93	7.5	0–8
Windthorst clay loam	.073	.083	4	1.50	.39	171	.71	.70	7.5	Subsoil
Windthorst fine sandy loam	.056	.032	18	.87	.17	145	.26	.96	7.0	Surface
Windthorst fine sandy loam	.049	.036	11	1.14	.47	182	.41	1.72	6.7	Subsoil
Windthorst fine sandy loam	.033	.039	22	1.00	.44	122	2.90	1.49	7.1	Deep Subsoil

The Denton stony clay occupies 18.7 per cent, the Denton clay 5.7 per cent, and the Frio fine sandy loam 5.1 per cent.

Composition of Soils. The composition of the soils of Erath county is given in Table 16 and the interpretation of the analyses in Table 17. The upland and first-bottom soils on an average contain fairly good supplies of phosphoric acid and nitrogen, and are well supplied with potash. The terrace soils are not so well supplied with phosphoric acid and nitrogen. The Bastrop fine sandy loam, Brackett gravelly loam, Denton fine sandy loam, Nimrod fine sand, Windthorst clay loam, and Windthorst fine sandy loam have a corn possibility of 12 to 24 bushels to the acre for active phosphoric acid, which indicates a need for phosphoric acid as a fertilizer. With the exception of the Denton fine sandy loam, the nitrogen is also low, the corn possibility being 18 to 28 bushels.

None of the samples examined were acid, and many of them are high in lime.

Pot Experiments. The results of some pot experiments on soils of Erath county are given in Table 18. Applications of phosphoric acid and nitrogen caused increased growth of the plants in all the pot experiments. Applications of potash resulted in little or no increase in growth. The corn possibility of the plant food taken up by the crops is shown in the table.

Fertilizers. The soil types mentioned above which are low in nitrogen and active phosphoric acid, may respond to phosphatic and nitrogenous fertilizers when the rainfall and other climatic conditions are favorable to an increase in yields. Fertilizers are being used in Erath county at the present time, and about 450 tons was sold in the county in 1930.

Lime. No need for applications of lime is indicated by the analyses. No acid soils were found; the soils were either neutral or slightly alkaline.

Classification of Soil Types

Bottom-land Soils. Surface soil, brown with a brown subsoil, calcareous. Frio series.

Surface soil, black with brown or gray subsoil, calcareous. Trinity series.

Upland Soils. Surface soil, grayish-brown. Subsoil, stiff red clay and gray below 20 inches generally, non-calcareous. Windthorst series.

Surface soil, light-grayish-brown. Subsoil, light-brown or yellow, showing gray mottling in wet places. Soil non-calcareous. Nimrod series.

Surface soil, brown with a light yellowish or grayish-brown chalky subsoil, soil is calcareous. Denton series.

Surface soil, brown or light-brown. Subsoil, heavy and variegated,

Table 17.—Interpretation of analyses of surface soils of Erath County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Bastrop fine sandy loam	23	18	135	good	good	good
Brackett gravelly loam	28	24	61	good	good	high
Brackett silty clay loam	38	30	245	good	good	high
Denton clay	48	40	125	good	good	high
Denton clay loam	43	30	180	good	good	good
Denton fine sandy loam	38	12	84	good	good	high
Denton loam	33	30	135	good	good	high
Erath clay	43	40	144	good	good	high
Frio fine sandy loam	18	35	105	good	good	good
Frio loam	33	45	188	good	good	high
Frio silty clay loam	33	45	211	good	good	high
Frio very fine sandy loam	38	50	188	good	good	high
Nimrod fine sand	18	18	73	low	good	good
San Saba clay	33	35	73	good	good	high
Trinity clay	43	45	306	good	good	high
Windthorst clay loam	38	12	188	good	good	good
Windthorst fine sandy loam	18	12	73	good	good	good

Table 18—Pot experiments on soils of Erath County

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
18214	Denton clay—surface—corn, 1st crop	39.8	16.4	17.7	35.4	....	24	289
18214	Denton clay—surface—sorghum, 2nd crop	40.5	23.5	22.1	40.2	40	24	201
18210	Frio fine sandy loam—surface—corn, 1st crop	29.5	7.7	23.6	32.3	17	....	313
18210	Frio fine sandy loam—surface—sorghum, 2nd crop	23.4	24.0	12.3	10.2	....	....	....
18211	Frio fine sandy loam—subsoil—corn, 1st crop	48.5	....	....	29.0	....	....	268
18211	Frio fine sandy loam—subsoil—sorghum, 2nd crop	50.0	....	....	30.7	....	....	124
18211	Frio fine sandy loam—subsoil—cotton, 3rd crop	53.3	....	....	50.1	....	....	285
18211	Frio fine sandy loam—subsoil—cowpeas, 4th crop	41.3	....	....	46.8	....	....	352
3378	Nimrod fine sand—subsoil—corn, 1st crop	16.4	....	2.9	....	....	6	372
3378	Nimrod fine sand—subsoil—sorghum, 2nd crop	16.9	....	3.7	....	....	....	....
3378	Nimrod fine sand—subsoil—corn, 3rd crop	52.4	....	7.5	....	....	7	....
3378	Nimrod fine sand—subsoil—sorghum, 4th crop	32.4	....	2.1	....	....	3	....
18212	San Saba clay—surface—corn, 1st crop	44.7	22.2	21.6	47.2	34	30	393
18212	San Saba clay—surface—sorghum, 2nd crop	44.1	12.4	20.8	43.0	20	21	265
18213	San Saba clay—subsoil—corn, 1st crop	29.1	....	....	30.9	....	....	255
18213	San Saba clay—subsoil—sorghum, 2nd crop	29.5	....	....	33.2	....	....	111
18213	San Saba clay—subsoil—cotton, 3rd crop	28.6	....	....	25.7	....	....	218
18205	Windthorst fine sandy loam—surface—corn, 1st crop	39.7	8.7	12.2	34.8	16	....	235
18205	Windthorst fine sandy loam—surface—sorghum, 2nd crop	31.9	24.7	17.1	31.0	78	....	176
18206	Windthorst fine sandy loam—subsoil—corn, 1st crop	24.9	11.8	6.3	28.7	26	....	214
18206	Windthorst fine sandy loam—subsoil—sorghum, 2nd crop	37.8	25.1	14.3	31.2	74	....	142
18207	Windthorst fine sandy loam—subsoil—corn, 1st crop	21.5	11.0	3.8	17.1	22	....	260
18207	Windthorst fine sandy loam—subsoil—sorghum, 2nd crop	30.9	22.0	9.3	32.0	65	....	223
18208	Windthorst fine sandy loam—surface—corn, 1st crop	35.2	11.1	14.4	38.2	21	....	237
18208	Windthorst fine sandy loam—surface—sorghum, 2nd crop	18.8	20.5	15.5	22.0	63	....	106
18209	Windthorst fine sandy loam—subsoil—corn, 1st crop	18.6	15.5	3.4	18.1	....	....	200
18209	Windthorst fine sandy loam—subsoil—sorghum, 2nd crop	25.4	19.0	11.8	27.2	56	....	164

red, maroon, purple, gray, brown and bright-yellow colors are found. Soil is calcareous. Erath series.

Surface soil, black. Subsoil, dark-gray or brown to a lighter grayish or yellowish-brown. Soil calcareous. San Saba series.

Surface soil, very light grayish-brown or yellowish-brown to almost white. Soil is calcareous. Brackett series.

Surface soil, brown to dark-brown. Subsoil, light-brown to yellowish-brown. Soil is calcareous. Lewisville series.

Surface soil, brown to reddish-brown. Subsoil, red more or less mottled with yellow. Bastrop series.

Condensed Description of Soils of Erath County

Bastrop fine sandy loam consists of brown to reddish-brown fine sandy loam to loamy fine sand, underlain by red stiff clay mottled with yellow gray. It occurs in the Paluxy, Armstrong, and Bosque Valleys, on benches not subject to overflow. It has good surface and underdrainage. The area is small and most of it is under cultivation.

Brackett gravelly loam is a light-gray, grayish-brown, or brownish-gray friable gravelly loam or gravelly clay loam, passing into grayish-yellow or cream-colored gravelly, marly clay or silty clay loam with some layers of gravelly clay loam. It occupies gently to rather steep slopes and in places is gullied. The surface drainage is adequate. The area is small and very little is cultivated.

Brackett silty clay loam consists of light-gray or pale-yellowish-brown silt loam to silty clay loam, passing into light-grayish or pale-yellowish silty clay to clay containing varying amounts of white limy material. The area is small. None of it is cultivated and it furnishes only poor pasturage.

Denton clay is a brown to dark-brown clay passing into lighter clay and then into yellowish-brown friable clay, which contains limy material. It occurs most extensively in the prairies from Selden to Chalk Mountain, and scatteringly on the high divides. The surface drainage is adequate. The underdrainage is moderately good. It is a strong, productive soil and practically all cultivated.

Denton clay loam is a brown to dark-brown friable clay loam, in places ranging to nearly black, underlain by a light-brown or yellowish-brown friable clay loam or clay, with some whitish limy material. It is widely distributed over the county. The surface is gently to moderately sloping, and seldom gullied. It is important because it is the best soil on many farms partly consisting of rough and stony soils. Most of it is planted to cotton, corn, oats, and the grain sorghums. This soil is rather droughty, and it is most productive in seasons of good rainfall.

Denton fine sandy loam consist of brown to dark-brown, friable, fine sandy loam, underlain by lighter-brown or yellowish-brown friable clay loam to clay. It occurs in many areas scattered through the central and southern parts of the county. It has a gently sloping to moderately sloping surface, and is well suited to farming operations. Good surface drainage is provided by nummerous draws and streams. It produces very well in average seasons, but crops do not succeed on it so well in dry seasons.

Denton loam consists of a brown to dark-brown friable loam passing into lighter brown or yellowish-brown friable silty clay loam or clay. Its principal use is for pasture.

Denton stony clay consist of dark-brown clay underlain by grayish or yellowish-brown, friable, calcareous clay resting on marl or limestone at depths varying from about 10 to 30 inches. Limestone fragments are scattered over the surface and through the soil and subsoil. It is almost entirely in pasture.

Erath clay is a brown to light-brown clay, passing into heavy clay of various colors. In places this subsoil clay is in the upper part dark red mottled with purple and in the lower part gray or yellow; in other places the layers are reversed. The surface is gently sloping and eroded in places. The drainage is good. It is of small area, little cultivated, but used for pasture.

Frio fine sandy loam is a brown or grayish-brown to dark-brown friable fine sandy loam to loamy fine sand passing into lighter-brown fine sandy loam, which continues with variations to considerable depths. The largest areas are along the Bosque River. The surface is flat, but both surface drainage and internal drainage are good. This is the most extensive alluvial soil in the county, although its total area is not large. About 90 per cent of it is cleared and cultivated.

Frio loam consists of brown to dark-brown loam passing into lighter-brown or grayish-brown friable loam to silty clay loam, underlain by light-gray or light-yellowish-brown, moderately calcareous loam to clay loam. This soil does not occupy a very large area, but is important as one of the best soils in the rougher sections of the county.

Frio silty clay loam consists of a brown to dark-brown friable silty clay loam or silt loam passing abruptly into brown silty clay loam, underlain by brown or dark-brown silty clay, which grades into grayish-brown friable to slightly dense silty clay. It is first-bottom land. The surface is flat or gently sloping, with good surface drainage. The larger part is planted to cotton, corn, and oats.

Frio very fine sandy loam consists of brown to dark-brown, smooth, friable, very fine sandy loam, passing into dark-brown loam to silty clay loam or silty clay, which grades into lighter brown, grayish-brown, or yellowish-brown friable clay loam. It occurs in the Paluxy, Armstrong, and Bosque bottoms. It has a flat surface and is subject to overflow. While total area is small, it is prized as good farming land, productive in all but extremely dry seasons.

Lewisville clay loam consists of brown to dark-brown clay loam to silty clay loam passing into brown clay, and this in turn into yellowish-brown friable clay to clay loam. It occurs chiefly along South Paluxy and Richardson Creeks. The topography is flat to sloping. Surface drainage is excellent, and the porous substratum provides good underdrainage and aeration. The area is too small to be of much importance, but the soil yields well.

Nimrod fine sand is a gray or light-grayish-brown, loose fine sand, below which is a very light-yellowish or grayish-yellow, incoherent fine sand. It occurs in scattered areas on flattish divides, swales, and hillsides with very gently to rather steep slopes. The soil remains cold and wet late in the spring. It is relatively unimportant because of its small extent and its natural deficiencies. The principal crops are cotton, corn, and peanuts.

San Saba clay consists of black heavy clay, underlain by dark-brown clay, passing beneath into grayish or yellowish-brown friable clay containing white, soft, limy material. The topography is nearly flat, slightly sloping or basinlike. This is one of the most productive soils in the county and practically all of it is cultivated. In dry years crops fail except in seepy spots.

Trinity clay consists of very dark-brown to black clay, underlain by dark-brown, dark-ashy-gray, grayish-brown, or yellowish-brown calcareous clay. It occurs in the bottoms of streams in all parts of the county. The surface is faintly sloping to flat. The drainage is fairly good but the land is subject to overflow. It is not very extensive, but it is practically all under cultivation, and is regarded as one of the best soils in the county.

Windthorst clay loam is a reddish-brown clay loam to brown sandy clay loam, passing into red or brownish-red heavy clay, which in places is mottled with yellow and gray in the lower depths. The clay subsoil is usually quite stiff. This type is small in extent, and little of it is cultivated. Its principal use is for pasture.

Windthorst fine sandy loam consists of brown to grayish-brown loamy fine sand to fine sandy loam, underlain by stiff red clay or fine sandy clay, mottled with yellow. The topography ranges from nearly flat and gently undulating or sloping to rather steeply sloping and gullied. The subsoil is impervious and rather unfavorable to underdrainage and aeration. It is the most extensive and important soil type in the county. It is well suited to growing crops under the prevailing climatic conditions, and is easy to cultivate. Most of it is cultivated to cotton, corn, and peanuts; it is also suitable for orchards.

Windthorst stony fine sandy loam consists of reddish-brown to brown loamy fine sand to fine sandy loam, underlain by red or brownish-red fine sandy clay to stiff clay with lenses of yellowish sandy material. It usually grades into partly weathered sandstone, underlain by solid sandstone, within three feet of the surface. Angular fragments of the reddish or brownish rock are present on the surface and in the soil. Practically none of it is cleared or cultivated.

SOILS OF HARRIS COUNTY

The soils of Harris county are separated into series on the basis of common origin and similarity of color, topography, and drainage. Twenty-nine soil types representing 15 series have been mapped.

The Coast Prairie region occupies the main part of the county. The interior Flat Woods region is found in the northern part, though it extends to some other parts.

The soil types of the Coast Prairie are classed as Lake Charles, Edna, Morse, Acadia, Harris, Katy, and Hockley series.

The upland soil types of the interior Flat Woods are classed as Norfolk, Orangeburg, Susquehanna, Lufkin, Caddo, and Kalmia series. The bottom-land soils are of the Ochlockonee and Trinity series.

The Lake Charles clay occupies 24.6 per cent of the county, the Lake Charles clay loam 16.8 per cent, the Katy fine sandy loam 11 per cent, the Acadia very fine sandy loam 7.4 per cent, and the Acadia clay 5.2 per cent. The other types occupy relatively small percentages of the county.

Composition of Soils. The average analyses of the soils of Harris county are given in Table 19 and the interpretation of the analyses in Table 20. The soils of this county are, on an average, somewhat low in nitrogen, active phosphoric acid and active potash though better supplied with potash than with the others. The Flat Woods soils of the upland average the lowest, the Coastal Plain soils come next, and the first-bottom soils are the best, on an average. The corn possibility (Table 20) for active phosphoric acid is 12 to 24 bushels per acre, with the exception of the Harris fine sandy loam, which is 30, and the Trinity clay, which is 45. The total nitrogen has a corn possibility of 13 to 28, except the Acadia clay, which is 33; the Harris clay, which is 58; the Lake Charles clay, which is 38; the Ochlockonee clay, which is 38, and the Trinity clay, which is 63. The active potash is also low in many of the samples, being less than 62 in all except six of the soil types.

Many of the samples of Harris county soils are slightly acid, having a pH slightly lower than 6, but most of the samples with an acidity lower than pH 6 (Table 19) are subsoils. The surface soils which are acid, include Acadia clay, Lufkin clay loam, Norfolk fine sand, Ochlockonee sand, Susquehanna clay loam, and Susquehanna fine sandy

Table 19.—Analyses of soils of Harris County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Acadia clay	.109	.032	11	.43	.11	72	.59	.10	5.7	0–6
Acadia clay	.169	.045	20	.44	.14	97	.76	1.02	6.5	6–36
Acadia clay loam	.048	.017	12	.47	.14	29	.44	.22	6.8	Surface
Acadia clay loam	.034	.015	8	.44	.15	36	.46	.37	6.7	Subsoil
Acadia clay loam	.023	.012	13	.45	.18	49	.81	1.02	7.6	16–36
Acadia fine sandy loam	.074	.022	29	.83	.07	125	.04	.25	6.1	0–6
Acadia fine sandy loam	.031	.013	18	.82	.11	93	.08	.10	5.6	6–18
Acadia fine sandy loam	.044	.016	8	.88	.10	115	.22	.45	5.2	18–36
Acadia very fine sandy loam	.047	.027	24	.52	.06	72	.25	.33	6.4	Surface
Acadia very fine sandy loam	.028	.018	11	.47	.08	35	.12	.38	6.3	Subsoil
Acadia very fine sandy loam	.030	.014	11	.73	.24	103	.40	1.10	5.6	15–36
Caddo fine sandy loam	.054	.025	10	.81	.08	151	.10	.15	6.0	0–5
Caddo fine sandy loam	.015	.016	11	.89	.08	83	.11	.10	6.0	5–18
Caddo fine sandy loam	.028	.014	8	.80	.09	168	.12	.25	5.4	18–24
Caddo fine sandy loam	.028	.016	10	1.10	.10	126	.12	.30	5.2	24–36
Edna very fine sandy loam	.047	.011	18	.30	.06	54	.15	.23	6.5	Surface Subsoil
Edna very fine sandy loam	.029	.012	14	.59	.05	63	.18	.32	6.6	Subsoil
Edna very fine sandy loam	.023	.011	15	.53	.05	61	.24	.39	6.6	Deep
Harris clay	.211	.064	....	1.16	.47	....	.48	....	6.5	0–6
Harris clay	.068	.040	....	1.29	.50	....	.32	....	6.9	6–36
Harris fine sandy loam	.094	.041	55	.52	.10	129	.15	.11	6.2	0–10
Harris fine sandy loam	.026	.017	19	.38	.09	128	.08	.45	6.5	10–36
Hockley fine sandy loam	.066	.022	20	.16	.07	59	.17	.17	6.4	Surface
Hockley fine sandy loam	.037	.014	10	.18	.07	45	.11	.11	5.7	Subsoil
Hockley fine sandy loam	.053	.020	7	.34	.10	76	.14	.26	5.8	26–36
Kalmia fine sandy loam	.090	.048	25	.46	.09	108	.19	.58	6.3	Surface
Kalmia fine sandy loam	.030	.022	17	.56	.09	84	.16	.48	5.8	Subsoil
Kalmia fine sandy loam	.020	.020	15	.51	.10	79	.23	.60	5.7	Deep Subsoil
Kalmia fine sandy loam	.015	.015	13	.57	.10	85	.25	.65	5.7	15–30
Kalmia sand	.043	.021	....	.57	.12	....	.08	....	6.1	Surface
Kalmia sand	.013	.013	....	.61	.08	....	.07	....	6.1	Subsoil
Katy fine sandy loam	.074	.024	16	.68	.12	82	.15	.46	6.2	Surface
Katy fine sandy loam	.051	.019	11	.33	.16	76	.21	.44	6.1	Subsoil
Katy fine sandy loam	.040	.014	9	.32	.09	76	.18	.50	6.2	Deep Subsoil
Katy fine sandy loam	.044	.015	19	.28	....	116	....	.10	5.7	15–24
Lake Charles clay	.121	.032	22	.80	.24	151	.50	1.15	6.7	Surface
Lake Charles clay	.073	.026	13	.72	.35	120	.63	.96	6.2	Subsoil
Lake Charles clay	.049	.020	12	.59	.32	133	2.76	3.09	6.7	Deep Subsoil

Table 19.—Analyses of soils of Harris County—Continued.

	Nitrogen per cent	Total Phos. Ac. per cent	Active Phos. Ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth inches,
Lake Charles clay	.045	.015	23	.75	.43	80	1.33	.24	7.3	20–26
Lake Charles clay loam	.090	.031	20	.33	.14	77	.42	.97	6.7	Surface
Lake Charles clay loam	.047	.020	24	.37	.16	74	.54	1.06	6.8	Subsoil
Lake Charles clay loam	.023	.014	26	.24	.11	87	1.23	1.68	7.4	Deep Subsoil
Lake Charles very fine sandy loam	.070	.021	38	.20	.10	108	.25	.49	6.5	Surface
Lake Charles very fine sandy loam	.042	.015	29	.22	.10	78	.25	.59	6.7	Subsoil
Lake Charles very fine sandy loam	.046	.016	12	.25	.11	85	.32	.59	6.4	Deep Subsoil
Lake Charles very fine sandy loam	.017	.010	16	.15	.06	88	.40	.55	7.1	15–24
Lufkin clay loam	.048	.018	26	.27	.19	90	.21	.18	5.7	Surface
Lufkin clay loam	.029	.012	16	.36	.09	84	.20	.20	5.9	Subsoil
Lufkin clay loam	.022	.011	12	.29	.27	67	.22	.35	6.1	Deep Subsoil
Morse clay	.152	.044	39	.73	.20	188	.43	.78	6.3	Surface
Morse clay	.047	.025	12	.96	.35	130	4.55	5.05	6.5	Subsoil
Morse clay	.065	.019	13	.81	.26	135	.61	.98	6.5	Deep Subsoi
Morse fine sandy loam	.069	.030	27	.42	.17	123	.32	.48	6.5	Surface
Morse fine sandy loam	.043	.024	13	.41	.19	117	.35	.49	6.1	Subsoil
Morse fine sandy loam	.039	....	11	.60	.14	214	.37	.63	5.7	Deep Subsoil
Morse fine sandy loam	.057	.024	13	.48	.14	129	.60	.95	5.8	15–24
Norfolk fine sand	.073	.027	17	.18	.09	75	.14	.23	5.9	Surface
Norfolk fine sand	.021	.014	13	.21	.08	87	.07	.10	6.2	Subsoil
Norfolk fine sand	.015	.011	16	.25	.10	179	.06	.12	6.4	18–36
Norfolk sand	.040	.024	26	.34	.04	88	.16	.25	7.2	0–5
Norfolk sand	.010	.018	15	.29	.09	38	.07	.10	6.5	5–30
Norfolk very fine sandy loam	.066	.028	29	.34	.10	144	.15	.35	6.7	0–4
Norfolk very fine sandy loam	.027	.018	13	.30	.08	84	.03	.15	6.8	4–10
Norfolk very fine sandy loam	.017	.015	10	.30	.11	66	.07	.15	6.1	10–18
Norfolk very fine sandy loam	.022	.020	10	.40	.07	99	.08	.20	5.6	18–26
Norfolk very fine sandy loam	.036	.019	10	.46	.11	88	.05	.20	5.1	26–36
Ochlockonee clay	.133	.047	40	.80	.17	125	1.31	2.15	7.2	Surface
Ochlockonee clay	.082	.039	32	.57	.18	152	.98	1.55	7.0	Subsoil
Ochlockonee clay	.089	.031	24	.72	.22	188	.95	1.40	6.8	15–36
Ochlockonee fine sand	.043	.021	19	.74	.07	66	.16	.34	6.2	0–6
Ochlockonee fine sand	.010	.012	12	.72	.21	54	.07	.29	6.4	6–18
Ochlockonee fine sand	.031	.013	14	.13	.08	70	.32	.25	6.2	18–36
Ochlockonee fine sandy loam	.060	.030	20	.66	.05	103	.15	.30	6.3	0–6
Ochlockonee fine sandy loam	.047	.033	18	.90	.08	108	.13	.30	5.5	6–18
Ochlockonee fine sandy loam	.053	.040	26	.94	.12	86	.21	.45	5.6	18–36

Ochlockonee sand	.040	.022	17	.49	.05	.46	.20	.19	5.5	0–5
Ochlockonee sand	.007	.012	14	.34	.06	8	.06	.14	6.0	5–28
Ochlockonee sand	.009	.013	14	.37	.07	49	.06	.29	6.3	28–36
Orangeburg fine sandy loam	.043	.022	16	.21	.07	58	.14	.20	6.2	Surface
Orangeburg fine sandy loam	.018	.024	12	.21	.08	85	.08	.13	5.7	Subsoil
Orangeburg fine sandy loam	.028	.018	9	.28	.10	76	.12	.22	5.7	Deep Subsoil
Orangeburg fine sandy loam	.037	.031	16	.51	.10	122	.14	.11	6.4	18–26
Susquehanna clay loam	.064	.022	13	.33	.12	83	.19	.15	5.7	0–8
Susquehanna clay loam	.056	.021	11	.35	.12	89	.19	.15	5.9	8–16
Susquehanna clay loam	.059	.021	10	.43	.14	68	.24	.20	5.8	16–24
Susquehanna clay loam	.044	.015	11	1.02	.16	88	.30	.60	6.1	24–36
Susquehanna fine sandy loam	.035	.025	14	.34	.10	55	.11	.15	5.9	Surface
Susquehanna fine sandy loam	.019	.015	11	.35	.08	55	.17	.27	6.0	Subsoil
Susquehanna fine sandy loam	.039	.016	7	.28	.11	55	.28	.58	6.0	Deep Subsoil
Susquehanna fine sandy loam	.037	.012	5	.26	.06	61	.15	.41	6.1	15–24
Tidal marsh	.381	.057	....	.73	.38	....	.50	....	6.4	0–8
Tidal marsh	.149	.032	60	.90	.38	568	.35	1.10	6.7	8–36
Trinity clay	.229	.084	102	.92	.59	489	2.18	3.52	7.0	0–4
Trinity clay	.070	.038	24	1.26	.71	213	1.39	2.15	7.6	4–24
Trinity clay	.050	.036	21	1.20	.76	99	1.63	1.91	7.7	24–36

Table 20.—Interpretation of analyses of surface soils of Harris County.

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Acadia clay	33	12	38	good	low	good
Acadia clay loam	18	12	26	low	fair	good
Acadia fine sandy loam	23	18	61	low	low	low
Acadia very fine sandy loam	18	18	38	low	low	good
Caddo fine sandy loam	18	6	84	low	low	low
Edna very fine sandy loam	18	12	38	low	low	fair
Harris clay	58	....	....	good	good	good
Harris fine sandy loam	23	30	73	fair	low	fair
Hockley fine sandy loam	23	12	38	low	low	fair
Kalmia fine sandy loam	28	18	61	fair	low	fair
Kalmia sand	18	....	....	low	good	fair
Katy fine sandy loam	23	12	50	low	fair	fair
Lake Charles clay	38	18	84	good	fair	good
Lake Charles clay loam	28	12	50	good	fair	good
Lake Charles very fine sandy loam	23	24	61	low	low	good
Lufkin clay loam	18	18	50	low	good	good
Morse clay	43	24	94	good	fair	good
Morse fine sandy loam	23	18	61	low	good	good
Norfolk fine sand	23	12	38	low	fair	good
Norfolk sand	13	18	50	low	low	good
Norfolk very fine sandy loam	23	18	73	low	low	fair
Ochlockonee clay	38	24	61	good	fair	high
Ochlockonee fine sand	18	12	38	low	fair	good
Ochlockonee fine sandy loam	18	12	61	low	low	fair
Ochlockonee sand	13	12	26	low	low	good
Orangeburg fine sandy loam	18	12	38	low	low	fair
Susquehanna clay loam	23	12	50	low	fair	fair
Susquehanna fine sandy loam	13	12	38	low	low	fair
Tidal marsh	63	....	....	good	good	good
Trinity clay	63	45	204	good	good	high

loam. The soils of the Lake Charles series, which occupy large areas, are not acid, but neutral, and contain good amounts of lime.

Pot Experiments. The results of pot experiments on some samples of soil from Harris county are given in Table 21. Most of the samples respond to applications of nitrogen and phosphoric acid, as is shown by the increased weights of the crops grown with the complete fertilizer compared with the weight of the crop which did not remove nitrogen or phosphoric acid. For example, the sample of Acadia very fine sandy loam gave 41.7 grams of corn with complete fertilizer, and 22.7 grams when phosphoric acid was not supplied. The amount of phosphoric acid removed by the 22.7 grams of corn was equivalent to 33 bushels of corn per acre. Lower quantities of crop were produced in subsequent crops.

A deficiency in crops also occurred when potash was the missing plant food on some of the soils, but many of the samples gave up enough potash for large crops. Potash may be deficient in these soils after they have been under cultivation.

Fertilizers. The analyses indicate that nitrogen and phosphoric acid in fertilizers are needed on many of the soils, for staple crops such as corn or cotton, and especially for truck crops. Potash also is needed on some of these types, such as Acadia clay loam, Hockley fine sandy loam, Ochlockonee fine sand, and Susquehanna fine sandy loam. After these soils have been in cultivation a few years, the need for fertilizer will be correspondingly increased. The use of superphosphate even on grazing land is advisable when the cattle chew bones or suffer from loin disease.

Lime. Lime is not needed for soils of the Lake Charles series. The analyses indicate little need for lime for cotton or corn, on any of the soils. Applications of lime would be advisable on soils with a pH below 6, where alfalfa, clover, or peanuts are to be grown.

Saline Spots. Small spots due to alkali are of frequent occurrence on some of the soil types in this county. Some of the spots are due to causes other than alkali. Analyses of some of the salty spots are given in Table 22. The predominant salts are chlorides, but some sodium carbonate, a black alkali, is also present.

Classification of Soils

Coast Prairie Region. Surface soil, dark-brown to black. Subsoil, dark-brown to black—deeper subsoil, ashy-gray, no limestone present. Lake Charles series.

Surface soil, grayish-brown and ashy-gray. Subsoil, stiff and heavy of light ashy-gray or mottled ashy-gray or pale-yellow. Iron concretions present in subsoil in some areas. Acadia series.

Table 21.—Pot experiments on soils of Harris County

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
9305	Acadia very fine sandy loam, probably—surface—corn, 1st crop	41.7		22.7			33	
9305	Acadia very fine sandy loam, probably—surface—sorghum, 2nd crop	13.0		13.0			14	
9305	Acadia very fine sandy loam, probably—surface—corn, 3rd crop	37.2		6.4			9	
9305	Acadia very fine sandy loam, probably—surface—sorghum, 4th crop	36.0		11.9			10	
9306	Acadia very fine sandy loam, probably—subsoil—corn, 1st crop	44.1			35.4			65
9306	Acadia very fine sandy loam, probably—subsoil—sorghum, 2nd crop	19.2			9.2			19
9306	Acadia very fine sandy loam, probably—subsoil—corn, 3rd crop	33.0			18.2			32
9306	Acadia very fine sandy loam, probably—subsoil—sorghum, 4th crop	22.0			3.7			5
20724	Hockley fine sandy loam—surface—corn, 1st crop	51.1	19.5	14.9	44.0	28	22	169
20724	Hockley fine sandy loam—surface—kafir, 2nd crop	40.5	8.6	18.5	29.1	16	20	77
20724	Hockley fine sandy loam—surface—cotton, 3rd crop	37.0			34.0			153
20724	Hockley fine sandy loam—surface—rice, 4th crop	65.5			60.2			226
20725	Hockley fine sandy loam—subsoil—corn, 1st crop	40.0	14.9	11.5	38.3	19	13	74
20725	Hockley fine sandy loam—subsoil—kafir, 2nd crop	37.0	2.7	10.7	28.9	6	10	63
20725	Hockley fine sandy loam—subsoil—cotton, 3rd crop	22.4			19.3			75
20725	Hockley fine sandy loam—subsoil—rice, 4th crop	55.0			47.6			154
9273	Katy fine sandy loam, probably—surface—corn, 1st crop	11.2			13.5			137
9273	Katy fine sandy loam, probably—surface—sorghum, 2nd crop				1.4			4
9273	Katy fine sandy loam, probably—surface—corn, 3rd crop	3.7			1.2			12
9273	Katy fine sandy loam, probably—surface—sorghum, 4th crop	8.4			3.5			25
9273	Katy fine sandy loam, probably—surface—corn, 5th crop	54.3			45.2			226
9273	Katy fine sandy loam, probably—surface—cowpeas, 6th crop	33.6			44.5			208
9273	Katy fine sandy loam, probably—surface—cotton, 7th crop	34.5			34.7			211
9273	Katy fine sandy loam, probably—surface—sorghum, 8th crop	34.0			38.8			84
9273	Katy fine sandy loam, probably—surface—rice, 9th crop	60.4			49.5			253
9274	Katy fine sandy loam—subsoil—corn, 1st crop	20.9			4.0			75
9274	Katy fine sandy loam—subsoil—sorghum, 2nd crop	28.4			4.2			36
20722	Katy fine sandy loam—surface—corn, 1st crop	47.9	20.3	10.9	37.1	27	20	80
20722	Katy fine sandy loam—surface—kafir, 2nd crop	44.8	33.7	20.2	33.2	55	25	62
20722	Katy fine sandy loam—surface—cotton, 3rd crop	28.7			28.6			121
20722	Katy fine sandy loam—surface—rice, 4th crop	68.6			65.5			213
20723	Katy fine sandy loam—subsoil—corn, 1st crop	45.0	12.9	5.8	32.2	16	9	58
20723	Katy fine sandy loam—subsoil—kafir, 2nd crop	5.3	3.4	9.1	4.7	6	8	31
20723	Katy fine sandy loam—subsoil—cotton, 3rd crop	22.5			22.6			63
20723	Katy fine sandy loam—subsoil—rice, 4th crop	57.1			48.1			153
1265	Lake Charles clay, probably—surface—corn, 1st crop	41.0	43.3			116		
1265	Lake Charles clay, probably—surface—sorghum, 2nd crop	42.5	15.0			26		
1265	Lake Charles clay, probably—surface—corn, 3rd crop	61.0	14.3			19		
1265	Lake Charles clay, probably—surface—sorghum, 4th crop	53.0	12.0			21		
5649	Lake Charles clay, probably—surface—corn, 1st crop	18.0	11.8			24		
5649	Lake Charles clay, probably—surface—sorghum, 2nd crop	30.5	2.8			5		

5649	Lake Charles clay, probably—surface—corn, 3rd crop	30.0	5.0	...	...	9	...	...
5649	Lake Charles clay, probably—surface—sorghum, 4th crop	22.0	3.0	...	...	6	...	...
5649	Lake Charles clay, probably—surface—corn, 5th crop	31.8	5.9	...	...	10	...	...
5649	Lake Charles clay, probably—surface—sorghum, 6th crop	31.0	3.2	...	...	11	...	...
5650	Lake Charles clay, probably—subsoil—corn, 1st crop	23.7	26.4	...	...	...	...	...
5650	Lake Charles clay, probably—subsoil—sorghum, 2nd crop	21.1	8.3	...	...	...	...	...
5650	Lake Charles clay, probably—subsoil—corn, 3rd crop	34.1	12.0	...	...	16	...	...
7357	Lake Charles clay, probably—surface—corn, 1st crop	47.0	...	...	41.5	...	...	176
7357	Lake Charles clay, probably—surface—sorghum, 2nd crop	20.8	...	...	19.9	...	...	44
7357	Lake Charles clay, probably—surface—corn, 3rd crop	41.4	...	...	31.5	...	...	60
7357	Lake Charles clay, probably—surface—corn, 4th crop	32.2	...	...	24.5	...	...	34
7358	Lake Charles clay, probably—subsoil—corn, 1st crop	29.3	20.8	...	...	...	...	...
7358	Lake Charles clay, probably—subsoil—sorghum, 2nd crop	25.2	5.7	...	...	11	...	...
7358	Lake Charles clay, probably—subsoil—corn, 3rd crop	19.5	7.0	...	...	11	...	...
7358	Lake Charles clay, probably—subsoil—sorghum, 4th crop	21.3	2.1	...	...	4	...	...
20579	Lake Charles clay—surface—corn, 1st crop	34.7	32.0	17.7	31.2	89	28	324
20579	Lake Charles clay—surface—sorghum, 2nd crop	29.9	19.7	24 0	30.4	43	35	201
20580	Lake Charles clay—subsoil—corn, 1st crop	34.7	22.5	9.6	36.0	47	14	276
20580	Lake Charles clay—subsoil—sorghum, 2nd crop	28.0	8.6	12.3	28.8	15	15	161
20581	Lake Charles clay—subsoil—corn, 1st crop	20.7	8.2	3.6	...	18	7	...
20581	Lake Charles clay—subsoil—sorghum, 2nd crop	15.8	3.7	8.0	...	9	9	...
20728	Lake Charles clay—surface—corn, 1st crop	45.8	21.6	23.5	45.4	35	30	237
20728	Lake Charles clay—surface—kafir, 2nd crop	37.5	8.8	23.3	30.6	25	31	113
20729	Lake Charles clay—subsoil—corn, 1st crop	35.8	18.4	11.8	39.8	28	23	234
20729	Lake Charles clay—subsoil—kafir, 2nd crop	39.2	4.1	14.2	37.2	9	22	153
5710	Lake Charles clay loam, probably—surface—corn, 1st crop	40.4	...	19.3	...	...	36	...
5710	Lake Charles clay loam, probably—surface—sorghum, 2nd crop	11.0	...	15.9	...	...	18	...
5710	Lake Charles clay loam, probably—surface—corn, 3rd crop	59.0	...	18.7	...	...	17	...
5710	Lake Charles clay loam, probably—surface—sorghum, 4th crop	39.4	...	13.0	...	...	18	...
5711	Lake Charles clay loam, probably—subsoil—corn, 1st crop	16.0	...	11.5	16.0	...	26	71
5711	Lake Charles clay loam, probably—subsoil—sorghum, 2nd crop	20.2	...	12.2	18.7	...	20	108
5711	Lake Charles clay loam, probably—subsoil—corn, 3rd crop	39.0	...	22.1	18.1	...	22	43
5711	Lake Charles clay loam, probably—subsoil—sorghum, 4th crop	33.0	...	18.2	18.3	...	24	42
5711	Lake Charles clay loam, probably—subsoil—corn, 5th crop	13 0	...	9.1	15.8	...	14	34
5711	Lake Charles clay loam, probably—subsoil—sorghum, 6th crop	14 2	...	9.9	5.2	...	5	6
5711	Lake Charles clay loam, probably—subsoil—corn, 7th crop	3.5	...	8.5	11.7	...	10	15
5711	Lake Charles clay loam, probably—subsoil—sorghum, 8th crop	3.8	...	3.1	7.9	...	7	9
5711	Lake Charles clay loam, probably—subsoil—corn, 9th crop	7.0	...	3.5	1.3	...	61	2
5711	Lake Charles clay loam, probably—subsoil—sorghum, 10th crop	1.0	...	1.2	1.5	...	...	...
9347	Lake Charles clay loam probably—surface—corn, 1st crop	44.2	...	...	44.7	...	...	104
9347	Lake Charles clay loam, probably—surface—sorghum, 2nd crop	41.7	...	...	28.5	...	71	...
9347	Lake Charles clay loam, probably—surface—corn, 3rd crop	...	...	24.2	...	...	36	...
9347	Lake Charles clay loam, probably—surface—sorghum, 4th crop	...	...	31.9	...	...	29	...
9348	Lake Charles clay loam, probably—subsoil—corn, 1st crop	25.9	...	...	16.5	...	...	102
9348	Lake Charles clay loam, probably—subsoil—sorghum, 2nd crop	29.9	...	...	25.7	...	...	49
9348	Lake Charles clay loam, probably—subsoil—corn, 3rd crop	21.9	...	...	12.6	...	...	42
9348	Lake Charles clay loam, probably—subsoil—sorghum, 4th crop	30.5	...	...	18.0	...	...	67
9348	Lake Charles clay loam, probably—subsoil—rice, 5th crop	55.0	...	...	36.2	...	...	158
20720	Lake Charles clay loam—surface—corn, 1st crop	50.0	11.7	12.0	38.2	17	22	65
20720	Lake Charles clay loam—surface—kafir, 2nd crop	39.5	7.1	14.7	36.3	12	20	73
20720	Lake Charles clay loam—surface—cotton, 3rd crop	33.9	...	...	32.4	...	...	126
20720	Lake Charles clay loam—surface—rice, 4th crop	61.1	...	...	57.0	...	...	169

Table 21.—Pot experiments on soils of Harris County—Continued

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
20721	Lake Charles clay loam—subsoil—corn, 1st crop	29.4	8.5	8.7	20.8	129	13	60
20721	Lake Charles clay loam—subsoil—kafir, 2nd crop	35.8	3.2	12.7	31.9	20	11	79
20721	Lake Charles clay loam—subsoil—cotton, 3rd crop	28.5	....	....	29.2	....	....	88
20721	Lake Charles clay loam—subsoil—rice, 4th crop	50.3	....	....	50.1	....	....	165
20726	Lake Charles clay loam—surface—corn, 1st crop	43.2	24.9	23.0	40.1	45	35	202
20726	Lake Charles clay loam—surface—kafir, 2nd crop	54.0	25.7	37.7	45.4	50	43	139
20726	Lake Charles clay loam—surface—cotton, 3rd crop	29.1	....	....	28.9	....	....	189
20726	Lake Charles clay loam—surface—rice, 4th crop	84.4	....	....	80.8	....	....	378
20727	Lake Charles clay loam—subsoil—corn, 1st crop	49.2	19.2	11.9	44.7	29	39	171
20727	Lake Charles clay loam—subsoil—kafir, 2nd crop	25.0	9.7	19.0	37.4	18	26	105
20727	Lake Charles clay loam—subsoil—cotton, 3rd crop	25.8	....	....	27.4	....	....	165
20727	Lake Charles clay loam—subsoil—rice, 4th crop	66.4	....	....	70.8	....	....	305
23123	Lake Charles very fine sandy loam, probably—surface—kafir	14.2	2.5	10.0	8.8	6	11	....
23124	Lake Charles very fine sandy loam, probably—subsoil—corn, 1st crop	24.5	14.5	5.8	....	21	8	....
23124	Lake Charles very fine sandy loam, probably—subsoil—kafir, 2nd crop	8.9	2.5	9.9	....	5	10	....
23124	Lake Charles very fine sandy loam, probably—subsoil—cotton, 3rd crop	23.6	....	12.0	....	....	18	....
23125	Lake Charles very fine sandy loam, probably—surface—corn, 1st crop	23.4	15.5	3.0	24.8	22	5	61
23125	Lake Charles very fine sandy loam, probably—surface—kafir, 2nd crop	5.7	2.2	10.6	3.9	8	11	20
23126	Lake Charles very fine sandy loam, probably—subsoil—corn, 1st crop	47.6	24.1	11.4	....	37	17	....
23126	Lake Charles very fine sandy loam, probably—subsoil—kafir, 2nd crop	2.2	4.3	12.9	....	10	14	....
23126	Lake Charles very fine sandy loam, probably—subsoil—cotton, 3rd crop	31.9	....	18.9	....	....	28	....

Surface soil, brown. Subsoil, mottled brownish-red and yellow with iron concretions present. Morse series.

Surface soil, light-gray faintly mottled with grayish-brown or dark-gray. Subsoil, light-gray almost white, some with pale-yellow or grayish-yellow mottlings. Edna series.

Surface soil, dark-brown finely mottled with dark-bluish-gray and light-brown. Subject to overflow from Gulf. Harris series.

Table 22.—Composition of saline spots in soils of Harris County, parts per million

Analysis Number	Depth, inches	Calc. Carb.	Mag. Carb.	Sod. Carb.	Sod. Sulp.	Sod. Chlor.
11283	0–10	128	336	19	119	148
11284	10–18	136	288	541	112	333
22110	0–¼	48	90	48	97	314
22111	¼–4	114	188	62	331	718
22112	4–12	147	312	35	267	957
22113	12–36	224	403	158	325	1023
30578	0–12	111	61	....	98	954

Surface soil, light-brown or brown, with light-gray mottled with light-brown, yellow, yellowish-brown subsurface. Subsoil, clay of heavy clay mottled gray and yellow. Reddish-brown and yellow-brown concretions. Katy series.

Surface soil, brown with yellowish-brown or light-brown subsurface. Subsoil, mottled yellow and gray or ashy-gray heavy clay. Hockley series.

Bottom-land Soils. Surface soil, dark brown. Subsoil, light soil is calcareous. Bottom-land. Trinity series.

Surface, brown with light or yellowish-brown subsoils mottled with gray. Ochlockonee series.

Surface soil, light-gray with pale-yellow subsoil occurring on river terraces. Kalmia series.

Upland Soils of Interior Flat Woods. Surface soil, gray or grayish-brown with red friable subsoil. Orangeburg series.

Surface soil, light gray with yellow or pale-yellow friable subsoil. Low in lime occurring on flat land. Norfolk series.

Surface soil, brownish-gray or brown with heavy dense clay subsoil mottled with red and yellow or red, yellow, and gray. Susquehanna series.

Surface soil, ashy-gray or gray. Subsoil and substratum heavy dense clay, light-gray with some pale-yellow or yellow mottling. Lime content low. Lufkin series.

Surface, brownish-gray or gray. Grayish-yellow or pale-yellow subsurface and pale-yellow subsoil, lower portions mottled with gray and yellow. Caddo series.

Condensed Description of Soils of Harris County

Acadia clay is an upland Coast Prairie soil with brownish-gray, ash-gray, or mottled clay surface, bluish-gray or light-gray stiff clay subsoil, is of small extent, occurring on flats.

Acadia clay loam is dark-gray clay loam or shallow very fine sandy loam, gray fine sandy clay loam, faintly mottled with yellow, gray, or dark-gray clay, mottled with light-gray, underlain by tough gray or light-gray clay, in many places showing yellow mottling and here and there some red mottling in the upper part of the subsoil. It is all forested. Little is under cultivation to corn, cotton, sorgo, and some truck crops.

Acadia fine sandy loam consists of brown loamy fine sand underlain by light-brown or pale yellowish-brown loamy fine sand or fine sandy loam, below which is a stiff gritty clay mottled with gray, yellow, bluish-gray, and yellow. The surface is nearly flat, drainage deficient. This is a forested soil of small extent, and little cultivated.

Acadia very fine sandy loam is a light-gray or light-brownish-gray loamy very fine sand or very fine sandy loam with some mottlings of pale-yellow underlain by very light-gray or pale yellowish-gray very fine sandy loam, below which is the subsoil, which is a mottled yellow and light-gray compact impervious clay or a yellowish-brown tough clay. The surface is nearly flat; drainage is slow. It is a forested soil little cultivated.

Caddo fine sandy loam is an upland soil with grayish-brown or brownish-gray loamy fine sand or fine sandy loam surface, underlain by pale-yellow or grayish-yellow fine sand or loamy fine sand, which grades into mottled gray and yellow friable fine sandy clay loam material, below which occurs gray or grayish-yellow gritty clay mottled with yellow and some red, and containing enough fine sand to render it fairly friable. It occupies flat or gently undulating areas. It is a forested soil of small extent, and occurs in the extreme northern part of the county. Cleared areas are usually utilized for pasture.

Edna very fine sandy loam is a Coast Prairie upland soil, with brownish-gray or ashy-gray very fine sandy loam surface, underlain by gray very fine sandy loam with yellowish-brown or pale-yellow and bluish-gray mottlings, below which is tough bluish-gray fine sandy clay mottled with yellowish-brown clay. Drainage is poor. The surface is flat or billowy, with numerous mounds and depressions. Practically none of the land is cultivated.

Harris clay is a Coast Prairie upland soil with a dark bluish-gray, dark-brown or black clay surface soil, underlain by a plastic and sticky dark bluish-gray clay. It is a marshy soil, salty in places and on the higher outer area of tidal marshes, sometimes subject to overflow by wind-blown salt water. It is of slight extent. None of it is in cultivation.

Harris fine sand is a grayish-brown or dark-brown fine sand underlain by pale-yellow, pale brownish-yellow or brownish-gray fine sand or loamy fine sand. It lies between areas of tidal marsh and the higher prairie soils and is subject to overflow by wind-blown salt water from the Gulf. The surface is flat, the drainage poor, and none is in cultivation.

Hockley fine sand is a Coast Prairie upland soil. The surface is a light-brown or grayish-brown loamy fine sand underlain by brownish-yellow fine sand, below which is pale-yellow fine sand, followed by a mottled yellow and gray tough clay containing reddish-brown ferruginous concretions. The drainage is good or excessive. The area is small.

Hockley fine sandy loam is a light-brown, brown, or dark-brown fine sandy loam underlain by light-brown or yellowish-brown fine sandy loam, which becomes heavier with depth. Below this is a yellow heavy fine sandy loam followed by a stiff pale-yellow clay. It is a prairie soil of considerable extent in the northwestern half of the county. The soil surface is flat or gently undulating. Drainage is usually deficient. Corn, cotton, rice, and vegetables are grown.

Kalmia fine sandy loam is an interior Flat Woods terrace soil. The surface is a brownish-gray or grayish-brown fine sandy loam, underlain by yellowish or pale-yellow loamy fine sand, which grades into a friable yellow or pale-yellow, fine sandy clay loam. None of it is tilled. The surface varies from flat to gently undulating, and drainage is usually good.

Kalmia sand is a grayish-brown or gray loose medium sand, underlain by loose yellow or pale-yellow sand. It is a terrace soil of small extent. Drainage is good. None of it is in cultivation.

Katy fine sandy loam is a rich-brown fine sandy loam grading into yellowish-brown or pale-yellow and gray fine sandy loam, and underlain by mottled bluish-gray and yellow plastic clay with reddish-yellow or red mottling. It is an extensive prairie soil. The surface is flat or billowy. The surface drainage is poor. About 10 per cent is under cultivation. Corn, cotton, potatoes, and sweet potatoes are grown. Vegetables do fairly well.

Lake Charles clay is a prairie soil, with a dark ashy-gray or black clay surface soil changing into ashy-gray, bluish-gray, or dark-gray heavy clay, with brown or yellowish-brown mottlings. It is very sticky when wet, but crumbles when dry. It is an extensive and important soil occurring particularly in the southeastern half of the county. The principal crops are corn, cotton, and rice.

Lake Charles clay loam is a black non-effervescing fine sandy clay loam merging into dark-gray or gray clay or fine sandy clay, which changes abruptly into light-gray or pale-yellow stiff clay with yellow or gray mottling. It is a prairie soil with a flat surface and of small area. The main cultivated crops are corn and cotton.

Lake Charles fine sandy loam consists of gray or dark brownish-gray mellow friable fine sandy loam underlain by a light-gray or light-brownish-gray loam or clay loam, below which is an ashy-gray mellow friable clay loam material which passes into an ash-gray or whitish-gray friable clay, which contains an abundance of lime particles and concretions. Alkali spots are numerous. The drainage is usually poor. It is a prairie soil of small area and occurs chiefly in the central and north-central parts of the county. The main crops are corn, cotton, and sorgo, with some potatoes and other vegetables.

Lake Charles very fine sandy loam is a dark-brown loamy very fine sand or very fine sandy loam, underlain by brown sandy clay loam, which grades into brown or mottled brown and yellowish-brown tough clay. It occurs as level areas with poor drainage. It is a prairie soil, small in extent and of minor importance. Most of it is utilized for pasture and hay land.

Lufkin clay loam is a light-gray or mottled white and gray clay loam, which grades into an ashy-gray clay with yellow mottling. It is of small extent, occurring in the northern part of the county. It is a forested soil, none of it being under cultivation.

Morse clay is a brown or dark-brown stiff clay, underlain by rich-brown sticky clay, below which is a plastic clay varying in color from bluish gray with mottlings of pale yellow, grayish-yellow, and some red, to yellow or yellow with gray mottlings. In a few places the surface soil is nearly black. It is a forested soil of very small extent. It occurs principally in the eastern part of the county. Practically none of this soil is tilled.

Morse fine sandy loam is a brown or grayish-brown friable, mellow, loamy fine sand or fine sandy loam, underlain by light brownish-gray or pale-yellow loamy fine sand or fine sandy loam, below which is gritty clay loam, mottled with gray, yellow, and some red followed by a stiff plastic clay mottled with yellow, gray, and red. It occurs mainly on gentle slopes which border streams. The principal areas are in the northeastern part of the county. It is a forested soil, and practically none of it is under cultivation.

Morse very fine sandy loam consists of brown loamy very fine sand which grades into light-brown loamy very fine sand and then into yellowish-brown, pale-yellow, or grayish-yellow loamy very fine sand, underlain at a depth of 18 or 22 inches by stiff, plastic clay mottled red and yellow, with some gray. It occurs principally in the eastern part of the county on slopes and on some nearly flat areas near the streams. It is of small extent, chiefly forested, and little cultivated.

Norfolk fine sand is a grayish-brown fine sand overlying a pale-yellow fine sand. It is forested. The surface varies from gently undulating to rolling and hillocky. It is confined entirely to the northern part of the county. None of it is in cultivation.

Ochlockonee clay is a brown silty clay grading into lighter-brown silty clay with some bluish-gray mottling, the bluish-gray increasing with depth and dominating the color of the lower subsoil except for some yellowish-brown mottlings. This is a first-bottom land which is subject to overflow, and occurs along many of the streams of the county. Drainage is usually very poor. None of it is in cultivation, practically all of it being covered by forest.

Ochlockonee fine sand is brown fine sand, loamy in places and grading downward into yellowish-brown fine sand and below this into pale-yellow loose fine sand. It is a first-bottom soil subject to frequent overflow. It occurs along the larger streams of the county. The surface is nearly flat to uneven with small mounds and low ridges with good drainage. None of it is farmed.

Ochlockonee fine sandy loam varies from a brown to dark-brown or grayish-brown fine sandy loam, which grades into brown clay loam with faint mottlings of rusty brown or yellowish-brown, below which is bluish-gray or ashy-gray stiff plastic clay with some mottlings of rusty brown and pale-yellow. It is a first-bottom soil, subject to frequent overflow, and occurs along the larger streams of the county. The drainage is fairly good when the soil is not inundated. It is an inextensive forested soil of low agricultural value, and none of it is farmed.

Ochlockonee sand on the surface, may be brown, yellowish-brown, or grayish-brown loose medium sand, usually carrying considerable fine sand, below which is a pale-yellow or pale-yellowish-brown incoherent sand. This is a first-bottom soil subject to overflow; is not in cultivation, but forested.

Orangeburg fine sandy loam is a grayish-brown loamy fine sand underlain by brownish-red loamy fine sand or fine sandy loam, below which is red, friable, fine sandy clay loam, below which is red, friable gritty clay. It occurs in the northern part of the county. The surface varies from sloping to undulating or gently rolling, with good drainage. This is a forested soil, with small areas in pasture or crop.

Suequehanna clay loam is a grayish-brown or brownish-gray clay loam, underlain by brownish-gray loam or clay usually faintly mottled with yellow, which grades into mottled bluish-gray, yellow and red clay followed by a stiff plastic clay mottled with red, yellow, and bluish-gray.

It occurs in the northern part of the county. It is a forested soil and none of it is cultivated.

Susquehanna fine sandy loam is a grayish-brown or light-brownish-gray very fine sandy loam, grading into a very light-gray or pale-yellow very fine sandy loam, usually mottled with pale-yellowish-brown and underlain by a light-yellow clay loam material mottled with yellowish-brown and dark-gray, followed by a stiff, plastic clay mottled with red, yellow, brown, and gray. This is a forested soil of small area and none of it is in cultivation. It occurs in the northern part of the county. The surface is flat, gently undulating, or sloping.

Trinity clay is a dark-brown or nearly black clay grading downward into a calcareous brown clay, below which is a stiff plastic dark-brown or black clay, usually calcareous. It is a first-bottom soil subject to overflow. It occurs along streams in the southeastern part of the county. None of this type of soil is cultivated.

SOILS OF REEVES COUNTY

Eighteen types of soil were mapped in Reeves county, divided into eight series. The upland soils are grouped in the Reeves, Verhalen, and Ector series. The alluvial soils include the Balmorhea, Toyah, Arno, Pecos, and Patrole series. The Reeves silty clay loam with the deep phase is the most extensive soil, occupying 33.2 per cent of the area. Next comes Reeves gravelly loam, 27.0 per cent; Verhalen clay, 12.1 per cent, and Verhalen gravelly loam, 6.9 per cent. The land used for cultivation is chiefly the Reeves silty clay loam, deep phase, Verhalen clay, Balmorhea clay, Toyah loam, Toyah silty clay loam, and Pecos silty clay loam. The other soils are chiefly used for grazing. The land in cultivation is irrigated. Alkali occurs in some soils where underdrainage is deficient or the ground water has been allowed to rise near the surface. It may become a serious problem where the irrigation is not accompanied by suitable underdrainage, or on heavy impervious soils.

Composition of Soils. The chemical composition of the soils of Reeves county is given in Table 23 and the interpretation of the analyses in Table 24. The soils on an average are well supplied with phosphoric acid, are high in total and active potash, but are somewhat less well supplied with nitrogen. They are all well supplied with lime, and none of them are acid, but some are inclined to be alkaline in reaction. The analyses indicate a probable need for nitrogen, especially for soils under irrigation and cultivated to truck crops. Alfalfa and other legumes would not need nitrogen, as they can take it from the air.

Fertilizers. Fertilizers will be needed for crops under irrigation, especially nitrogen for crops other than alfalfa or legumes, and phosphoric acid with nitrogen for truck crops. No definite recommendation

Table 23.—Analyses of soils of Reeves County.

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Arno clay	.060	.165	468	1.82	1.08	471	9.58	2.76	8.2	0–8
Arno clay	.061	.163	153	2.32	1.12	322	9.54	17.60	8.3	8–36
Arno very fine sandy loam	.014	.073	244	1.93	.12	79	4.65	6.93	7.7	0–10
Arno very fine sandy loam	.054	.133	61	2.32	.68	200	11.70	10.00	7.3	10–36
Balmorhea clay	.205	.175	142	2.20	.66	433	12.33	10.00	8.4	0–15
Balmorhea clay	.041	.100	406	2.87	.84	530	5.45	4.56	8.4	15–36
Lake bed clay	.035	...	...	...	...	...	...	...	8.2	0–36
Lake bed clay	...	...	...	...	.95	...	9.29	...	...	36–72
Lake bluff clay	.020	...	...	...	.64	...	9.09	...	8.0	0–4
Patrole silty clay loam	.034	.075	131	1.31	.19	186	14.31	20.70	7.5	0–8
Patrole silty clay loam	.018	.082	68	1.47	.30	201	11.12	14.60	7.7	8–18
Patrole silty clay loam	.036	.105	61	2.04	.64	360	11.56	18.90	7.5	18–36
Pecos clay	.076	.143	73	2.20	1.08	299	12.98	10.00	7.3	0–24
Pecos clay	.040	.179	166	2.13	1.13	250	11.77	10.00	7.8	24–36
Pecos silty clay loam	.092	.146	179	2.10	.70	294	8.43	15.80	8.3	0–6
Pecos silty clay loam	.056	.148	64	2.05	.89	235	11.01	17.90	7.3	6–30
Pecos silty clay loam	.038	.168	166	2.05	1.03	251	10.87	19.60	7.5	30–36
Reeves chalk	.029	.017	40	.95	.06	5	6.72	1.10	7.1	0–36
Reeves fine sandy loam	.030	.041	136	1.35	.33	262	2.43	3.07	8.4	0–8
Reeves fine sandy loam	.031	.054	111	1.18	.43	197	5.24	6.56	8.2	8–36
Reeves gravelly loam	.063	.077	73	2.06	.34	220	13.39	10.00	8.5	Surface
Reeves gravelly loam	.040	.057	30	1.25	.20	130	20.07	10.00	8.1	Subsoil
Reeves gravelly fine sandy loam	.043	.049	...	1.32	.23	...	6.57	...	7.7	0–8
Reeves gravelly fine sandy loam	.039	.046	153	1.32	.19	270	7.57	13.40	8.3	8–36
Reeves sand	.017	.033	183	1.42	.16	9	7.12	3.15	7.3	0–36
Reeves silty clay loam	.069	.140	341	2.23	.69	365	9.43	8.72	8.0	Surface
Reeves silty clay loam	.036	.080	162	1.29	.64	211	10.73	7.99	7.9	Subsoil
Reeves silty clay loam	.025	.040	54	...	.49	79	14.88	9.95	...	24–36
Toyah loam	.092	.110	686	3.33	.50	913	3.03	5.30	7.3	0–12
Toyah loam	.046	.120	681	3.35	.65	836	2.82	4.70	7.5	12–36
Toyah fine sandy loam	.082	.126	90	3.24	.56	372	3.26	10.00	7.0	0–15
Toyah fine sandy loam	.060	.115	489	2.93	.59	748	7.08	7.17	7.4	15–36
Toyah silty clay loam	.108	.165	913	3.49	.78	939	1.81	3.10	7.2	0–10
Toyah silty clay loam	.063	.106	495	3.49	.60	835	3.66	5.85	7.7	10–36
Verhalen clay	.048	.070	464	2.99	1.04	825	1.56	2.96	7.1	Surface
Verhalen clay	.051	.063	280	3.71	.79	898	0.74	1.40	7.1	10–36
Verhalen gravelly clay loam	.046	.047	73	3.61	.55	639	1.36	.35	7.2	0–10
Verhalen gravelly clay loam	.051	.039	...	3.20	.48	...	2.50	...	8.2	10–36
Verhalen loamy fine sand	.046	.049	170	2.71	.23	361	7.17	9.45	8.5	0–8
Verhalen loamy fine sand	.022	.050	88	2.36	.23	169	9.09	14.60	8.5	8–30

Table 24.—Interpretation of analyses of surface soils of Reeves County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Arno clay	18	55	196	good	good	high
Arno very fine sandy loam	8	50	50	good	fair	high
Balmorhea clay	58	45	188	good	good	high
Lake bed clay	13	....	....	....	....	....
Lake bluff clay	8	....	....	....	good	high
Patrole silty clay loam	13	45	94	good	good	high
Pecos clay	23	35	135	good	good	high
Pecos silty clay loam	28	45	135	good	good	high
Reeves chalk	13	24	26	low	low	high
Reeves fine sandy loam	13	45	125	good	good	high
Reeves gravelly loam	23	35	105	good	good	high
Reeves gravelly fine sandy loam	18	....	....	good	good	high
Reeves sand	8	45	26	good	good	high
Reeves silty clay loam	23	50	163	good	good	high
Toyah loam	28	60	297	good	good	high
Toyah fine sandy loam	28	40	163	good	good	high
Toyah silty clay loam	33	65	301	good	good	good
Verhalen clay	18	55	286	good	good	good
Verhalen gravelly clay loam	18	35	245	good	good	good
Verhalen loamy fine sand	18	45	163	good	good	high

can be made in the absence of fertilizer experiments on which to base these recommendations.

Lime is not needed. Alkali will occur on poorly drained soils under irrigation when the ground water is allowed to rise too near the surface.

Classification of the Soil Series

Bottom-land Soils. Surface soils, chocolate-brown to chocolate-red in color. Subsoil, contains whitish gypsum. Arno series.

Surface soil, very dark-brown to black. Subsoil, brown to yellowish-brown. Balmorhea series.

Surface soil, ashy-gray mottled with rusty brown. Subsoil, bluish to greenish-gray chalky material containing gypsum. Patrole series.

Surface soil, dark-brown to black. Subsoil, chocolate brown to chocolate red with gypsum. Pecos series.

Surface soil, brown of mellow consistency. Subsoil, at 8 to 14 inches chocolate-brown, stiffer material. Toyah series.

Upland Soils. Surface soil, brownish-gray to light-brown. Subsoil, light-buff, pale-salmon, or whitish material of chalky consistency. Reeves series.

Surface soil, chocolate to reddish or dull-red color underlaid at various depths by whitish to light-pinkish material of chalky consistence. Verhalen series.

Surface soil, brownish-gray to whitish containing abundance of limestone fragments. Subsoil, cream-colored loam to light-buff-colored clay loam. Ector series.

Condensed Description of Soil Types of Reeves County

Arno clay is a chocolate-red to dark chocolate-red clay, which passes into salmon-colored fine sandy loam, sandy clay loam, loamy fine sand or even fine sand. The soil is very plastic and sticky when wet, and cracks on drying. Alkali content is too high for production of crops. The surface is flat and subject to overflow and the drainage is poor. It is used exclusively for pasture.

Arno very fine sandy loam is light chocolate-red very fine sand or loamy very fine sand, overlying chocolate-red clay. It is found on flat to billowy or hummocky land in the Pecos River bottoms. The surface drainage is good, but the underdrainage is deficient, owing to the impervious clay. Following irrigation the water table rises in places to within three and one-half or four feet from the surface. A small portion is under cultivation to cotton.

Balmorhea clay is black clay, rich in organic matter, underlain by greenish-yellow, yellowish-brown, or grayish, soft, chalky, calcareous material. The surface is flat but drainage is fair. The two areas in the Balmorhea district are entirely in cultivation. The area south of Pecos is used for pasture.

Ector gravelly loam is light-brown or yellowish-brown gravelly loam or gravelly silty clay loam, grading into cream-colored to light-buff or light yellowish-brown gravelly silty clay loam. It is not extensive. The surface is smooth to steeply sloping. The drainage is good. It is used for pasture.

Patrole silty clay loam is an ashy-gray silty clay loam, passing into light-gray silty clay loam mottled with yellow and rusty brown, below which is chocolate-red, stiff clay. It occurs only in the Pecos River flood plain, and is used exclusively for pasture. It has a high alkali content.

Pecos clay is a dark-gray or grayish-brown clay, which dries to an ashy cast, underlain by chocolate-red clay. The soil is very sticky and plastic when wet, but crumbles on drying. It occurs in the Pecos River bottoms. The surface is flat and the drainage poor. It is used almost exclusively for pasture. Only patches are cultivated to cotton and alfalfa.

Pecos silty clay loam is a dark-gray or grayish-brown silty clay loam, grading into dark-gray or olive-brown clay. The soil is sticky and plastic when wet but crumbles on drying. It is not extensive, and occurs only in the Pecos River bottoms. The surface is flat. Most of it is under cultivation to cotton and alfalfa.

Reeves chalk is light cream-colored chalky material, composed largely of gypsum, with some hard layers or lenses. This soil is used entirely for pasture, but its value for this is low.

Reeves fine sandy loam is light-brown to light-buff fine sandy loam, often rather heavy, underlain by yellowish-brown to brownish-yellow, heavy fine sandy clay loam. It is not very extensive. The surface is mainly gently undulating, and the drainage is good. It is used exclusively for pasture. With irrigation, it is suited to vegetables, cantaloupes, watermelons, and cotton.

Reeves gravelly fine sandy loam is a light-brown to yellowish-brown gravelly fine sandy loam, underlain by a light yellowish-brown or light buff-colored gravelly fine sandy clay. It occurs only in isolated areas north and east of Four-Mile Draw, usually on slopes and well-rounded ridges. The drainage is good, but the soil is retentive of moisture. It is used entirely for pasture land.

Reeves gravelly loam is grayish - brown, light-brown, or yellowish-brown gravelly loam, underlain by light-buff gravelly loam, which passes into whitish chalk of high gypsum content. The surface is strewn with gravel or quartz and vari-colored pebbles. It is widely distributed and is utilized for pasture.

Reeves silty clay loam is light-brown, brownish-gray, or faintly buff-colored silty clay loam, underlain by pink chalky material. It occupies extensive areas and is devoted to pasture. It is not a valuable agricultural soil. There is also a deep phase of this type, which is used to a small extent for the production of corn, alfalfa, and cantaloupes.

Toyah fine sandy loam is brown fine sandy loam or loamy fine sand, grading into light-brown or yellowish-brown fine sandy loam, which passes into brown or yellowish-brown friable loam or clay loam. It is confined to the first-bottoms of streams chiefly along Toyah Creek. The surface is flat, with good to excessive drainage. About 20 per cent is cultivated to alfalfa and cotton.

Toyah loam is a brown mellow loam, passing into brown friable loam or clay loam. It is a first-bottom or recent-alluvial soil. The surface is nearly flat, but with good surface drainage. The underdrainage is also good; a gravel stratum occurs. Most of it is under cultivation.

Toyah silty clay loam is a dark-brown to brown silty clay loam, passing into dark-brown or chocolate-brown silty clay loam or silty clay. The soil is friable and easy to cultivate, forming a good tilth. It is a first-bottom alluvial soil, widely distributed along all the creeks of the area. The surface is nearly flat, with good surface drainage and underdrainage. A large fraction is under cultivation.

Verhalen clay typically is chocolate-brown clay, which passes into a stiffer and more reddish or reddish-brown clay. The surface is nearly flat, but with good surface drainage. The underdrainage is good owing to a gravel substratum, except when the gravel has formed into a hardpan. Some of this soil is farmed under irrigation to alfalfa, cotton, kafir and milo.

Verhalen gravelly clay loam is of reddish-brown or chocolate-brown gravelly clay loam, passing into chocolate-brown or light-brownish-red clay loam to clay, containing considerable gravel. It is extensively developed adjacent to the Davis Mountains. It occurs on gently rolling ridges with good drainage. The soil is used only for pasture.

Verhalen loamy fine sand is reddish-brown loamy fine sand, underlain by brownish-red or chocolate brownish-red loamy fine sand to fine sandy loam. It is not extensive. The surface is gently sloping, and the drainage is good. It would probably produce fair yields of the general farm crops of this section under irrigation but at present it is used for pasture.

SOILS OF ROCKWALL COUNTY

Eight types of soil occur in Rockwall county, in five series. The upland prairie soils are classed in the Houston and Wilson series. The terrace soils, chiefly in the northwest section of the county, are of the Bell and Lewisville series. The alluvial soils are grouped in the Trinity series. The Houston clay is the most extensive type, occupying 38.1 per cent of the area. The Houston black clay, 28.1 per cent; the Trinity clay, 18.0 per cent, and the Wilson clay loam, 7.9 per cent, are extensive soils in the order given.

Composition of Soils. The chemical analyses of the soil types is given in Table 25 and the interpretation of the analyses in Table 26. The corn possibility of the nitrogen varies from 18 to 38 bushels per acre; that of the active phosphoric acid from 18 to 50, and that of the active potash from 73 to 196. This indicates that both nitrogen and phosphoric acid are needed by some of these soil types, especially phosphoric acid in those of the Wilson series. None of the soils are acid, and some are high in lime.

Pot Experiments. Pot experiments on a number of samples are given in Table 27. Decided increases in growth of the crops due to nitrogen and phosphoric acid are to be observed with the surface soils of the Houston black clay sample No. 21073, and with nitrogen on the surface soil of Houston black clay No. 21075. Less marked responses to nitrogen and phosphoric acid can be observed with some of the other surface soils.

Fertilizers. These results indicate that the Houston soils which do not produce well need applications of fertilizer and that the lack of response to fertilizers observed with these soils may be due to other limiting conditions, such as moisture. The response to applications of potash is small or none, and the soils seem to be well supplied with potash.

Lime. Applications of lime are not needed on these soils.

Classification of Soil Types

Bottom-land Soils. Surface soil, dark ashy-gray to black or dark-brown. Subsoil, black or nearly black and dark ashy-gray, heavy plastic clay. Soils calcareous. Trinity clay.

Upland Soils. Surface soil, black or dark-bluish-gray. Subsoil, dark-bluish-gray to very dark-brown, both soil and subsoil are calcareous. Bell series.

Surface soil, black to brown. Subsoil, dark-yellowish-brown to whitish-yellow calcareous clay. Houston series.

Surface soil, brown to yellowish-brown. Subsoil, pale-yellowish-brown, highly calcareous. Lewisville series.

Surface soil, black or dark-brown to grayish-brown. Subsoil, dark-bluish gray. Heavy plastic clay. Wilson series.

Table 25.—Analyses of soils of Rockwall County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Bell clay	.090	.090	345	....	.62	455	1.83	3.02	7.3	0–8
Bell clay	.086	.057	182	.77	.58	312	1.50	2.25	7.4	8–36
Houston black clay	.120	.089	127	.73	.38	276	5.60	5.51	7.4	Surface
Houston black clay	.098	.073	67	.76	.36	141	6.18	6.24	7.4	Subsoil
Houston clay	.109	.143	66	.89	.34	151	15.91	9.96	7.5	Surface
Houston clay	.052	.108	19	.85	.32	59	19.68	10.00	7.6	Subsoil
Houston clay	.039	.046	5	.77	....	44	....	10.00	7.9	12–36
Lewisville clay	.102	.148	31	.93	.41	136	12.46	21.80	7.3	0–8
Lewisville clay	.058	.120	15	1.24	.32	70	16.82	31.10	7.5	8–36
Trinity clay	.135	.131	106	.72	.45	196	10.84	7.91	7.4	Surface
Trinity clay	.098	.115	76	.65	.42	127	13.17	7.91	7.4	Subsoil
Wilson clay	.117	.045	29	.57	.20	149	1.34	1.60	6.8	Surface
Wilson clay	.068	.026	15	.57	.14	107	1.34	1.66	6.8	Subsoil
Wilson clay loam	.104	.044	28	1.11	.24	161	.69	.88	6.7	Surface
Wilson clay loam	.075	.029	11	.95	.25	88	.85	1.01	6.8	Subsoil
Wilson fine sandy loam	.043	.027	26	.61	.12	188	.36	.60	6.7	0–7
Wilson fine sandy loam	.060	.024	21	.54	.25	159	.78	1.40	6.7	7–18
Wilson fine sandy loam	.027	.025	35	.73	.26	110	....	1.70	7.4	18–36

Table 26.—Interpretation of analyses of surface soils of Rockwall County.

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Bell clay	28	50	196	good	good	high
Houston black clay	33	45	135	good	good	high
Houston clay	33	35	84	good	good	high
Lewisville clay	33	24	73	good	good	high
Trinity clay	38	45	94	good	good	high
Wilson clay	33	18	73	good	fair	high
Wilson clay loam	33	18	84	good	good	good
Wilson fine sandy loam	18	18	94	low	fair	good

Condensed Description of Soils of Rockwall County

Bell clay is a black, dark ashy-brown, or dark ashy-gray, calcareous clay, with a dark-bluish-gray heavy, calcareous clay subsoil. The surface soil is very plastic and waxy when wet, but when dry it crumbles. It occurs on a high terrace bordering the west county line. The drainage is good. It is an important soil. Practically all of it is under cultivation.

Houston black clay is a very dark-brown to black calcareous clay, underlain by very dark-brown or dark-bluish-gray to black calcareous clay. The surface soil when wet is very sticky, and locally the type is called "black waxy land." When dry, however, it crumbles into a fine condition. It is the most extensive and important soil type in the county. It occurs chiefly in a belt averaging about four miles in width, running north and south across the east-central part of the county. The surface is undulating to very gently rolling. The drainage is good. Erosion is going on. Practically all of it is in cultivation. It is the most productive upland soil in the county.

Houston clay is an ashy-brown or dark ashy-brown to dark ashy-gray, calcareous clay, underlain by yellowish-brown calcareous clay. Below this is a light-yellowish-brown to pale-brownish-yellow or cream-colored, highly calcareous clay, which grades beneath into the parent material, a whitish to pale-bluish-gray marly clay. While this soil is a heavy clay and is very plastic when wet, it crumbles to a desirable tilth on drying. It occurs on slopes along streams and drainage ways and on narrow divides where the surface layer of black soil has been thinned by erosion. Most of it is under cultivation.

Lewisville clay is a brown, highly calcareous clay, underlain by a pale-yellowish-brown highly calcareous clay, which in turn grades into a substratum of pale-yellow marly clay. It is a terrace soil of small extent and of minor importance.

Trinity clay is a black or nearly black, calcareous clay, which in places extends to depths of three feet or more without change. It is a first-bottom soil. The principal area, averaging about two miles in width, extends across the county in a north and south direction in the valley of the East Fork of the Trinity River. This type is productive and important.

Wilson clay is a dark ashy-brown to nearly black, stiff, heavy clay, underlain by dark-bluish-gray to almost black very stiff clay, which grades downward into lighter-colored clay, and passes into brownish-yellow highly calcareous clay. It occurs in the eastern part of the county in a narrow belt running north and south and bordering the eastern margin of the Houston black clay. It is slightly more compact, and does not crumble and crack to such an extent as the Houston soils, and

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid	Potash
21069	Houston black clay—surface—corn, 1st crop	50.0	15.7	46.4	50.4	23	110	577
21069	Houston black clay—surface—kafir, 2nd crop	47.3	12.4	50.9	49.0	19	111	338
21069	Houston black clay—surface—cotton, 3rd crop	28.2	....	....	26.2	....	....	298
21070	Houston black clay—subsoil—corn, 1st crop	33.1	16.3	26.2	29.6	26	40	279
21070	Houston black clay—subsoil—kafir, 2nd crop	35.2	5.2	36.0	33.8	9	43	206
21070	Houston black clay—subsoil—cotton, 3rd crop	29.6	....	....	26.7	....	....	225
21070	Houston black clay—subsoil—cowpeas, 4th crop	39.8	....	....	52.6	....	....	439
21073	Houston black clay—surface—corn, 1st crop	28.9	10.6	7.3	27.2	16	8	260
21073	Houston black clay—surface—kafir, 2nd crop	13.7	7.0	11.5	27.4	11	15	185
21073	Houston black clay—surface—cotton, 3rd crop	23.7	....	....	26.1	....	....	217
21073	Houston black clay—surface—cowpeas, 4th crop	43.4	....	....	39.4	....	....	404
21074	Houston black clay—subsoil—corn, 1st crop	21.3	7.0	5.1	12.7	12	8	84
21074	Houston black clay—subsoil—kafir, 2nd crop	16.7	2.4	5.3	11.4	5	6	73
21074	Houston black clay—subsoil—cotton, 3rd crop	15.9	....	....	13.0	....	....	101
21074	Houston black clay—subsoil—cowpeas, 4th crop	20.0	....	....	19.6	....	....	178
21075	Houston black clay—surface—corn, 1st crop	21.2	13.8	34.7	34.1	21	44	302
21075	Houston black c ay—surface—kafir, 2nd crop	20.8	7.3	16.3	30.1	16	30	228
21075	Houston black clay—surface—cotton, 3rd crop	27.8	....	....	31.3	....	....	278
21075	Houston black clay—surface—cowpeas, 4th crop	45.4	....	....	47.0	....	....	630
21076	Houston black clay—subsoil—corn, 1st crop	14.1	6.1	4.9	8.5	10	7	104
21076	Houston black clay—subsoil—kafir, 2nd crop	27.9	2.3	7.2	17.2	40	4	88
21076	Houston black clay—subsoil—cotton, 3rd crop	11.5	....	....	11.8	....	....	116
21076	Houston black clay—subsoil—cowpeas, 4th crop	16.9	....	....	18.7	....	....	167
21067	Trinity clay—surface—corn, 1st crop	43.6	25.1	46.3	47.8	40	98	656
21067	Trinity clay—surface—kafir, 2nd crop	39.5	7.3	34.1	31.7	14	96	356
21067	Trinity clay—surface—cotton, 3rd crop	36.5	....	....	35.2	....	....	348
21067	Trinity clay—surface—cowpeas, 4th crop	67.0	....	....	62.9	....	....	914
21068	Trinity clay—subsoil—corn, 1st crop	17.4	12.0	8.5	13.2	26	14	168
21068	Trinity clay—subsoil—kafir, 2nd crop	34.8	4.0	20.9	34.0	7	24	230
21068	Trinity clay—subsoil—cotton, 3rd crop	26.0	....	....	24.3	....	....	199
21068	Trinity clay—subsoil—cowpeas, 4th crop	41.7	....	....	40.0	....	....	297
21077	Wilson clay—surface—corn, 1st crop	49.5	23.2	38.4	48.2	41	57	394
21077	Wilson clay—surface—kafir, 2nd crop	23.4	11.8	46.6	50.0	24	57	208
21077	Wilson clay—surface—cotton, 3rd crop	32.5	....	....	30.3	....	....	279
21077	Wilson clay—surface—cowpeas, 4th crop	55.1	....	....	56.3	....	....	599
21078	Wilson clay—subsoil—corn, 1st crop	40.1	9.3	10.6	39.1	16	14	123
21078	Wilson clay—subsoil—kafir, 2nd crop	35.3	3.7	13.9	30.1	7	18	113
21078	Wilson clay—subsoil—cotton, 3rd crop	24.6	....	....	24.3	....	....	179
21078	Wilson clay—subsoil—cowpeas, 4th crop	49.4	....	....	49.3	....	....	282
21071	Wilson clay loam—surface—corn, 1st crop	42.7	27.1	26.9	46.2	48	34	384
21071	Wilson clay loam—surface—kafir, 2nd crop	45.2	9.5	25.2	42.9	20	35	207
21071	Wilson clay loam—surface—cotton, 3rd crop	36.4	....	....	36.0	136	....	290
21071	Wilson clay loam—surface—cowpeas, 4th crop	63.5	....	....	59.4	....	....	529
21072	Wilson clay loam—subsoil—corn, 1st crop	42.8	7.3	8.0	39.4	13	10	307
21072	Wilson clay loam—subsoil—kafir, 2nd crop	39.0	5.0	10.5	33.4	16	13	150
21072	Wilson clay loam—subsoil—cotton, 3rd crop	34.0	....	....	32.1	....	....	245
21072	Wilson clay loam—subsoil—cowpeas, 4th crop	59.2	....	....	60.0	....	....	345

is more difficult to plow. It has less power to hold water and is not able to resist drought as the Houston soils.

Wilson clay loam is an ashy-brown to dark ashy-brown clay loam, underlain by dark-bluish-gray, stiff, non-calcareous clay, below which is yellowish-brown or cream-colored calcareous clay. It is very sticky when wet but crumbles if cultivated at the proper time. It is locally called "rawhide land." It occurs in a belt, with an average width of about one mile, extending across the county north and south, along the eastern county line. The surface is gently undulating to undulating. The drainage is good. It is not as productive as the Houston black clay.

Wilson fine sandy loam is a brown, mellow, friable, non-calcareous fine sandy loam. The subsurface layer is a bluish-gray, stiff, plastic, non-calcareous clay, which in places is mottled with brown. Below this is a bluish-gray, stiff, plastic, non-calcareous clay, without mottling. It is of a minor importance, occurring only in two small areas in the southeastern part of the county. The surface is undulating to rolling, and the drainage is good.

SOILS OF TARRANT COUNTY

Thirty-one types of soil were mapped in Tarrant county, classed in 24 series. The Crawford, Durant, Denton, San Saba, and Wilson series occur in the Fort Worth prairie, while the Houston and Ellis series occur in the Black Prairie section. The Nimrod and Windthorst series include upland soils of the West Cross Timbers. The Kirvin, Tabor, Lufkin, and Norfolk series are upland soils of the East Cross Timbers. The terrace soils include the Lewisville, Bell, Irving, Simmons, Leaf, Kalmia, and Amite series. The Lewisville and Bell soils are calcareous. The bottom soils include the Frio, Trinity, Catalpa, and Ochlockonee series. The Denton clay is the most extensive type, occupying 34.9 per cent of the county, Kirvin fine sandy loam occupies 14.4 per cent of the county, San Saba clay 7.2 per cent, Tabor fine sandy loam 6.5 per cent, Frio clay 5.7 per cent, and Houston black clay 5.0 per cent.

Composition of Soils. The chemical analyses of the soils of Tarrant county are given in Table 28 and the interpretation of the analyses in Table 29. The Black Prairie soils average the highest in plant food. The alluvial, or first-bottom soils, come next, after which are those of the Fort Worth Prairie. The soils of the East Cross Timbers and of the West Cross Timbers are low in nitrogen, active phosphoric acid, and also in potash, although better supplied with potash than with the nitrogen or phosphoric acid. None of the soils or subsoils are acid. They are usually well supplied with lime and some are high in lime. Soil types particularly low in active phosphoric acid with a corn possibility of 6 to 18 bushels per acre, include the Amite fine sandy loam, Crawford clay, Durant clay loam, Durant fine sandy loam, Irving clay, Kalmia fine sandy loam, Leaf clay loam, Lewisville clay, Lufkin fine sandy loam,

Table 28.—Analyses of soils of Tarrant County

	Nitrogen per cent	Total phos. ac. per cent	Active phos. ac. per million	Total potash per cent	Acid soluble potash per cent	Active potash per million	Acid soluble lime per cent	Basicity per cent	Reaction pH	Depth, inches
Amite fine sandy loam	.038	.035	19	.54	.17	84	.23	.25	7.1	0–10
Amite fine sandy loam	.041	.034	7	.96	.25	147	.18	.15	6.7	10–36
Bell clay	.129	.129	129	1.08	.46	146	5.26	1.87	7.3	0–8
Bell clay	.085	.074	67	1.03	.44	100	6.12	1.63	7.5	8–20
Bell clay	.061	.126	66	1.06	.49	106	6.38	1.23	7.5	20–36
Catalpa clay	.103	.134	81	1.02	.28	268	.63	1.92	7.3	0–36
Crawford clay	.103	.049	9	.88	.28	98	.67	.39	6.6	0–8
Crawford clay	.081	.055	7	.83	.37	96	2.10	3.11	7.4	8–36
Denton clay	.135	.076	32	1.15	.51	140	7.65	6.28	7.2	Surface
Denton clay	.083	.056	7	1.11	.44	85	13.88	6.68	7.4	Subsoil
Durant clay loam	.109	.076	8	.87	.34	133	.70	1.13	7.3	0–8
Durant clay loam	.083	.090	2	1.11	.43	70	.80	1.53	7.6	8–36
Durant fine sandy loam	.105	.105	14	.87	.20	144	.37	1.18	6.9	0–8
Durant fine sandy loam	.080	.128	8	1.10	.52	105	.76	1.23	7.1	8–36
Frio clay	.138	.133	39	1.54	.66	162	11.08	9.95	7.3	Surface
Frio clay	.106	.142	58	1.71	.75	62	11.63	5.42	7.5	Subsoil
Frio fine sandy loam	.068	.091	122	.75	.20	175	.43	8.71	7.5	0–8
Frio fine sandy loam	.055	.097	53	.80	.24	126	.43	4.10	7.1	8–36
Frio loam	.084	.044	54	1.27	.28	167	.60	.86	7.4	0–12
Frio loam	.040	.028	13	1.30	.30	66	.53	.24	7.6	12–36
Houston black clay	.182	.109	186	1.03	.57	239	3.33	3.15	7.3	0–10
Houston black clay	.124	.088	58	.93	.45	65	10.53	9.12	7.4	10–36
Houston clay	.161	.189	156	1.18	.59	154	12.91	9.75	7.4	0–10
Houston clay	.084	.211	188	1.19	.49	96	12.40	10.00	7.5	10–36
Irving clay	.105	.032	11	.83	.19	106	.89	7.53	7.1	0–8
Irving clay	.065	.031	5	.82	.24	95	.97	8.27	7.4	8–36
Kalmia fine sand	.018	.028	48	.49	.04	35	.48	.77	7.7	0–7
Kalmia fine sand	.009	.019	11	.47	.04	25	.48	.28	7.5	7–36
Kalmia fine sandy loam	.019	.025	6	.43	.07	35	.15	.48	7.2	0–15
Kalmia fine sandy loam	.031	.023	1	.92	.38	116	.19	.58	7.0	15–36
Kirvin fine sandy loam	.038	.056	23	.54	.10	72	.18	.48	7.0	Surface
Kirvin fine sandy loam	.046	.068	8	.69	.30	104	.24	.49	6.3	Subsoil
Kirvin fine sandy loam	.043	.085	8	.68	.30	63	.23	.78	6.3	20–36
Leaf clay loam	.087	.068	9	.81	.30	184	.52	1.01	7.3	Surface
Leaf clay loam	.075	.047	4	1.04	.54	121	.63	1.38	6.9	Subsoil
Leaf clay loam	.039	.027	6	.77	.30	106	1.69	2.39	7.7	20–36
Leaf fine sandy loam	.032	.017	36	.59	.11	103	.24	1.57	7.0	0–7
Leaf fine sandy loam	.032	.024	6	.83	.36	91	.52	1.52	6.8	7–30
Leaf fine sandy loam	.027	.013	4	.83	.21	69	.21	2.36	7.0	18–36
Lewisville clay	.095	.048	9	.70	.17	113	1.10	2.00	7.5	Surface
Lewisville clay	.056	.020	6	.69	.16	78	3.08	1.21	7.1	Subsoil

Table 28—Analyses of soils of Tarrant County—Continued

	Nitrogen per cent	Total Phos. Ac.	Active Phos. Ac. per	Total potash	Acid soluble potash	Active potash per	Acid soluble lime	Basicity per cent	Reaction pH	Depth, inches
Lufkin fine sandy loam	.066	.065	3	.92	.08	91	.23	.44	7.4	0–10
Lufkin fine sandy loam	.037	.031	7	.92	.18	28	.54	.54	7.5	10–36
Nimrod fine sand	.017	.013	14	.46	.09	11	.13	.29	6.7	0–8
Nimrod fine sand	.013	.011	9	.55	.08	31	.08	.34	6.8	8–36
Norfolk fine sand	.039	.030	31	.46	.01	50	.11	.40	6.8	0–6
Ochlockonee fine sandy loam	.036	.062	25	.82	.12	116	.21	.35	7.4	0–36
San Saba clay	.145	.073	45	1.14	.53	201	2.33	3.42	7.4	0–12
San Saba clay	.102	.060	20	1.19	.48	134	1.76	2.63	7.3	12–36
Simmons clay	.116	.064	56	1.36	.48	234	1.22	2.22	7.4	0–12
Simmons clay	.064	.039	24	1.10	.41	144	1.67	2.41	7.5	12–36
Tabor fine sandy loam	.031	.047	24	.52	.09	79	.15	.46	7.0	Surface
Tabor fine sandy loam	.041	.038	4	.59	.21	56	.32	.48	6.7	Subsoil
Tabor fine sandy loam	.042	.054	7	.59	.25	51	.35	.98	6.7	20–36
Trinity clay	.087	.118	15	1.28	.47	124	5.02	5.10	6.4	Surface
Trinity clay	.089	.130	27	1.43	.53	39	10.86	20.20	7.5	15–36
Wilson clay	.083	.034	29	.90	.31	188	.80	1.50	7.4	0–6
Wilson clay	.052	.024	12	.94	.35	128	.81	.39	7.1	6–36
Wilson clay loam	.094	.061	21	.93	.19	116	.46	.97	7.0	Surface
Wilson clay loam	.048	.052	8	.79	.23	63	.71	1.01	7.2	Subsoil
Windthorst fine sandy loam	.028	.013	10	.76	.11	30	.19	.20	7.1	0–8
Windthorst fine sandy loam	.016	.016	3	.42	.14	80	.78	.63	5.8	8–36

Nimrod fine sand, as well as others given in Table 29. Those low in total nitrogen, with a corn possibility of less than 23 bushels, include the Amite, Kalmia, Kirvin, and other soils shown in Table 29. Kalmia fine sand, Kalmia fine sandy loam, Nimrod fine sand, and Windthorst fine sandy loam are low in active potash.

Pot Experiments. Pot experiments on some of the soils are given in Table 30. Increases in crops are shown by phosphoric acid on almost all the soils, including the Houston black clay. Responses to applications of nitrogen are also to be observed. Responses to potash do not occur, and the corn possibility of the potash removed is high.

Fertilizers. The analyses indicate the need for fertilizers containing nitrogen, phosphoric acid, and in some cases, potash, on many of the soils of Tarrant county. While fertilizers cannot be recommended, at present, on the Black Prairie soils, they would probably produce good results on many of the other soils, as indicated by the interpretation of the analyses in Table 29. The need of complete fertilizers for truck crops is especially indicated.

Classification of the Soil Series

Bottom-land Soils. Surface soil, grayish-brown to brown or mostly black. Subsoil, grayish-brown and calcareous. Frio series.

Surface soil, black or jet-black. Subsoil, black to bluish-gray and is calcareous. Trinity series.

Surface soil, brown with lighter-brown calcareous subsoil. Catalpa series.

Surface soils, light-brown to brown in color. Subsoil, light-brown-yellowish or grayish in color, not calcareous. Ochlockonee series.

Upland Soils. Surface soil, grayish-brown to reddish color. Subsoil, brownish- red to red, calcareous. Amite series.

Surface soil, black. Subsoil, black to bluish-black. Bell series.

Surface soil, red to reddish-brown. Subsoil, stiff red clay. Calcareous in lower depths. Crawford series.

Surface soil, dark-brown to brown. Subsoil, brown. Denton series.

Surface soil, dull-red to brownish-red. Subsoil, dull-red to red, containing varying amounts of iron concretions. Tarrant series.

Surface soil, brown to black. Subsoil, calcareous, varying from black or brown to olive-colored. Houston series.

Surface soil, dark ashy-gray. Subsoil, ashy-gray. Soils are not calcareous. Irving series.

Surface soil, grayish-brown. Subsoil, yellow or orange-yellow. Low in lime. Kalmia series.

Surface soil, grayish-brown to reddish-brown. Subsoil, brownish-red to deep red and of a stiff texture. Kirvin series.

Surface soil, grayish-brown to brown. Subsoil, plastic clay, generally mottled yellow red and gray. Leaf series.

Table 29.—Interpretation of analyses of surface soils of Tarrant County

	Corn possibilities in bushels per acre			Acid soluble phosphoric acid	Acid soluble potash	Acid soluble lime
	Nitrogen	Active phosphoric acid	Active potash			
Amite fine sandy loam	13	12	50	good	good	good
Bell clay	38	45	73	good	good	high
Catalpa clay	33	40	125	good	good	good
Crawford clay	33	6	50	good	good	good
Denton clay	38	24	73	good	good	high
Durant clay loam	33	6	73	good	good	good
Durant fine sandy loam	33	12	73	good	good	good
Frio clay	38	24	84	good	good	high
Frio fine sandy loam	23	45	84	good	good	good
Frio loam	28	30	84	good	good	high
Houston black clay	53	45	115	good	good	high
Houston clay	48	45	84	good	good	high
Irving clay	33	12	61	good	fair	good
Kalmia fine sand	8	30	26	low	low	good
Kalmia fine sandy loam	8	6	26	low	low	fair
Kirvin fine sandy loam	13	18	38	fair	low	fair
Leaf clay loam	28	6	94	good	good	high
Leaf fine sandy loam	13	24	61	low	fair	good
Lewisville clay	28	6	61	good	fair	high
Lufkin fine sandy loam	23	6	50	good	low	good
Nimrod fine sand	8	12	26	low	fair	good
Norfolk fine sand	13	24	26	low	low	good
Ochlockonee fine sandy loam	13	18	61	good	fair	good
San Saba clay	43	30	105	good	good	high
Simmons clay	33	30	115	good	good	high
Tabor fine sandy loam	13	18	50	fair	low	fair
Trinity clay	28	12	61	good	good	high
Wilson clay	28	18	94	good	good	good
Wilson clay loam	28	18	61	good	good	high
Windthorst fine sandy loam	13	6	26	low	fair	fair

Table 30.—Pot experiments on soils of Tarrant County.

Lab. No.	Type name	Weight crops in grams				Corn possibility of plant food withdrawn, in bushels per acre		
		With complete fertilizer	Without nitrogen	Without phosphoric acid	Without potash	Nitrogen	Phosphoric acid*	Potash
18228	Amite fine sandy loam—surface—corn, 1st crop	28.9	8.9	21.5	28.4	16	33	152
18228	Amite fine sandy loam—surface—sorghum, 2nd crop	28.5	23.0	23.2	27.3	55	35	99
18229	Amite fine sandy loam—subsoil—corn, 1st crop	32.2	14.6	6.4	27.8	26	9	301
18229	Amite fine sandy loam—subsoil—sorghum, 2nd crop	33.9	21.4	10.0	26.1	51	15	137
18234	Denton clay—surface—corn, 1st crop	19.3	22.8	19.2	22.4	72	29	492
18234	Denton clay—surface—sorghum, 2nd crop	30.0	31.7	31.4	32.1	91	47	358
18235	Denton clay—subsoil—corn, 1st crop	9.6	12.4	7.6	11.8	49	12	156
18235	Denton clay—subsoil—sorghum, 2nd crop	27.0	25.0	16.0	24.9	71	24	184
18226	Houston black clay—surface—corn, 1st crop	18.1	16.3	12.7	18.2	47	18	349
18226	Houston black clay—surface—sorghum, 2nd crop	29.7	26.8	27.6	29.9	75	41	228
18227	Houston black clay—subsoil—corn, 1st crop	13.3	12.1	5.5	11.6	43	9	146
18227	Houston black clay—subsoil—sorghum, 2nd crop	24.2	24.3	13.4	19.5	66	36	138
18230	Kirvin fine sandy loam—surface—corn, 1st crop	29.2	7.5	19.9	32.3	17	44	221
18230	Kirvin fine sandy loam—surface—sorghum, 2nd crop	24.0	21.2	16.8	25.2	63	36	122
18231	Kirvin fine sandy loam—subsoil—corn, 1st crop	21.7	10.7	6.0	23.0	19	33	178
18231	Kirvin fine sandy loam—subsoil—sorghum, 2nd crop	16.4	20.2	7.6	17.3	55	24	80
18232	San Saba clay—surface—corn, 1st crop	22.5	20.9	13.2	21.5	66	33	294
18232	San Saba clay—surface—sorghum, 2nd crop	36.1	37.5	25.8	32.7	86	54	199
18233	San Saba clay—subsoil—corn, 1st crop	17.1	16.0	7.2	16.1	46	10	177
18233	San Saba clay—subsoil—sorghum, 2nd crop	25.4	22.0	12.5	25.0	58	18	156

*Estimated from weight of crop.

Surface soil, brown to dark-brown. Subsoil, brown. Lewisville series.

Surface soil, gray to dark-gray. Subsoil, gray or mottled gray and yellow. Lufkin series.

Surface soil, pale-yellow or yellowish-gray fine sand. Nimrod series.

Surface soil, grayish-brown. Subsoil, yellow and friable. Norfolk series.

Surface soil, black. Subsoil, black to dark-gray. San Saba series.

Surfaec soil, black. Subsoil, black to bluish-gray or dark-gray. Simmons series.

Surface soil, gray to brownish-gray. Subsoil, yellow or mottled gray and yellow plastic clay. Tabor series.

Surface soil and subsoil vary from dark-gray to black. Non-calcareous. Wilson series.

Surface soil, grayish-brown. Subsoil, red, usually stiff and often mottled with yellow in the lower part. Windthorst series.

Condensed Description of Soils of Tarrant County

Amite fine sandy loam is a brown to reddish-brown loamy fine sand to fine sandy loam; below which is a red to dull-red, friable, heavy, fine sandy loam to fine sandy clay. It occurs on the broad terraces along the bottoms of the West Fork of Trinity River. It is a very important type and the most of it is in cultivation to cotton, corn, wheat, oats, peanuts, sweet potatoes, watermelons, muskmelons, berries, and garden vegetables.

Bell clay is a black calcareous clay, which in places carries lime concretions on the surface and through the soil and subsoil. It occurs on the second bottoms of the West Fork of Trinity River and on the high terraces in the northeastern and southeastern parts of the county. The topography varies from nearly level to somewhat rolling. The drainage is good. It is fairly retentive of moisture, but crops suffer during extended dry spells. When wet it is waxy, sticky, and plastic. This is a strong, productive soil used for cotton, corn, and sorghums.

Catalpa clay is a dark-brown to brown silty clay which may pass into a dark-brownish-gray to gray silty clay. It is developed in the first bottoms of streams issuing from the Black Prairie in the eastern part of the county. It is subject to overflow and not much of it is under cultivation. Cotton and corn are the chief crops.

Crawford clay is a reddish-brown to chocolate-brown clay, grading into brownish-red to reddish-brown stiff or moderately stiff clay. It occurs in small areas in the Grand Prairie section. The surface is gently rolling to rolling, and the drainage is good. It is inclined to be droughty. This is a productive soil. Cotton, wheat, kafir, milo, and feterita do well.

Denton clay is a calcareous dark-brown or brown to grayish-brown stiff clay, plastic and sticky when wet and friable when dry, below which is a brown or light-brown stiff clay that grades downward into yellowish-brown, brownish-yellow, or yellow stiff clay. The surface is gently sloping to gently rolling, and both the surface drainage and the internal drainage are good. The area is large. The chief crops are cotton, corn, oats, and wheat.

Durant clay loam is a dull-red to brownish-red or reddish-brown clay loam or sandy clay loam, below which is a dull-red or brownish-red, stiff, heavy clay. It occurs chiefly along the western edge of the East Cross Timbers on the crests of ridges and hills and the slopes along streams, and is well drained. In dry years it is inclined to be droughty. Cotton, corn, wheat, and oats are grown.

Durant fine sandy loam is reddish-brown to brown fine sandy loam, underlain by brownish-red to red clay, usually of stiff structure, with mottlings of yellow and yellowish-brown. It occurs mainly in the vicinity of Crowley and Wheatland on flat to nearly level interstream areas. Drainage is poor in wet seasons. The area is small. Most of it is under cultivation to cotton, corn, wheat, oats, peanuts, watermelons, and muskmelons.

Ellis clay is a greenish-brown to brown clay, underlain by olive-colored heavy clay. It is very plastic when wet. Only a small area is found. The topography is rolling to hilly, making most of the land unsuited to cultivation, but suited for pasture.

Frio clay is a dark-brown, brown, or grayish-brown silty clay, passing into a subsoil of brown, light-brown, or grayish-brown, stiff, heavy silty clay. It occurs in the first bottoms of the larger streams in extensive areas. It is subject to overflow. Only a small proportion is under cultivation to cotton and corn. It is a strong, productive soil.

Frio fine sandy loam is a grayish-brown to brown fine sandy loam, which may be underlain by a subsoil that varies in texture from fine sandy loam to silty clay, normally of light-brown, yellowish-brown, brownish-gray, or gray color. It occurs in large bodies along the West Fork of the Trinity River and most of the larger creeks of the area. It is a first-bottom soil, subject to overflow. The greater part of it is still unimproved. Cotton and corn are the chief crops.

Frio loam is a dark-gray, dark-grayish-brown, or grayish-brown loam, below which is a grayish-brown to brown or gray clay loam or clay. It occupies first bottoms along the major streams of the county, and is subject to overflow. About one-half of it is in cultivation to cotton and corn.

Houston black clay is a black calcareous clay, passing into black or very dark brown, stiff, plastic clay, and this, locally, into dark yellowish-brown calcareous clay. It occurs in the Black Prairie region east of Arlington and Mansfield and on the Grapevine Prairie. The topography varies from nearly level to undulating and slightly rolling. The surface drainage is good. It is an important soil and more than 90 per cent of it has been improved and is under cultivation. It is used for the production of corn, cotton, wheat, oats, Johnson grass hay, grain sorghum, and broomcorn.

Houston clay is a dark-brown to brown, stiff clay, usually calcareous, below which is a brown to light-brown, heavy calcareous clay, which in turn generally grades into a yellowish-brown calcareous clay. It occurs on rolling country in the Black Prairie in small areas and on the Grapevine Prairie. It is used for the same crops as the Houston black clay.

Irving clay is a dark ashy-gray to black, stiff, silty clay, but generally becomes ashy-gray or very dark-gray in the lower parts. It occupies level areas on the terraces. The soil when wet is very plastic and sticky. The total area is not large. The principal crops are cotton, corn, wheat, and oats.

Kalmia fine sand is a light-brown, grayish-brown, or brown fine sand, only slightly loamy, grading into yellow or orange-yellow fine sand. It occurs on the terraces of the West Fork of Trinity River. Very little is under cultivation. It is used for peanuts, watermelons, and muskmelons, and for trucking.

Kalmia fine sandy loam is brown to light-brown or grayish-brown fine sand to loamy fine sand or light fine sandy loam, grading into yellow, pale-yellow, or orange-yellow fine sand to light fine sandy loam, below which is yellow fine sandy clay. It occurs on the terraces of the West Fork of Trinity River. The surface is nearly level, but the drainage is good on account of the pervious character of the soil material. It is chiefly used for market gardening. All the more important vegetables are produced. Small fruits, chiefly dewberries and blackberries, are grown to some extent.

Kirvin fine sandy loam is a light reddish-brown to brown fine sand to fine sandy loam, passing into reddish-brown fine sand to fine sandy loam, and underlain at depths by red clay. It is the chief soil of the East Cross Timbers. The surface is undulating to rolling and slightly hilly. The drainage is good to excessive. The greater part of the soil is under cultivation to corn and cotton, oats and wheat, potatoes and peanuts, watermelons, and muskmelons. Peaches and small fruits occupy a considerable area.

Leaf clay loam is a light-brown to brown clay loam to sandy clay loam. In the better drained areas this passes into a subsoil consisting of red to dark-red stiff clay. This in turn grades into yellowish-brown, brown, or olive-brown, stiff, heavy clay, which is rarely calcareous. In the less well drained areas the subsoil consists of a yellowish-brown or olive-brown heavy, stiff clay, which may be mottled in the upper part with gray or red. It occurs chiefly in the vicinity of Wheatland and Everman, on the terraces of Village Creek. The surface is mainly level. The drainage varies from fair to good. The greater part is under cultivation to cotton and corn with some wheat and oats.

Leaf fine sandy loam is a grayish-brown to brown loamy fine sand to fine sandy loam, passing into light-brown or sometimes yellowish-brown fine sandy loam, below which is a mottled red and yellow or red, yellow, and gray, plastic, stiff, heavy clay. It occurs on the terraces of the West Fork of Trinity River and its tributaries, in positions varying from 15 to 50 feet or more above overflow. The drainage varies from good to excessive. Less than half of it is under cultivation, the rest being used for pasture. Cotton, corn, and peanuts are the leading crops.

Lewisville clay is a dark-brown, fairly stiff clay, which grades into brown or dark-brown stiff clay, usually containing some cream-colored or whitish limy material. This passes into yellowish or cream-colored and whitish clay or chalky material. It occupies undulating areas on the high terraces in the southeastern, eastern, and northeastern parts of the county. The drainage is good and the soil is fairly retentive of moisture. Both soil and subsoil are very sticky and plastic when wet. Most of it is under cultivation to cotton and corn with some wheat, oats, and sorghums.

Lufkin fine sandy loam is brownish-gray to gray fine sandy loam to fine sand, usually passing into a gray or yellowish-gray loamy fine sand or fine sandy loam, and underlain by a subsoil of dark-gray, gray, yellowish-gray, or bluish-gray, stiff, heavy clay, which may be more or less mottled with yellowish-brown, yellow, and gray at lower depths. The subsoil when wet is very plastic and almost impervious to moisture. It occurs in small areas in the East Cross Timbers. It occupies poorly-drained flats and depressions and areas along small drainage ways. The underdrainage is restricted by the heavy subsoil. Only a small proportion is under cultivation, but the areas farmed give fairly good yields of cotton and corn.

Nimrod fine sand is a grayish-brown fine sand of loose structure, underlain by a subsoil of light-gray to pale-yellow loose fine sand. It occurs in the West Cross Timbers in the northwestern part of the county. It occupies forested slopes and flats, and is generally well drained. Little of it is under cultivation, and the yields of crops are low. It is best suited to peanuts, cowpeas, sweet potatoes, muskmelons, and watermelons.

Norfolk fine sand is a grayish-brown fine sand passing into a subsoil of yellowish-brown fine sand. It occurs in the East Cross Timbers, and its area is not large. It is mostly covered with blackjack oak.

Ochlockonee fine sandy loam includes a variety of first-bottom soils. The surface soil is chiefly a fine sandy loam, though ranging in texture from loamy fine sand to loam, and in color from gray to brown or dark-brown. It is a first-bottom soil, subject to overflow. It is chiefly in forest.

San Saba clay is a black calcareous clay, stiffer in the subsoil, and generally passing into a dark-gray or dark-brown, stiff, calcareous clay. The surface is flat, nearly level, and drainage is poor. It occurs on the Grand Prairie, in flat areas on the divides and depressions about the heads of and along small drainage ways. On account of its slow drainage, the soil is necessarily late in spring. It is best suited to cotton and corn.

Simmons clay is a very dark brown to black clay or silty clay grading into dark-brown, dark-gray, or dark-brownish-gray, heavy, stiff clay, which in turn passes into brownish-gray, gray, or olive-colored, heavy, rather tough clay. It occurs on the terraces of the West Fork of Trinity River; also on the terraces of the larger tributaries of that stream. The total area is not large. The surface is level or nearly level, and the drainage is imperfect. In the more poorly drained areas alkali spots are noticeable. The greater part of the type is under cultivation to cotton and corn, both of which do well.

Tabor fine sandy loam is a light-brown to brown or grayish-brown fine sand to fine sandy loam underlain by yellowish-brown to yellow or pale-yellow, stiff heavy clay loam to clay. It occurs in the East Cross Timbers on low slopes and flats adjacent to drainage ways. It is not as well drained as the Kirvin soils, nor as poorly drained as the Lufkin. It is one of the more extensive soils. Probably one-half of it is under cultivation to cotton, corn, oats, the sorghums, sweet potatoes, and peanuts.

Trinity clay is a black calcareous clay. It occurs in the first bottoms of the West Fork of Trinity River and is subject to periodic overflow. Probably 40 per cent is under cultivation to cotton, corn, and alfalfa.

Wilson clay is a black to ashy-black clay, which may pass into a bluish-black, olive-colored, or dark-bluish-gray heavy clay, stiff and plastic when wet and almost impervious to moisture. The surface is flat to nearly level, and drainage is poor during wet seasons. Cotton and corn are the chief crops.

Wilson clay loam is an ashy-black or black heavy clay loam, underlain by black or ashy-black, stiff, heavy clay. The area is not large. The greater part is under cultivation to corn and cotton. The surface is flat to nearly level, and the drainage is imperfect.

Windthorst fine sandy loam is light-brown, grayish-brown, or reddish-brown loamy fine sand to fine sandy loam, passing into dull-red fine sandy clay to clay loam, which becomes mottled with yellow in the lower subsoil, where the clay is usually plastic and rather tough. It is confined to the northwestern corner of the county. The surface varies from nearly level to rolling, and the drainage is good to excessive. The greater part of the type is in forest. Corn, cotton, peanuts, and sweet potatoes are grown with some watermelons and muskmelons.

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SUMMARY

This Bulletin discusses the chemical composition and fertility of typical soils of Cameron, Coleman, Dallas, Erath, Harris, Reeves, Rockwall, and Tarrant counties.

Methods of maintenance of soil fertility are outlined, and an explanation of terms is given.

Pot experiments were made on a number of the samples. Saline soils occur in some of the counties.

The analyses were averaged in three groups: upland, second-bottom, and first-bottom, or alluvial soils.

The forested upland soils are usually low in nitrogen and phosphoric acid. They are a little better supplied with potash but contain less than the prairie soils. They are low in lime but are usually neutral and not acid, except in Harris county.

The upland prairie soils are better supplied with plant food and with lime than are the forested soils. None are acid.

The bottom or terrace soils are better supplied with plant food than the upland forested soils but not as well supplied as the prairie soils. They are limestone soils and not acid.