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Soils of Collin, Frio, Galveston, Midland,
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the Trans-Pecos Area



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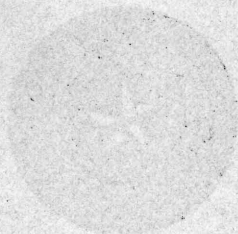
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AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
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Chemical analyses and some pot experiments are reported for representative samples of typical soils of Collin, Frio, Galveston, Midland, Potter, and Van Zandt Counties and the Trans-Pecos Area. The bottomland, or alluvial, soils are better supplied with plant food than the upland soils. A new method of classification of constituents of soils, consisting of 5 classes based upon composition, is given and its relation to previous methods of interpretation is discussed. Many of the soils are deficient in phosphoric acid and nitrogen. They are better supplied with potash, although some are low in potash. A few are low in lime with a tendency to become acid, but most are well supplied with lime and some are calcareous soils high in lime. Classifications of the analyses of the individual soil types are given.

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SOILS OF COLLIN, FRIO, GALVESTON, MIDLAND, POTTER, AND VAN ZANDT COUNTIES AND THE TRANS-PECOS AREA

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This Bulletin deals with the composition and fertility of samples of soils collected from seven counties and the reconnaissance survey of the Trans-Pecos area including 9 counties. It is the fourteenth 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 U. S. 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 U. S. 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 Collin County, Texas, by M. W. Beck and E. G. Fitzpatrick.

Soil Survey of Frio County, Texas, by M. W. Beck, H. W. Hawker, and L. G. Ragsdale.

Soil Survey of Galveston County, Texas, by Z. C. Foster and W. J. Moran.

Soil Survey of Midland County, Texas, by E. H. Templin and J. A. Kerr.

Soil Survey of Potter County, Texas, by E. H. Templin and A. E. Shearin.

Soil Survey of Van Zandt County, Texas, by A. W. Goke, W. I. Watkins, E. N. Poulson, Z. C. Foster, E. G. Fitzpatrick, and W. J. Moran.

Soil Survey (Reconnaissance) of the Trans-Pecos Area, Texas, by W. T. Carter, M. W. Beck, H. M. Smith, H. W. Hawker, E. H. Templin, and T. C. Reitch.

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 store of nitrogen and humus in the soil should be maintained. For this purpose, growing legumes in a proper rotation, and turning these under or grazing them off, is usually advisable. The nitrogen in the soil may be supplemented by the use of nitrogenous fertilizers. Losses of nitrogen due to cropping eventually result in a deficiency of nitrogen.

2. Deficiency of phosphoric acid in the soil should be corrected by the use of phosphates as a fertilizer. Losses of phosphoric acid due to cropping eventually result in a deficiency of phosphoric acid.

3. Any acidity sufficient to be injurious to the crops being grown, if present, should be corrected by applications of ground limestone or lime. Lime and limestone are also used for improving the physical character of heavy soils poor in lime or for supplying lime to 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. Losses of potash due to cropping eventually result in a deficiency of potash.

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

6. Land under irrigation should have good underdrainage, either natural or artificial, so that salts dissolved in the irrigation water will be washed out and will not accumulate in the soil.

Humus and nitrogen. The maintenance of the humus content of the soil aids materially in maintenance of fertility. Humus is produced by the partial decay of vegetable matter in the soil. Humus, in sufficient quantity, helps soils to hold a favorable amount of water, so as better to resist drouth. It aids to give 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 is the storehouse of 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. This nitrogen is slowly changed by soil organisms to nitrates or ammonia, in which forms the nitrogen may be taken up by plants or washed from the soil. The storing of nitrogen in the insoluble humus compounds protects the soil from rapid depletion of 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. Artificial manure may be prepared from leaves, straw, or similar waste material. Legume crops, which have power to take nitrogen from the air, may be grown in rotation with other crops, and if turned under or grazed off will introduce vegetable matter into the soil. 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 the feeding value of the crop is secured when it is grazed at the same time that 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. Making the crop into hay, and saving 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 in the liquid excrement or that part of the solid excrement which cannot be saved. When the legume is made into hay to be sold, the land is more likely to lose nitrogen than to gain it and also loses phosphoric acid and potash. Crops other than legumes add vegetable matter to the soil when plowed under or grazed off, or serve as cover crops to reduce losses from leaching or from washing when the land would otherwise be bare, but legumes are the only plants which can take up 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 renovating crops whenever possible.

The maintenance of the nitrogen content of the soil is more important than the maintenance of its humus content. Nitrogen may be purchased as a fertilizer, but it is expensive when bought in this way, and ordinarily a farmer growing staple crops 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. What legume is 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 the soils of Texas are frequently rich in potash, there is variation among the different soils, so that some soils need potash as a fertilizer. In general, potash is the least often needed of the three plant foods for field crops. 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 classification given later. Some of the soils described, when compared with other soils of the State, are low in active potash although they are much better supplied with potash than with phosphoric acid or nitrogen.

Acidity. Some soils contain organic or inorganic acids and 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. Legumes require more lime than other crops. Acidity may be corrected by the use of ground limestone, ground oyster shells, air-slaked lime, or hydrated lime. Few acid soils are found in the counties described in this Bulletin.

HOW TO USE THE ANALYSES

Analyses of the soils are given in connection with the descriptions of the various types of soil in connection with each county. The classifications of the analyses are also given, in order to show the comparative strength or weakness of each type.

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 condition which limits the yield may be a poor physical condition, with respect to cultivation, drainage, or other factors. It may also be the presence of injurious substances, such as soluble salts. The soil may supply insufficient amounts of water for good growth of the plants, or, on the other hand, it may be too wet. Plant diseases may also be present.

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

If the crop yields are low and the plant food is deficient, fertilizer should be used. It is not possible to tell from the appearance or the analysis of the soil the formula of the fertilizer which will give the best results. The depth of the soil, the character of the subsoil, and the kind of weather during the growing season influence the yield of crops as much as does the plant food. That great variations are caused by the kind of season can be seen by observing the variation of the yields on the same land from one year to another.

EXPLANATION OF TERMS

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 available for the use of crops.

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 soluble in 0.2 N nitric acid and is the part of the total phosphoric acid which is more easily taken up by plants. The relation of the active phosphoric acid to the fertility of the soil is shown in the table giving the classes of the constituents. 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 there is between total phosphoric acid and the needs of the soil. Pot experiments have shown (Bulletin 267) that plants grown on soils low in active phosphoric acid and high in lime can remove more phosphoric acid from the soil than they can from soils containing the same quantities of active phosphoric acid and low amounts of lime.

Total potash represents the entire amount of potash in the soil. A large part of this is locked up in highly insoluble silicates and for centuries may not become available for the use of plants. 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 which is dissolved by strong hydrochloric acid. As pointed out by Hilgard, there is a relation between the amount of acid-soluble potash in 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 that soluble in 0.2 N nitric acid and is the part of the total potash which can be readily taken up by plants. This has been shown by pot experiments discussed in Bulletins 145 and 325. There is a close relation between the amount of active potash in the soil and the amount which is available for the growth 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 of the fertility of the soil.

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 0.2 N nitric acid in the method for determining active phosphoric acid and active potash. When the basicity is over 8 per cent, stronger acid is used. The term basicity is used merely as a convenient one for the determination referred to. The basicity represents all of the carbonate of lime and, in addition, about 86 per cent of the exchangeable bases of the soil (Bulletin 442).

Acidity is here represented by what is termed the pH (or hydrogen ion concentration), which shows the intensity of acidity. A neutral soil is represented by a pH value of 7.0. The lower the number below 7, the more acid the soil. A soil of pH 6.0 would be ten times more acid than a soil of 7.0, and one with 5.0 pH would be ten 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. If acid, applications of lime should be made to produce the favorable pH. However, soils do not all act alike in this respect, and sometimes acid soils do not respond to the addition of lime.

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 expressed in bushels of corn per acre. It is based on 2,000,000 pounds of the soil.

No claim is made that the corn possibility indicates the possible yield from the soil, as this depends upon other conditions in addition to the fertility of the soil. The corn possibility is a convenient way of comparing amounts of various foods in the soil. For example, with the Houston black clay of Collin County (No. 33710, Table 4) the corn possibility for total nitrogen is 23, for active phosphoric acid is 17, and for the active potash, 236. The soil is probably deficient in both phosphoric acid and nitrogen. This may be compared with the Bell clay of Collin County (No. 33705, Table 4), which has a corn possibility of 32 bushels for nitrogen, 44 for phosphoric acid, and 432 for potash. Other comparisons can be made from the tables.

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

CLASSIFICATION OF CONSTITUENTS OF SOILS

In previous bulletins dealing with the composition of Texas soils, we have given tables showing the interpretation of the analyses. In this publication, the constituents of the soils are grouped into five classes. Class No. 1 contains the highest quantities and Class No. 5 contains the lowest, while the others are intermediate. This is intended to give an easy way of comparing the composition of different soils and of observing their relative strengths and weaknesses. In deciding on the limits of composition to be used for each class, we have endeavored to use regular gradations and to arrange the gradations in such a way as to have the greatest possible meaning with respect to the information at present available. We have taken into consideration the pot experiments and their relation to the composition of the soil (Bulletins 126, 145, 151, 213, 267, and 355) and have also considered the field experiments which were available. The soils whose active phosphoric acid is placed in Class 5 are very likely to be deficient in phosphoric acid for the growth of crops. The same applies to active potash and to nitrogen. The relations are not so evident with the acid-soluble potash, the total phosphoric acid, and the total potash, but Class 5 contains the lowest percentages of these constituents, and the soils are the weakest in this respect. Soils whose acid-soluble lime is placed in Class 5 are quite low in lime and there is a possibility of a deficiency of lime. Soils whose pH is placed in Class 5 are decidedly acid.

The constituents placed in Class 4 are present in larger quantities than those in Class 5. In the cases of total nitrogen, active phosphoric acid, and active potash, the soils containing quantities of the constituents falling in these classes are likely to respond to applications of fertilizer,

provided that rainfall and other conditions are favorable to the growth of crops. Soils with the pH in Class 4 are acid but not as acid as those in Class 5. Soils in Class 3 with respect to active phosphoric acid and active potash may respond to applications of these fertilizers when truck crops are grown but may not respond when field crops are grown. Response to nitrogen may occur with soils whose nitrogen is placed in Class 3. There is less probability of response to fertilizers with Classes 1 and 2, since these include the highest percentages. These are also the strongest soils.

The limits of classes of constituents and the relation between the different classes and the interpretations used in previous bulletins are given in Table 1.

TABLE 1. Limits and interpretations of classes of constituents.

Class Number	5	4	3	2	1
Nitrogen					
Limits—Per cent.....	0-.030	.031-.060	.061-.120	.121-.180	.181+
Maximum corn possibility....	10	18	33	48	49+
Maximum number of 40 bu. corn crops.....	10	20	40	60	61+
Total phosphoric acid					
Limits—Per cent.....	0-.025	.026-.050	.051-.100	.101-.150	.151+
Interpretation.....	Low	Low to fair	Fair to good	Good	High
Maximum number of 40 bu. corn crops.....	20	40	80	120	121+
Active phosphoric acid					
Limits—P.p.m.....	0-30	31-100	101-200	201-400	401+
Maximum corn possibility....	18	40	45	50	51+
Total potash					
Limits—Per cent.....	0-.30	.31-.60	.61-1.21	1.21-1.80	1.81+
Acid-soluble potash					
Limits—Per cent.....	0-.10	.11-.20	.21-.40	.41-.80	.81+
Interpretation.....	Low	Low to fair	Fair to good	Good	High
Maximum number of 40 bu. corn crops.....	50	100	200	400	401+
Active potash					
Limits—P.p.m.....	0-50	51-100	101-200	201-400	401+
Maximum corn possibility....	26	50	94	171	172+
Lime					
Limits—Per cent.....	0-.10	.11-.20	.21-.40†	.41-2.00	2.01+
Interpretation.....	Low	Low to fair	Fair to good	Good	High
Basicity					
Limits—Per cent.....	0-.30	.31-.60	.61-2.00	2.01-5.00	5.01+
pH					
Limits.....	0-5.0	5.1-5.5	5.6-6.0	6.1-7.5	7.6+
Acidity.....	Very acid	acid	Slightly acid	practically neutral	Alkaline

Lime in the three lower classes is probably all contained in the exchange complex of soils with low exchange capacities. The maximum lime in Class 3 is equivalent to 14.3 milliequivalents per 100 grams. Lime in Class 2 may be present as exchangeable lime in soils with higher total exchange capacity or there may be small amounts of limestone or soluble neutral calcium salts in the soil. Soils in Class 1 all contain some limestone.

The basicity of Classes 5, 4, and 3 is sufficiently low to preclude the possibility of the presence of much limestone in the soil. Class 5 contains soils with basicity so low that there is danger of making the soils too acid for satisfactory plant growth when acid-forming nitrogenous fertilizers are used for a number of years, while Class 4 contains many soils which may be injured in this way. Basicity in Class 3 may still be entirely due to the exchange complex in the soil; the maximum, 2.00% of calcium carbonate, is equivalent to 40 milliequivalents. Soils in both Classes 1 and 2 contain limestone.

Reaction (pH) classes are based on ranges of pH for satisfactory plant growth. Class 1 (7.51+) is definitely alkaline, Class 2 is so nearly neutral that good growth of most crops is not inhibited, Class 5 contains soils which are so acid that many crops, particularly legumes, will not grow well, and Classes 3 and 4 contain soils which may be sufficiently acid to damage growth of certain crops.

The classification is not intended to give a grouping which can be interpreted in terms of crop yields or possible fertilizer responses, since these are determined by many factors in addition to chemical composition, upon which the classification is based. However, certain general relationships may be noted. Soils in Class 1 are probably not deficient with respect to the element concerned, except possibly where unusually heavy demands are made on the soil, as in the growth of very large truck crops. Most soils in Class 5 and many in Class 4 are low in fertility with respect to the element concerned. Some soils in Class 3 and a few in Class 2 may be deficient when heavy crops are grown. It must be remembered in this connection that a soil may be high in total quantity of an element and still be deficient in the quantity which is readily available to plants, and that the available supply, rather than the total supply, is the determining factor in crop growth and fertilizer response, insofar as chemical composition is concerned.

SALINE SOILS

Saline soils are soils modified by the presence of soluble salts, chiefly sodium chloride or sodium sulphate. Soluble salts occur in sufficient quantity to be injurious to crops in some of the soils of the counties here discussed. 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 other places, the soluble salts accumulate as a result of irrigation or of 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 out 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 subirrigation occur in various sections of Texas. They may also be produced in yards or gardens by frequent sprinkling with water which contains soluble salts. The formation

of saline spots may be prevented by drainage which allows rain water to pass through the soil and prevents the ground water from rising and evaporating. 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 readily go through the soil. 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 soils are alkaline when sodium carbonate or bicarbonate are present, in which case they are called **black alkali** soils. Texas soils sometimes, but not frequently, contain black alkali. The composition of the salts in some of the saline soils is given in connection with the discussion of soils of some of the counties.

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. 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; they also show the amounts of phosphoric acid, potash, or nitrogen removed from the pot by the plants grown in the experiments expressed in their equivalent of bushels of corn per 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 in the amount of crop produced between the crop receiving the complete fertilizer (KPN) and the crop which had no potash (PN), and yet the crop produced without potash in the field might be equal to the possibility of production under the climatic conditions prevailing. In this case 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 capacity of the soil to furnish plant food to 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.

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 highest quantity of crop which can be produced under these and other prevailing soil and climatic conditions. It is obvious that a plant having twice the capacity of another to assimilate phosphoric acid will need only half the quantity in the soil in order to produce an equivalent yield; that a soil furnishing enough phosphoric acid for 30 bushels of corn may not contain enough for 50 bushels; that 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 soil may contain enough plant food for 30 bushels of corn and yet not enough for a large crop of tomatoes. These are all illustrations of the factors mentioned above which affect the ability of the plant to use the food offered it by the soil.

The classifications given in this bulletin refer entirely to the quantity of the various elements in 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

The average composition of a number of soil types in the counties was calculated from the figures for two or more samples of the same soil type. In calculating the averages, figures out of agreement with figures for the same constituent in other samples of the same soil type were omitted from the averages. For example, one sample of Bell clay surface soil from Collin County (No. 33751, Table 4) contained 696 p.p.m. active phosphoric acid. This is not in agreement with two other Bell clays from the same county, which contained 26 p.p.m. and 53 p.p.m. The figure for No. 33751 was therefore omitted from the average. Several other similar cases occur in the tables. Whenever a figure has thus been omitted from the average, it is enclosed in parentheses.

For the purpose of discussion, the soils were usually divided into three groups: (1) upland soils, (2) second bottom, or high-terrace soils above overflow, and (3) first bottom, or alluvial, soils subject to overflow. In certain counties, the classification was more detailed. The average composition of these groups is given in Table 2; the classification according to analyses is given in Table 3.

Soil Group	gen Per Cent	Phos. Acid Per Cent	Phos. Ac. Per Million	Potash Per Cent	Soluble Potash Per Cent	Potash Lime Per Million	Soluble Lime Per Cent	ity Per Cent	pH
Upland surface soils									
Collin county, calcareous.....	.147	.115	35	1.55	.55	214	3.57	16.63	8.2
Collin county, noncalcareous.....	.102	.038	51	.83	.26	221	.76	1.23	7.2
Frio county, dark-colored.....	.074	.043	49	1.00	.42	314	1.63	2.12	7.4
Frio county, light-colored.....	.052	.026	12	.71	.20	163	1.80	3.20	7.7
Galveston county, dark-colored.....	.139	.032	19	1.04	.22	152	.36	.97	6.5
Galveston county, light-colored.....	.082	.045	121	1.49	.36	527	.16	.69	7.2
Midland county, dark-colored.....	.042	.034	31	1.10	.35	334	.29	.59	7.3
Midland county, light-colored.....	.094	.072	173	1.44	.54	446	4.56	7.98	7.7
Potter county, calcareous.....	.143	.076	156	1.72	.52	259	4.20	8.49	8.1
Potter county, noncalcareous.....	.122	.079	194	1.93	.59	466	.46	.86	7.2
Van Zandt county, Blackland Prairie.....	.077	.030	18	1.16	.22	111	.32	.54	5.9
Van Zandt county, with friable subsoils.....	.029	.025	26	.67	.07	134	.15	.19	6.8
Van Zandt county, with heavy subsoils.....	.039	.026	11	.72	.27	232	.26	.56	6.1
Trans-Pecos, basins and plains.....	.087	.090	206	2.32	.68	427	9.52	16.57	8.4
Terrace surface soils									
Collin county.....	.139	.161	222	1.36	.64	396	1.58	6.72	7.7
Van Zandt county.....	.027	.022	24	.81	.08	101	.13	.10	6.0
Alluvial surface soils									
Collin county.....	.182	.157	18	1.10	.61	212	16.91	27.71	8.1
Frio county.....	.140	.126	138	1.28	.69	349	19.06	30.93	7.9
Midland county.....	.084	.100	488	1.96	.84	811	2.63	5.57	7.4
Potter county.....	.097	.082	247	1.83	.67	480	1.93	3.51	7.9
Van Zandt county.....	.078	.031	13	1.44	.18	143	.19	.40	7.1
Trans-Pecos.....	.054	.118	451	2.60	.52	458	4.71	7.61	8.6
Upland subsoils									
Collin county, calcareous.....	.103	.096	19	1.46	.46	169	3.06	17.95	8.3
Collin county, noncalcareous.....	.067	.023	8	.82	.28	144	.76	1.25	6.5
Frio county, dark-colored.....	.066	.045	37	1.11	.47	257	1.83	3.34	7.3
Frio county, light-colored.....	.046	.027	8	.67	.18	137	2.39	4.21	7.9
Galveston county, dark-colored.....	.065	.021	5	1.09	.27	127	.46	1.06	6.8
Galveston county, light-colored.....	.038	.036	39	1.77	.38	465	.16	.76	7.2
Midland county, dark-colored.....	.042	.035	25	1.20	.42	316	.50	.82	7.3
Midland county, light-colored.....	.061	.068	131	1.61	.53	279	7.44	13.26	7.8
Potter county, calcareous.....	.105	.084	38	1.60	.49	133	9.72	19.66	8.1
Potter county, noncalcareous.....	.090	.062	102	2.03	.65	461	.62	1.15	7.4
Van Zandt county, Blackland Prairie.....	.080	.031	21	1.11	.24	117	.35	.62	6.0
Van Zandt county, friable subsoils.....	.025	.026	13	.76	.14	115	.16	.17	6.3
Van Zandt county, heavy subsoils.....	.054	.021	35	.94	.18	155	.20	.38	6.3
Trans-Pecos, basins and plains.....	.069	.087	128	2.18	.68	340	12.79	22.42	8.3
Terrace subsoils									
Collin county.....	.108	.132	137	1.31	.61	282	1.48	10.08	7.7
Van Zandt county.....	.016	.018	10	.88	.05	55	.06	.05	6.0
Alluvial subsoils									
Collin county.....	.155	.114	18	1.00	.50	147	20.35	30.98	8.2
Frio county.....	.092	.109	127	1.21	.65	178	20.70	33.26	8.0
Midland county.....	.062	.108	427	1.98	.79	699	3.07	6.04	7.5
Potter county.....	.060	.071	251	1.83	.64	442	2.74	4.73	8.1
Van Zandt county.....	.029	.030	3	1.45	.13	92	.11	.20	5.8
Trans-Pecos.....	.039	.111	517	2.80	.49	473	4.64	7.90	8.7

TABLE 3. Classes of constituents of soils by groups.

Soil Group	Nitro- gen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basic- ity	pH
Upland surface soils									
Collin county, calcareous.....	2	2	4	2	2	2	1	1	1
Collin county, noncalcareous.....	3	4	4	3	3	2	2	3	2
Frio county, dark-colored.....	3	4	4	3	2	2	2	2	2
Frio county, light-colored.....	4	4	5	3	4	3	2	2	1
Galveston county, dark-colored.....	2	4	5	3	3	3	3	3	2
Galveston county, light-colored.....	3	4	3	2	3	1	4	3	2
Midland county, dark-colored.....	4	4	4	3	3	2	3	4	2
Midland county, light-colored.....	3	3	3	2	2	1	1	1	1
Potter county, calcareous.....	2	3	3	2	2	2	1	1	1
Potter county, noncalcareous.....	2	3	3	1	2	1	2	3	2
Van Zandt county, Blackland Prairie.....	3	4	5	3	3	3	3	4	3
Van Zandt county, friable subsoils.....	5	5	5	3	5	3	4	5	2
Van Zandt county, heavy subsoils.....	4	4	5	3	3	2	3	4	2
Trans-Pecos, basins and plains.....	3	3	2	1	2	1	1	1	1
Terrace surface soils									
Collin county.....	2	1	2	2	2	2	2	1	1
Van Zandt county.....	5	5	5	3	5	3	4	5	3
Alluvial surface soils									
Collin county.....	1	1	5	3	2	2	1	1	1
Frio county.....	2	2	3	2	2	2	1	1	1
Midland county.....	3	3	2	1	1	1	1	1	2
Potter county.....	3	3	2	1	2	1	2	2	1
Van Zandt county.....	3	4	5	2	4	3	4	4	2
Trans-Pecos.....	4	2	1	1	2	1	1	1	1
Upland subsoils									
Collin county, calcareous.....	3	3	5	2	2	3	1	1	1
Collin county, noncalcareous.....	3	5	5	3	3	3	2	3	2
Frio county, dark-colored.....	3	4	4	3	2	2	2	2	2
Frio county, light-colored.....	4	4	5	3	4	3	1	2	1
Galveston county, dark-colored.....	3	5	5	3	3	3	2	3	2
Galveston county, light-colored.....	4	4	4	2	3	1	4	3	2
Midland county, dark-colored.....	4	4	5	3	2	2	2	3	2
Midland county, light-colored.....	3	3	3	2	2	2	1	1	1
Potter county, calcareous.....	3	3	4	2	2	3	1	1	1
Potter county, noncalcareous.....	3	3	3	1	2	1	2	3	2
Van Zandt county, Blackland Prairie.....	3	4	5	3	3	3	3	3	3
Van Zandt county, friable subsoils.....	5	4	5	3	4	3	4	5	2
Van Zandt county, heavy subsoils.....	4	5	4	3	4	3	4	4	2
Trans-Pecos, basins and plains.....	3	3	3	1	2	2	1	1	1
Terrace subsoils									
Collin county.....	3	2	3	2	2	2	2	1	1
Van Zandt county.....	5	5	5	3	5	4	5	5	3
Alluvial subsoils									
Collin county.....	2	2	5	3	2	3	1	1	1
Frio county.....	3	2	3	2	2	3	1	1	1
Midland county.....	3	2	1	1	2	1	1	1	2
Potter county.....	4	3	2	1	2	1	1	2	1
Van Zandt county.....	5	4	5	2	4	4	4	5	3
Trans-Pecos.....	4	2	1	1	2	1	1	1	1

The upland soils are averaged in several groups, as shown in Tables 2 and 3. The upland soils of the Blackland Prairie and the counties in the western part of the state are better supplied with plant food than are the upland soils of the East Texas Timber Country. For example, the nitrogen in the East Texas Timber Country soils with friable subsoils in Van Zandt County averaged .029 per cent (Class 5), while that in the soils of the Blackland Prairie section of the same county averaged .077 per cent (Class 3) and the calcareous soils in Potter County averaged .143 per cent (Class 2). The light-colored upland soils of Galveston and Midland counties are higher in plant food than the dark-colored upland soils in the same counties, while in Frio County the dark-colored soils are higher. The calcareous upland soils are better supplied with plant food than are the noncalcareous upland soils. Soils with heavy subsoils in Van Zandt County contain more plant food than the soils with light subsoils in the same county. Nitrogen in the different upland soil groups varied widely; the better soils mentioned above contain much more nitrogen than the poorer soils. For example, the light-colored soils of Midland County contained .094 per cent nitrogen while the dark-colored soils of the same county contained only .042 per cent. Active phosphoric acid in most of the soils was low, particularly in the soils of Van Zandt County, the light-colored soils of Frio County, and the dark-colored soils of Galveston County. The quantity of potash, particularly the active or readily available part, varied from medium to high. Lime and basicity varied from high to medium content in most soils, but some of the groups, particularly those in Van Zandt County, were low. None of the soils, with the exception of those in Van Zandt County, were acid, and those in Van Zandt County were only slightly acid.

The terrace soils, which are those occupying flat to undulating old stream benches above overflow, vary considerably in composition. Those in Collin County in the Blackland Prairie area are well supplied with plant food, while those in Van Zandt County in the East Texas Timber Country are low in practically all of the plant food elements. Those in Collin County were higher in plant food than the upland soils in the same county. In Van Zandt County there was no significant difference between the composition of the terrace soils and that of the upland soils.

The alluvial soils, or those on flat stream bottoms subject to overflow, are better supplied with plant food than upland or terrace soils in the same county. Here, again, those of Van Zandt County are relatively low in plant food, particularly with respect to active phosphoric acid.

FERTILIZERS FOR THE SOILS STUDIED

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

In the upland soils group, the soils of Frio, Midland, and Van Zandt Counties, the noncalcareous soils of Collin County, the light-colored soils of Galveston County, and the soils of the Trans-Pecos Area vary from slightly deficient to decidedly low in nitrogen. The upland soils of all the counties studied, excepting the calcareous soils of Collin County, the

light-colored soils of Midland County, and the soils of Potter County, or the average are somewhat low in phosphoric acid, and some are decidedly deficient. The upland light-colored soils of Frio County, the dark-colored soils of Galveston County, and the Blackland Prairie and friable subsoil groups in Van Zandt County may be deficient in active potash.

The use of fertilizers is generally advisable for field crops on the soils in the eastern part of the state, and especially so for truck and fruit crops. Fertilizers suggested for use are given in other publications of the Experiment Station. In general, the sandy soils are likely to need more potash than the soils of heavier texture. 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 terrace soils of Van Zandt County probably need fertilizers supplying nitrogen, phosphoric acid, and potash. Those of Collin County probably do not need fertilizers. The alluvial or first-bottom soils probably do not need fertilizers at present although field trials on some areas, particularly in Van Zandt County, may show good response to their use. When the soils produce heavy growth of stem and leaves but do not fruit well, applications of phosphoric acid fertilizers may correct this condition. Where the soil fertility has begun to decrease on account of cultivation over a period of years, fertilizers will probably be of advantage. Fertilizers may be of advantage for vegetable crops.

USE OF LIME

Few of the soils described in this bulletin are acid and lime is not needed on most of them. If lime may be needed, it will be mentioned in the discussion of the soils of the county concerned.

The use of lime on well-drained sandy soils is not advisable 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 soil during the winter months. The acidity of these surface soils at the present time is generally not high enough to be injurious to crops ordinarily grown. They may become more acid after longer cultivation.

SOILS OF COLLIN COUNTY

Collin County is in northeastern Texas and lies entirely within the geographical division known as the Blackland Prairies. Eighteen types and phases of soil were mapped in 8 series. The most extensive soil is the Houston black clay, which in all phases occupies 46.5 per cent of the area, followed by the Houston clay, which occupies 16.1 per cent of the area. The percentages of the area covered by soils of the series are given below, following the description of the series. Upland soils include

the calcareous Houston and Sumter series and the noncalcareous Wilson and Crockett series. Terrace soils include the calcareous Bell and Lewisville series. Flat stream bottom soils include the calcareous Trinity and Catalpa series.

Description of Soils of Collin County

Upland Soils:

Crockett soils—Black to brown or spotted, moderately friable, cloddy to moderately granular, noncalcareous topsoil with reddish or yellowish mottled with gray subsoil. Cover 0.1 per cent of area.

Houston soils—Black, dark-gray or ashy-black to brown, friable, granular, calcareous topsoil with dark-gray, brown or yellowish, highly calcareous, moderately friable or crumbly subsoil. Cover 64.7 per cent of area.

Sumter soils—Brown or yellowish-brown, friable, granular, calcareous topsoil on rolling, steep slopes, with brownish-yellow to greenish-yellow crumbly, calcareous subsoil. Cover 8.1 per cent of area.

Wilson soils—Black to dark gray, noncalcareous, nongranular topsoil, very tight when dry, with brown or dark gray dense, tough subsoil. Cover 5.1 per cent of area.

Flat to Undulating Old Stream Bottoms, above Overflow:

Bell soils—Black, heavy, friable, granular, calcareous topsoil, with dark-gray calcareous, crumbly subsoil. Cover 7.7 per cent of area.

Lewisville soils—Brown, friable, granular, calcareous topsoil with dark brown calcareous, crumbly subsoil. Cover 2.0 per cent of area.

Flat Stream Bottoms:

Catalpa soils—Brown, friable, permeable, calcareous topsoil with brown or grayish, friable, permeable, calcareous subsoil. Cover 5.1 per cent of area.

Trinity soils—Black to dark brown, friable, permeable, calcareous topsoil with black or dark gray, heavy but permeable and crumbly, calcareous subsoil. Cover 7.2 per cent of area.

Composition of Soils

Table 4 gives the analyses of the different soil types and Table 5 the classes of constituents of the surface soils. The soils are moderately to well supplied with nitrogen, all of them falling in Classes 1, 2, or 3. They are low in active phosphoric acid; with the exception of one sample of Lewisville clay (in Class 1), the soils all fall in Class 4 (4 soil types) or Class 5 (5 soil types). Most of the soils are well supplied with active potash, only the Houston clay (Class 4) falling in classes lower than Class 3. They are moderately to well supplied with total phosphoric acid and total and acid-soluble potash. They are high in lime, basicity, and pH, many soil types falling in Class 1 in these constituents.

Pot Experiments

Results of pot experiments are given in Table 6. Most of the soils respond to nitrogen and phosphoric acid, but do not respond to potash.

TABLE 4. Analyses of soils of Collin County.

Laboratory Number	Type name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
33705	Bell clay, surface.....	.112	.056	26	1.16	.64	342	1.58	2.71	8.0	0-7
33706	Bell clay, subsoil.....	.087	.025	8	1.12	.61	227	1.48	2.48	7.8	7-18
33707	Bell clay, deep subsoil.....	.092	.031	7	1.12	.63	269	1.45	2.68	7.7	18-24
33751	Bell clay, surface.....	.155	(.189)	(696)	1.88	.....	657	.....	3.61	7.7	0-7
33752	Bell clay, subsoil.....	.128	(.186)	(787)	1.92	.....	516	.....	2.83	8.2	7-18
33753	Bell clay, deep subsoil.....	.056	.089	10	.85	.....	85	.....	45.50	8.2	18-36
33767	Bell clay, surface.....	.150	.078	53	.....	.....	310	.....	7.86	8.3	0-7
33768	Bell clay, subsoil.....	.099	.058	7	.....	.....	119	.....	18.60	8.1	7-18
33769	Bell clay, deep subsoil.....	.069	.045	5	.....	.....	92	.....	26.26	8.1	18-36
Average	Bell clay, surface.....	.139	.067	40	1.52	.64	436	1.58	4.73	8.0	.....
Average	Bell clay, subsoil.....	.105	.042	8	1.52	.61	287	1.48	7.97	8.0	.....
Average	Bell clay, deep subsoil.....	.072	.055	7	.99	.63	149	1.45	24.81	8.0	.....
33756	Catalpa clay, surface.....	.167	.138	23	.98	.....	221	.....	28.00	8.0	0-7
33757	Catalpa clay, subsoil.....	.148	.130	13	.82	.....	179	.....	37.00	8.3	7-18
33710	Houston black clay, surface.....	.139	.061	20	1.03	.55	271	3.57	6.55	8.6	0-7
33711	Houston black clay, subsoil.....	.097	.044	11	1.00	.46	210	3.06	3.95	8.7	7-18
33712	Houston black clay, deep subsoil.....	.084	.038	8	1.02	.49	177	2.64	3.40	8.6	18-24
33736	Houston black clay, surface.....	.109	.144	(571)	1.81	.....	291	.....	4.22	7.8	0-7
33737	Houston black clay, subsoil.....	.082	.132	(536)	1.70	.....	239	.....	6.29	8.3	7-18
33738	Houston black clay, deep subsoil.....	.068	.113	(365)	1.61	.....	140	.....	8.90	8.5	18-36
33761	Houston black clay, surface.....	.178	.132	26	.....	.....	127	.....	22.50	8.0	0-7
33762	Houston black clay, subsoil.....	.130	.113	14	.....	.....	84	.....	24.50	8.2	7-18
33763	Houston black clay, deep subsoil.....	.103	.089	7	.....	.....	62	.....	27.74	8.1	18-36
33764	Houston black clay, surface.....	.175	.087	35	.....	.....	318	.....	7.58	8.4	0-7
33765	Houston black clay, subsoil.....	.150	.063	14	.....	.....	287	.....	5.10	8.3	7-18
33766	Houston black clay, deep subsoil.....	.065	.049	6	.....	.....	94	.....	24.00	8.2	18-36
Average	Houston black clay, surface.....	.150	.106	27	1.44	.55	252	3.57	10.21	8.2	.....
Average	Houston black clay, subsoil.....	.115	.088	14	1.35	.46	205	3.06	9.96	8.4	.....
Average	Houston black clay, deep subsoil.....	.080	.072	7	1.32	.49	118	2.64	16.01	8.4	.....
33758	Houston clay, surface.....	.175	.117	21	.....	.....	81	.....	38.70	8.4	0-7
33759	Houston clay, subsoil.....	.086	.092	5	.....	.....	57	.....	48.10	8.4	7-18
33760	Houston clay, deep subsoil.....	.053	.079	7	.....	.....	72	.....	60.64	8.3	18-36
33745	Irving clay, surface.....	.109	.038	12	.64	.....	166	.....	1.42	6.8	0-7
33746	Irving clay, subsoil.....	.100	.025	6	.54	.....	139	.....	1.29	6.1	7-36
33747	Irving clay, deep subsoil.....	.037	.010	6	.65	.....	167	.....	1.56	6.6	36-54
33748	Lewisville clay, surface.....	.170	.472	795	1.74	.....	507	.....	18.00	7.8	0-7
33749	Lewisville clay, subsoil.....	.124	.419	525	1.67	.....	409	.....	25.20	8.1	7-24
33750	Lewisville clay, deep subsoil.....	.055	.101	8	.89	.....	78	.....	45.00	8.3	24-36
33739	Sumter clay, surface.....	.108	.146	74	1.77	.....	195	.....	20.20	8.1	0-7
33740	Sumter clay, subsoil.....	.071	.129	50	1.69	.....	139	.....	19.76	8.1	7-18
33741	Sumter clay, deep subsoil.....	.049	.137	48	1.84	.....	152	.....	19.17	8.1	18-36
5953	Trinity clay, surface.....	.241	.237	22	.....	.53	231	18.15	(10-)	.....	0-6
5954	Trinity clay, subsoil.....	.160	.075	33	.....	.42	73	24.86	(10-)	.....	6-18

TABLE 4. Analyses of soils of Collin County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
33708	Trinity clay, surface.....	.156	.120	12	1.16	.69	160	15.67	27.14	8.2	0-7
33709	Trinity clay, subsoil.....	.158	.119	14	1.10	.58	159	15.83	28.05	8.2	7-24
33754	Trinity clay, surface.....	.162	.131	13	1.17	.....	234	.....	28.00	8.0	0-7
33755	Trinity clay, subsoil.....	.154	.133	12	1.09	.....	178	.....	27.90	8.1	7-18
Average	Trinity clay, surface.....	.186	.163	16	1.17	.61	208	16.91	27.57	8.1	.....
Average	Trinity clay, subsoil.....	.157	.109	20	1.10	.50	137	20.35	27.98	8.2	.....
33742	Wilson clay, surface.....	.098	.025	34	.64	.....	206	.....	1.40	7.5	0-7
33743	Wilson clay, subsoil.....	.068	.016	8	.65	.....	165	.....	1.36	6.9	7-18
33744	Wilson clay, deep subsoil.....	.048	.019	7	.63	.....	142	.....	1.35	7.3	18-36
33702	Wilson clay, surface.....	.112	.046	35	.66	.26	181	.76	1.28	7.1	0-7
33703	Wilson clay, subsoil.....	.068	.026	7	.65	.28	122	.76	1.25	5.9	7-18
33704	Wilson clay, deep subsoil.....	.057	.023	10	.59	.30	167	.80	1.28	6.0	18-24
Average	Wilson clay, surface.....	.105	.036	35	.65	.26	193	.76	1.34	7.3	.....
Average	Wilson clay, subsoil.....	.068	.031	8	.65	.28	144	.76	1.31	6.4	.....
Average	Wilson clay, deep subsoil.....	.053	.020	9	.61	.30	155	.80	1.32	6.6	.....
33733	Wilson clay loam, surface.....	.096	.044	85	1.19	.....	275	.....	1.02	7.0	0-7
33734	Wilson clay loam, subsoil.....	.064	.028	10	1.17	.....	145	.....	1.14	6.6	7-18
33735	Wilson clay loam, deep subsoil.....	.054	.024	11	1.15	.....	159	.....	1.29	7.2	18-36

TABLE 5. Classes of constituents of surface soils of Collin County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
Average	Bell clay.....	2	3	4	2	2	1	2	2	1
33756	Catalpa clay.....	2	2	5	3	.....	2	.....	1	1
Average	Houston black clay....	2	2	5	2	2	2	1	1	1
33758	Houston clay.....	2	2	5	.....	.....	4	.....	1	1
33745	Irving clay.....	3	4	5	3	.....	3	.....	3	2
33748	Lewisville clay.....	2	1	1	2	.....	1	.....	1	1
33739	Sumter clay.....	3	2	4	2	.....	3	.....	1	1
Average	Trinity clay.....	1	1	5	3	2	2	1	1	1
Average	Wilson clay.....	3	4	4	3	3	3	2	3	2
33733	Wilson clay loam.....	3	4	4	3	.....	2	.....	2	2

TABLE 6. Pot experiments on soils of Collin County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels		
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash
33705	Bell clay, surface, corn.....	26.6	18.1	17.5	31.8	44	32	432
"	Bell clay, surface, sorghum.....	37.3	38.1	13.7	39.5	63	19	246
33706	Bell clay, subsoil, corn.....	.....	1.3	9.8	13.9	3	24	293
"	Bell clay, subsoil, sorghum.....	.....	11.5	6.2	21.2	22	15	191
33710	Houston black clay, surface, corn.....	20.0	7.3	9.7	21.3	17	23	236
"	Houston black clay, surface, sorghum..	32.2	14.0	10.2	31.4	23	19	224
33711	Houston black clay, subsoil, corn.....	13.1	3.8	8.1	16.1	7	20	168
"	Houston black clay, subsoil, sorghum..	31.3	11.3	11.9	31.0	14	17	155
33712	Houston black clay, deep subsoil, corn	.....	.....	7.9	.....	.....	21	.....
5953	Trinity clay, probably, surface, corn...	46.4	41.4	.....	.....	101	.....	.....
"	Trinity clay, probably, surface, sorghum.....	34.2	33.4	.....	.....	90	.....	.....
5954	Trinity clay, probably, subsoil, corn...	24.7	13.7	.....	.....	24	.....	.....
"	Trinity clay, probably, subsoil, sorghum.....	24.5	19.6	.....	.....	33	.....	.....
33708	Trinity clay, surface, corn.....	27.9	16.5	18.6	22.3	50	39	472
"	Trinity clay, surface, sorghum.....	31.1	28.0	10.8	26.8	69	20	.....
33709	Trinity clay, subsoil, corn.....	.....	8.0	29.5	.....	24	66	.....
33702	Wilson clay, surface, corn.....	37.2	23.1	21.2	33.4	43	38	315
"	Wilson clay, surface, sorghum.....	35.5	31.1	12.5	37.0	57	26	138
33703	Wilson clay, subsoil, corn.....	.....	2.8	14.7	22.9	4	28	187
"	Wilson clay, subsoil, sorghum.....	.....	8.0	4.2	23.6	13	10	83
33704	Wilson clay, deep subsoil, corn.....	.....	.....	10.1	.....	.....	15	.....

Fertilizers

The need for fertilizers carrying nitrogen and phosphoric acid is indicated in most of the soils. Potash fertilizers and lime are not needed except possibly on small areas or for special crops.

SOILS OF FRIO COUNTY

Frio County is in southwest Texas and lies entirely within the geographical division known as the Rio Grande Plain. Thirty types and phases of soil were mapped in 13 series. The most extensive soil is Duval fine sandy loam which occupies 30.1 per cent of the area, followed by Webb fine sandy loam, which occupies 23.8 per cent of the area. Upland

soils include the dark colored Victoria, Orelia, San Antonio, and Miguel series, the light brown Maverick series, the red Duval and Webb series, and the Brennan and Nueces series. Flat stream bottom soils include the Blanco, Frio, Leona, and Randall series.

Description of Soils of Frio County

Upland Soils:

Brennan soils—Very light grayish-brown or gray, noncalcareous, friable topsoil with yellow, noncalcareous, crumbly subsoil. Cover 6.1 per cent of area.

Duval soils—Red or reddish-brown, noncalcareous, friable topsoil with red, crumbly subsoil, noncalcareous except where thin. Cover 32.8 per cent of area.

Maverick soils—Light-brown, calcareous, thin, friable topsoil with brown or yellow, thin, crumbly, calcareous subsoil. Cover 9.8 per cent of area.

Miguel soils—Brown or grayish-brown, noncalcareous topsoil, tight when wet, with brown or mottled noncalcareous, very tough, dense subsoil. Cover 1.0 per cent of area.

Nueces soils—Gray, noncalcareous, friable topsoil with pale yellow, noncalcareous, friable subsoil. Cover 1.7 per cent of area.

Orelia soils—Dark-brown or black, noncalcareous topsoil, tight and crusty when dry, with dark-brown or dark-gray, dense, heavy noncalcareous subsoil. Cover 4.7 per cent of area.

San Antonio soils—Dark brown, noncalcareous topsoil, tight when dry, with brown or reddish-brown, dense, heavy noncalcareous subsoil. Cover 2.5 per cent of area.

Victoria soils—Black to very dark-brown or dark grayish-brown, calcareous, heavy but friable topsoil, with very dark blackish-gray, calcareous, crumbly subsoil. Cover 9.8 per cent of area.

Webb soils—Red or reddish-brown, noncalcareous topsoil with dull red, rather heavy and dense, noncalcareous subsoil. Cover 24.7 per cent of area.

Flat Stream Bottoms:

Blanco soils—Gray or light gray, calcareous, friable topsoil with light gray or yellowish, calcareous, crumbly subsoil. Cover 2.1 per cent of area.

Frio soils—Light brown to grayish, calcareous, friable topsoil with light-brown or gray, calcareous, crumbly subsoil. Cover 4.4 per cent of area.

Leona soils—Black or very dark brown, calcareous, friable topsoil with gray or brown, calcareous, crumbly subsoil. Cover 0.3 per cent of area.

Composition of Soils

Table 7 gives the analyses of the different soil types and Table 8 the classes of constituents of the surface soils. The heavy soils are moderately to well supplied with nitrogen (Classes 2 and 3) while the light

TABLE 7. Analyses of soils of Frio County.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
31916	Blanco silty clay loam, surface.....	.115	.091	17	.73	.33	261	33.51	61.30	8.1	0-7
31917	Blanco silty clay loam, subsoil.....	.069	.084	17	.65	.27	102	34.62	63.80	8.0	7-19
31896	Brennan fine sandy loam, surface.....	.037	.022	14	.82	.25	365	.19	.16	7.7	0-7
31897	Brennan fine sandy loam, subsoil.....	.035	.020	8	.73	.38	343	.16	.10	7.8	7-19
31936	Brennan fine sandy loam, surface.....	.053	.023	7	.72	.17	164	.36	.35	7.5	0-7
31937	Brennan fine sandy loam, subsoil.....	.050	.031	7	.73	.17	117	.35	.52	7.9	7-19
Average	Brennan fine sandy loam, surface.....	.045	.022	10	.77	.21	264	.27	.25	7.6	.....
Average	Brennan fine sandy loam, subsoil.....	.042	.025	7	.73	.27	230	.25	.31	7.8	.....
31894	Duval fine sandy loam, depression phase, surface.....	.113	.044	11	.90	.40	592	.37	.61	7.4	0-7
31895	Duval fine sandy loam, depression phase, subsoil.....	.060	.042	6	.90	.30	333	.29	.40	7.2	7-19
3182	Duval fine sandy loam, probably, surface.....	.038	.012	16	.44	.42	235	.14	.14	.....	0-3
4678	Duval fine sandy loam, surface.....	.031	.033	5	.70	.20	219	.10	.35	.....	0-18
4679	Duval fine sandy loam, subsoil.....	.048	.048	4	.95	.42	281	.17	.48	.....	18-36
24021	Duval fine sandy loam, surface.....	.048	.036	15	.87	.22	161	.34	.80	.....	0-13
24022	Duval fine sandy loam, subsoil.....	.047	.052	15	.78	.29	170	.53	1.28	.....	14-27
24023	Duval fine sandy loam, deep subsoil.....	.014	.024	13	.81	.14	102	1.73	3.00	.....	27-63
24024	Duval fine sandy loam, deep subsoil.....	.014	.025	33	1.11	.17	122	2.44	3.95	.....	63-92
31880	Duval fine sandy loam, surface.....	.052	.024	7	.71	.....	256	.....	.23	6.5	0-7
31881	Duval fine sandy loam, subsoil.....	.054	.024	3	.87	.....	254	.....	.40	7.2	7-19
31892	Duval fine sandy loam, surface.....	.038	.035	8	.....	.....	324	.....	.21	7.3	0-7
31893	Duval fine sandy loam, subsoil.....	.041	.025	5	.....	.....	264	.....	.30	6.4	7-19
31886	Duval fine sandy loam, deep phase, surface.....	.037	.031	39	.....	.....	253	.....	.21	7.4	0-7
31887	Duval fine sandy loam, deep phase, subsoil.....	.039	.023	11	.....	.....	273	.....	.15	6.7	7-19
31912	Duval fine sandy loam, deep phase, surface.....	.046	.021	10	.....	.....	210	.....	.00	6.9	0-7
31913	Duval fine sandy loam, deep phase, subsoil.....	.038	.023	7	.....	.....	234	.....	.15	6.9	7-19
31934	Duval fine sandy loam, shallow phase, surface.....	.032	.018	7	.....	.....	155	.....	.00	7.5	0-7
31935	Duval fine sandy loam, subsoil.....	.031	.017	6	.....	.....	137	.....	.00	7.4	7-19
Average	Duval fine sandy loam, surface.....	.048	.029	13	.72	.31	267	.24	.28	7.2	.....
Average	Duval fine sandy loam, subsoil.....	.045	.032	7	.88	.34	243	.33	.40	6.9	.....
Average	Duval fine sandy loam, deep subsoil.....	.014	.024	13	.81	.14	102	1.73	3.00	.....	.....
31882	Frio clay, surface.....	.153	.156	28	1.35	1.00	408	21.56	41.05	7.6	0-7
31883	Frio clay, subsoil.....	.098	.129	19	1.31	.90	186	24.63	45.40	7.8	7-19
31930	Frio clay, surface.....	.155	.174	35	.....	.....	218	.....	43.95	8.0	0-7
31931	Frio clay, subsoil.....	.085	.124	17	.....	.....	81	.....	46.65	8.0	7-19
Average	Frio clay, surface.....	.154	.165	32	1.35	1.00	313	21.56	42.50	7.8	.....
Average	Frio clay, subsoil.....	.092	.127	18	1.31	.90	134	24.63	46.03	7.9	.....
31926	Frio silty clay, surface.....	.149	.085	14	.....	.....	242	.....	4.83	8.0	0-7
31927	Frio silty clay, subsoil.....	.105	.089	8	.....	.....	144	.....	5.57	7.9	7-19

TABLE 7. Analyses of soils of Frio County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
31884	Hidalgo clay loam, surface.....	.133	.107	55	1.48	.92	561	7.50	12.30	8.1	0-7
31885	Hidalgo clay loam, subsoil.....	.092	.100	32	1.36	.....	283	.....	19.60	8.1	7-19
31928	Hidalgo clay loam, surface.....	.129	.084	52	.....	.....	474	.....	2.43	7.4	0-7
31929	Hidalgo clay loam, subsoil.....	.073	.073	13	.....	.....	331	.....	.....	7.4	7-19
Average	Hidalgo clay loam, surface.....	.131	.096	54	1.48	.92	518	7.50	7.37	7.8	.....
Average	Hidalgo clay loam, subsoil.....	.083	.087	23	1.36	.....	307	.....	19.6	7.8	.....
31918	Hidalgo fine sandy loam, surface.....	.068	.062	10	.....	.30	43	11.29	20.20	8.2	0-7
31919	Hidalgo fine sandy loam, subsoil.....	.062	.058	5	.....	.30	25	13.77	25.50	8.1	7-19
31908	Leona clay, surface.....	.129	.126	597	1.76	.73	618	2.10	3.50	7.8	0-7
31909	Leona clay, subsoil.....	.103	.119	572	1.66	.79	376	2.84	4.90	8.2	7-19
31924	Maverick fine sandy loam, surface.....	.096	.043	13	.48	.15	48	6.57	12.30	7.6	0-7
31925	Maverick fine sandy loam, subsoil.....	.082	.045	6	.42	.11	16	8.99	16.20	8.0	7-19
31890	Miguel fine sandy loam, surface.....	.056	.042	43	.84	.39	193	.22	.36	6.2	0-7
31891	Miguel fine sandy loam, subsoil.....	.059	.033	12	1.04	.46	255	.35	1.00	7.8	7-19
31910	Nueces fine sand, surface.....	.023	.015	13	.82	.23	75	.08	.00	8.1	0-7
31911	Nueces fine sand, subsoil.....	.017	.012	10	.81	.05	72	.07	.00	7.8	7-19
31898	Orelia clay, surface.....	.125	.082	287	1.60	.59	582	.93	1.36	7.5	0-7
31899	Orelia clay, subsoil.....	.086	.067	155	1.56	.93	388	.86	1.57	7.9	7-19
31904	Orelia clay loam, surface.....	.101	.035	18	1.16	.41	258	1.11	2.06	8.4	0-7
31906	Orelia clay loam, subsoil.....	.084	.040	47	1.17	.49	200	1.90	3.51	8.1	7-19
31932	Orelia clay loam, surface.....	.103	.068	237	1.08	.37	435	.63	.95	7.4	0-7
31933	Orelia clay loam, subsoil.....	.097	.064	182	1.18	.40	347	.62	.93	7.4	7-19
Average	Orelia clay loam, surface.....	.102	.052	128	1.12	.39	347	.87	1.51	7.9	.....
Average	Orelia clay loam, subsoil.....	.091	.052	115	1.18	.45	274	1.26	2.22	7.7	.....
31914	Orelia fine sandy loam, surface.....	.067	.044	116	.....	.37	461	.40	.60	6.8	0-7
31915	Orelia fine sandy loam, subsoil.....	.066	.046	116	.....	.44	508	.41	.74	7.1	7-19
31920	San Antonio clay loam, surface.....	.097	.033	18	.....	.41	296	.68	1.00	7.6	0-7
31921	San Antonio clay loam, subsoil.....	.079	.037	20	.....	.41	179	2.74	4.35	7.9	7-19
31922	San Antonio fine sandy loam, surface.....	.075	.025	7	.86	.32	298	.45	.61	7.4	0-7
31923	San Antonio fine sandy loam, subsoil.....	.074	.024	4	.86	.....	205	.....	.70	7.4	7-19
31902	Victoria clay, surface.....	.108	.064	148	1.14	.56	297	2.31	4.03	7.8	0-7
31903	Victoria clay, subsoil.....	.076	.063	141	1.20	.....	215	.....	5.33	7.9	7-19
31905	Victoria clay loam, surface.....	.135	.041	33	.....	.40	432	.89	1.70	7.9	0-7
31907	Victoria clay loam, subsoil.....	.103	.059	43	.....	.33	209	2.81	5.00	8.2	7-19
31888	Webb fine sandy loam, surface.....	.048	.036	13	1.12	.40	357	.19	.26	.....	0-7
31889	Webb fine sandy loam, subsoil.....	.083	.032	6	1.29	.77	379	.51	.95	6.7	7-19
31900	Webb fine sandy loam, surface.....	.047	.031	8	.....	.....	174	.....	.20	6.7	0-7
31901	Webb fine sandy loam, subsoil.....	.054	.043	4	.....	.42	171	.29	.50	6.2	7-19
Average	Webb fine sandy loam, surface.....	.048	.034	11	1.12	.40	266	.19	.23	6.7	.....
Average	Webb fine sandy loam, subsoil.....	.069	.038	5	1.29	.60	275	.40	.73	6.5	.....

TABLE 8. Classes of constituents of surface soils of Frio County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
31916	Blanco silty clay loam.	3	3	5	3	3	2	1	1	1
Average	Brennan fine sandy loam.....	4	5	5	3	3	2	3	5	1
Average	Duval fine sandy loam.	4	4	5	3	3	2	3	5	2
Average	Frio clay.....	2	1	4	2	1	2	1	2	1
31926	Frio silty clay.....	2	3	5	.....	.....	2	.....	2	1
Average	Hidalgo clay loam.....	2	3	4	2	1	1	1	1	1
31918	Hidalgo fine sandy loam.....	3	3	5	.....	3	5	1	1	1
31908	Leona clay.....	2	2	1	2	2	1	1	2	1
31924	Maverick fine sandy loam.....	3	4	5	4	4	5	1	1	1
31890	Miguel fine sandy loam	4	4	4	3	3	3	3	4	2
31910	Nueces fine sand.....	5	5	5	3	3	4	5	5	1
31898	Orelia clay.....	2	3	2	2	2	1	2	3	1
Average	Orelia clay loam.....	3	3	3	3	3	2	2	3	1
31914	Orelia fine sandy loam.	3	4	3	.....	3	1	3	4	2
31920	San Antonio clay loam.	3	4	5	.....	2	2	2	3	1
31922	San Antonio fine sandy loam.....	3	5	5	3	3	2	2	3	2
31902	Victoria clay.....	3	3	3	3	2	2	1	2	1
31905	Victoria clay loam.....	2	4	4	.....	3	1	2	3	1
Average	Webb fine sandy loam.	4	4	5	3	3	2	4	5	2

soils, principally fine sandy loams, are low in nitrogen (Classes 4 and 5). Most of the soils are low in total and active phosphoric acid (Classes 4 and 5), moderately to well supplied with total and acid-soluble potash, and well supplied with active potash, lime, and basicity. The Hidalgo fine sandy loam and Nueces fine sand are low in active potash. The Brennan, Duval, Miguel, Orelia, and Webb fine sandy loams and the Nueces fine sand are low in basicity and low to moderate in lime. All of the soils are neutral to alkaline in reaction (pH), most of them falling in Class 1.

Pot Experiments

Results of pot experiments are given in Table 9. Most of the soils respond to nitrogen and phosphoric acid but do not respond to potash. The corn possibility of the upland soils with respect to nitrogen and phosphoric acid is low.

Fertilizers

The need for fertilizers carrying nitrogen and phosphoric acid is strongly indicated on most of the soils. Some of the soils of lighter texture may respond to potash. Lime is at present not needed on most of the soils, but may be needed for legume crops or after the soils have been in cultivation for a longer period of time. This is particularly the case with the soils of light texture.

SOILS OF GALVESTON COUNTY

Galveston County is in the southeastern part of Texas and lies entirely within the geographical division known as the Gulf Coast Prairie. Twelve types and phases of soil were mapped in five series. The most extensive

TABLE 9. Pot experiments on soils of Frio County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels		
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash
31880	Duval fine sandy loam, surface, corn.....		7.8	13.2		11	18	.....
"	Duval fine sandy loam, surface, kafir.....		11.2	5.5		13	11	.....
"	Duval fine sandy loam, surface, sorghum.....		5.6	4.9		6	7	.....
31881	Duval fine sandy loam, subsoil, corn.....		3.2	13.5		4	18	.....
"	Duval fine sandy loam, subsoil, kafir.....		4.9	3.2		4	5	.....
31886	Duval fine sandy loam, deep phase, surface, corn.....		26.7	9.5		42	13	.....
"	Duval fine sandy loam, deep phase, surface, kafir.....		23.2	5.8		57	12	.....
"	Duval fine sandy loam, deep phase, surface, corn.....		16.8	4.7		18	7	.....
31887	Duval fine sandy loam, deep phase, subsoil, corn.....	38.5	6.0	8.1	33.0	11	11	368
"	Duval fine sandy loam, deep phase, subsoil, kafir.....	5.5	13.4	4.1	5.9	15	7	44
"	Duval fine sandy loam, deep phase, subsoil, corn.....	29.5	5.5	4.0	4.2	7	6	.....
31882	Frio clay, surface, corn.....		15.5	24.5	27.9	45	57	595
"	Frio clay, surface, kafir.....		32.0	20.5	35.1	78	33	396
"	Frio clay, surface, corn.....		33.3	6.0	30.8	64	12	454
31885	Hidalgo clay loam, subsoil, corn.....		5.0	16.6		8	38	.....
"	Hidalgo clay loam, subsoil, kafir.....		14.4	7.5		17	11	.....
"	Hidalgo clay loam, subsoil, corn.....		8.7	4.5			7	.....
31888	Webb fine sandy loam, surface, corn.....		17.5	8.0		27	13	.....
"	Webb fine sandy loam, surface, kafir.....		14.3	5.2		16	10	.....
"	Webb fine sandy loam, surface, corn.....		6.8	5.0		9	7	.....
31889	Webb fine sandy loam, subsoil, corn.....	23.4	19.3	31.2	40	30	494	
"	Webb fine sandy loam, subsoil, kafir.....	12.0	7.1	9.5	18	10	58	
"	Webb fine sandy loam, subsoil, corn.....		3.5	4.0	5.2		6	.....

soil is the Lake Charles clay, which occupies 25.4 per cent of the area, followed by the Lake Charles clay loam, which covers 23.2 per cent of the area, and the Lake Charles fine sandy loam, which occupies 14.0 per cent of the area. Prairie soils include the dark-colored Lake Charles series, and the light-colored Acadia, Nueces, and Galveston series. Flat marshy or semimarshy prairies are occupied by soils of the Harris series. Tidal marsh occupies 4.3 per cent of the area, beach sand 2.1 per cent, and made land 2.6 per cent.

Description of Soils of Galveston County

Acadia soils—Light-brown, gray or slightly mottled, acid topsoil, hard and tight when dry, with gray or slightly mottled dense clay, acid subsoil. Cover 2.2 per cent of area.

Galveston soils—Dark-gray or brownish-gray, loose and incoherent, acid topsoil with yellow or gray, acid subsoil. Cover 6.4 per cent of area.

Harris soils—Gray, marshy topsoil with high salt content and gray or brown dense clay subsoil with high water table. Cover 19.2 per cent of area.

Morse soils—Brown surface soil resting on a mottled red, yellow, and gray clay subsoil. Cover 0.6 per cent of area.

TABLE 10. Analyses of soils of Galveston County.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
32681	Harris clay, surface.....	.121	.044	89	1.89	.63	886	.25	1.28	6.8	0-5
32682	Harris clay, subsoil.....	.063	.045	62	1.99	.69	851	.23	1.41	7.2	5-25
32683	Harris clay, deep subsoil.....	.031	.029	29	1.78	.....	805	.....	1.50	7.7	25-60
32684	Harris clay, deep subsoil.....	.020	.019	13	1.58	.....	531	.....	5.18	8.1	60-70
32649	Lake Charles clay, surface.....	.168	.034	13	1.21	.36	184	.49	1.32	5.8	0-7
32650	Lake Charles clay, subsoil.....	.097	.032	5	1.35	.34	165	.50	1.10	5.0	7-19
32651	Lake Charles clay, deep subsoil.....	.080	.026	5	1.39	.39	164	.50	1.20	5.0	19+
32656	Lake Charles clay, surface.....	.160	.034	13	1.11	.33	238	.44	1.32	5.8	0-6
32657	Lake Charles clay, subsoil.....	.064	.016	5	1.03	.32	156	.66	1.30	6.6	6-25
32658	Lake Charles clay, deep subsoil.....	.041	.015	2	.98	.34	174	.69	1.31	7.5	25-60
32659	Lake Charles clay, deep subsoil.....	.025	.020	2	1.12	.43	233	1.02	2.05	8.1	60-70
32660	Lake Charles clay, surface.....	.137	.049	(129)	1.08	.....	245	.....	1.89	7.8	0-7
32661	Lake Charles clay, subsoil.....	.079	.028	5	1.16	.....	187	.....	1.63	7.5	7-17
Average	Lake Charles clay, surface.....	.155	.039	13	1.13	.35	222	.47	1.51	6.5	.....
Average	Lake Charles clay, subsoil.....	.080	.025	5	1.18	.33	169	.58	1.34	6.4	.....
Average	Lake Charles clay, deep subsoil.....	.061	.021	4	1.19	.37	169	.60	1.26	6.3	.....
32644	Lake Charles clay loam, surface.....	.155	.034	29	1.10	.13	162	.31	1.21	7.3	0-7
32645	Lake Charles clay loam, subsoil.....	.051	.017	8	1.09	.21	92	.51	1.12	7.8	7-19
32667	Lake Charles clay loam, surface.....	.120	.033	6	.84	.21	6	.24	.70	6.0	0-8
32668	Lake Charles clay loam, subsoil.....	.048	.021	4	1.22	.39	181	.47	1.38	6.6	8-30
32669	Lake Charles clay loam, deep subsoil.....	.032	.019	2	1.27	.35	189	.39	1.20	7.4	30-44
32670	Lake Charles clay loam, deep subsoil.....	.023	.018	5	1.28	.48	132	2.48	4.20	8.3	44-52
32671	Lake Charles clay loam, surface.....	.138	.031	29	1.17	.29	219	.67	1.00	7.6	0-8
32672	Lake Charles clay loam, subsoil.....	.060	.025	5	1.13	.38	117	.57	1.20	7.3	8-15
32673	Lake Charles clay loam, deep subsoil.....	.034	.016	5	1.15	.42	149	1.99	3.20	8.1	15-30
Average	Lake Charles clay loam, surface.....	.138	.033	21	1.04	.21	129	.41	.97	7.0	.....
Average	Lake Charles clay loam, subsoil.....	.053	.021	6	1.15	.33	130	.52	1.23	7.2	.....
Average	Lake Charles clay loam, deep subsoil.....	.033	.018	4	1.21	.39	169	1.19	2.20	7.8	.....
32646	Lake Charles very fine sandy loam, surface.....	.140	.026	31	1.07	.15	107	.43	.90	6.9	0-7
32647	Lake Charles very fine sandy loam, subsoil.....	.065	.020	6	1.03	.21	81	.54	.91	7.6	7-13
32648	Lake Charles very fine sandy loam, deep subsoil.....	.046	.017	5	1.08	.25	81	1.02	1.92	8.1	13-22
32662	Lake Charles very fine sandy loam, surface.....	.119	.027	14	.74	.08	84	.17	.32	6.3	0-6
32663	Lake Charles very fine sandy loam, subsoil.....	.051	.018	4	.81	.16	93	.25	.49	7.0	6-15
32664	Lake Charles very fine sandy loam, deep subsoil.....	.036	.018	3	.87	.24	106	.35	.70	7.7	15-23
32665	Lake Charles very fine sandy loam, deep subsoil.....	.045	.018	2	.83	.27	112	1.41	2.31	8.1	23-36
32666	Lake Charles very fine sandy loam, deep subsoil.....	.022	.016	1	.92	.26	106	1.38	2.18	7.8	36-60
32674	Lake Charles very fine sandy loam, surface.....	.112	.020	15	1.00	.18	123	.13	.10	5.5	0-7

TABLE 10. Analyses of soils of Galveston County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
32675	Lake Charles very fine sandy loam, subsoil..	.070	.011	6	.99	.17	73	.21	.40	5.6	7-19
32676	Lake Charles very fine sandy loam, deep subsoil.....	.029	.012	6	.96	.23	117	.30	.70	7.8	19-40
32677	Lake Charles very fine sandy loam, deep subsoil.....	.017	.017	5	.98	.29	49	7.22	9.41	8.0	40-50
Average	Lake Charles very fine sandy loam, surface..	.124	.024	20	.94	.14	105	.24	.44	6.2	.....
Average	Lake Charles very fine sandy loam, subsoil..	.062	.016	5	.94	.18	82	.33	.60	6.7	.....
	Lake Charles very fine sandy loam, deep subsoil.....	.037	.016	5	.97	.24	101	.56	1.11	7.9	.....
32678	Nueces sand, surface.....	.043	.045	152	1.08	.08	168	.07	.10	7.6	0-7
32679	Nueces sand, subsoil.....	.013	.026	16	1.54	.06	79	.08	.10	7.2	7-24
32680	Nueces sand, deep subsoil.....	.062	.041	120	1.37	.....	265	.....	.01	6.2	24-36

TABLE 11. Classes of constituents of surface soils of Galveston County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
32681	Harris clay.....	2	4	4	1	2	1	3	3	2
Average	Lake Charles clay.....	2	4	5	3	3	2	2	3	2
Average	Lake Charles clay loam.....	2	4	5	3	3	3	2	3	2
Average	Lake Charles very fine sandy loam.....	2	5	5	3	4	3	3	4	2
32678	Nueces sand.....	4	4	3	3	5	3	5	5	1

TABLE 12. Pot experiments on soils of Galveston County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels			
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash	
32644	Lake Charles clay loam, surface, corn..	39.2	11.0	32.1	40.9	20	67	174	
"	Lake Charles clay loam, surface, sorghum.....	35.0	24.0	23.8	33.5	21	43	103	
32645	Lake Charles clay loam, subsoil, corn..	25.0	1.7	9.8	27.4	2	18	135	
"	Lake Charles clay loam, subsoil, sorghum.....	19.2	2.8	5.5	21.9	4	12	69	
32647	Lake Charles fine sandy loam subsoil, corn.....		2.5			3			
32649	Lake Charles clay, surface, corn.....		13.6			21			
32650	Lake Charles clay, subsoil, corn.....		2.4			3			
32651	Lake Charles clay, deep subsoil, corn, ..		2.8	14.3		4	24		

Lake Charles soils—Black, dark-gray or brown, noncalcareous, tight topsoil with heavy, black or gray, noncalcareous subsoil slowly permeable to water. Cover 62.6 per cent of area.

Composition of Soils

Table 10 gives the analyses of the different soils and Table 11 the classes of constituents of the surface soils. Only the Nueces fine sand is low in nitrogen (Class 4), the rest of the soils falling in Class 2. The soils are low in total and active phosphoric acid (Classes 4 and 5), moderately supplied with total potash (Class 3), moderate to low in acid soluble potash (Classes 3, 4, 5), moderate to high in active potash (Classes 3, 2, 1), and moderate to low (Classes 3, 4, 5) in lime and basicity. Seven of the 11 surface samples are slightly acid in pH while the other 4 are slightly alkaline. The acidity of Lake Charles clay, No. 32649, and Lake Charles fine sandy loam, No. 32674, probably is sufficiently high to interfere with good growth of legumes.

Pot Experiments

Results of pot experiments are given in Table 12. All of the soils studied respond readily to applications of phosphoric acid and nitrogen but give no response to potash.

Fertilizers

The need for fertilizers carrying nitrogen and phosphoric acid is shown on many of these soils; potash may be needed in some areas where heavy demands are made by truck crops. Lime is not generally needed, but small applications may be necessary on certain areas for legume crops, or after the soils have been in cultivation for a longer period.

Saline Soils

The composition of the soluble salts in some soils of Galveston County is given in Table 13. Most of the salts are chlorides, with small quantities of sodium carbonate in some of the soils. The sodium carbonate in No. 32652 and 32653 is sufficiently high to be of considerable damage to crop growth. The total quantity of soluble salts present is much

TABLE 13. Composition of soluble salts in some soils of Galveston County (parts per million).

Laboratory Number		Depth Inches	Calcium Sulphate	Calcium Chloride	Magnesium Carbonate	Magnesium Sulphate	Magnesium Chloride	Sodium Carbonate	Sodium Sulphate	Sodium Chloride
2069	Whitish soil.....					72	95			893
2070	Black soil.....			717			558			1841
9796	Gray sand.....	0-1 1/4	5666			5703	6410			108682
9797	Grayish black sand.....	1 1/4-2	63				72	227		1433
9798	Gray sand.....	2-10			76	94	13			300
9799	Drab sand.....	12-24			96			72	129	597
9800	Gray sand.....	24-36			116			190	760	388
9801	Gray sand.....	36-42	255	372			307			118
9802	Gray sandy loam.....	0-12			136			64	200	288
9803	Yellowish brown sand..	12-24			225			24	197	800
9804	Gray sand.....	24-36	38			112	71			1527
9805	Gray sand.....	36-42	65			48	42			1168
27833	Surface soil.....	0-7								413
27834	Subsoil.....	7-19								231
32652	Whitish very fine sandy loam, surface...	0-1 1/4			61			1375		1160
32653	Dark gray very fine sandy loam, subsoil...	3/4-7			38			1094		726
32654	Gray fine sandy clay, subsoil.....	7-24			33			384		196
32655	Gray clay, subsoil.....	24-42			29			320		206

smaller than that in spots found in Potter County (Table 20) and in the Trans-Pecos Area (Table 27), but still sufficiently high to interfere with satisfactory crop growth. Different crops vary considerably in their tolerance to soluble salts. Citrus trees in Cameron County, for example, were injured by 600 parts per million of soluble salts (Bulletin 430), which is considerably lower than the content of many of the soils listed in Table 13.

SOILS OF MIDLAND COUNTY

Midland county is in western Texas. Most of the county lies within the geographical division known as the High Plains; the southeast corner of the county lies on the Edwards Plateau. Twenty-three types and phases of soil in 6 series were mapped. The most extensive soil is the Reagan gravelly loam which occupies 26.8 per cent of the area, followed

TABLE 14. Analyses of soils of Midland County.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
29351	Ector gravelly clay loam, surface.....	.105	.068	58	1.28	.73	581	.77	1.51	7.2	0-7
29386	Frio loam, surface.....	.106	.....	283	1.69	.70	593	4.57	8.36	7.7	0-7
29387	Frio loam, subsoil.....	.115	.....	498	2.19	.91	951	1.89	3.34	7.7	7-19
29331	Frio silt loam, surface.....	.095	.103	524	1.74	.....	647	.....	8.95	7.4	0-7
29332	Frio silt loam, subsoil.....	.053	.104	257	1.58	.50	270	7.13	13.30	7.7	7-19
29345	Frio silt loam, surface.....	.083	.069	520	1.52	.55	853	4.33	7.56	7.7	0-7
29348	Frio silt loam, subsoil.....	.055	.080	373	1.42	.52	505	4.87	10.80	7.7	7-19
Average	Frio silt loam, surface.....	.089	.086	522	1.63	.55	750	4.33	8.26	7.6	.....
Average	Frio silt loam, subsoil.....	.054	.092	315	1.50	.51	388	6.00	12.05	7.7	.....
29317	Randall clay, surface.....	.068	.127	556	2.52	1.02	977	.80	1.43	7.1	0-7
29318	Randall clay, subsoil.....	.045	.127	580	2.46	.99	887	.70	1.35	7.1	7-19
29349	Randall clay, surface.....	.069	.....	555	2.33	1.08	985	.83	1.55	7.0	0-7
29350	Randall clay, subsoil.....	.044	.119	.....	2.27	1.04	882	.75	1.41	7.1	7-19
Average	Randall clay, surface.....	.069	.127	556	2.43	1.05	981	.82	1.49	7.1	.....
Average	Randall clay, subsoil.....	.045	.123	580	3.37	1.02	885	.73	1.38	7.1	.....
29333	Reagan fine sandy loam, surface.....	.066	.041	41	.89	.51	585	1.85	3.54	7.6	0-7
29334	Reagan fine sandy loam, subsoil.....	.051	.046	104	1.46	.54	445	3.70	6.30	8.3	7-19
29388	Reagan fine sandy loam, shallow phase, surface.....	.044	.039	5	1.32	.35	441	1.58	2.73	7.7	0-7
29390	Reagan fine sandy loam, shallow phase, subsoil.....	.044	.032	38	1.45	.47	481	3.18	5.52	7.8	7-19
29394	Reagan fine sandy loam, surface.....	.062	.044	100	1.84	.53	659	1.54	2.60	7.8	0-7
29395	Reagan fine sandy loam, subsoil.....	.041	.030	94	1.76	.55	414	3.21	6.50	7.9	7-19
Average	Reagan fine sandy loam, surface.....	.057	.041	49	1.35	.46	562	1.66	2.96	7.7	.....
Average	Reagan fine sandy loam, subsoil.....	.045	.036	79	1.56	.52	447	3.36	6.11	8.0	.....
29380	Reagan loam, surface.....	.062	.049	141	.93	.37	330	3.35	5.10	7.9	0-7
29381	Reagan loam, subsoil.....	.047	.051	122	1.41	.33	194	4.97	8.02	7.8	7-19
29372	Reagan loam, shallow phase, surface.....	.069	.066	80	1.41	.42	284	7.95	14.30	7.7	0-7
29373	Reagan loam, shallow phase, subsoil.....	.056	.071	29	1.22	.43	141	14.18	27.60	7.6	7-19
Average	Reagan loam, surface.....	.066	.058	111	1.17	.40	307	5.65	7.55	7.8	.....
Average	Reagan loam, subsoil.....	.052	.061	76	1.32	.38	168	9.58	9.01	7.7	.....
29356	Reagan gravelly silty clay loam, surface.....	.105	.072	59	1.14	.34	109	8.77	17.00	7.8	0-7
29359	Reagan gravelly silty clay loam, subsoil.....	.070	.063	49	1.32	.34	52	12.78	23.80	7.8	7-12
29313	Reagan silty clay loam, surface.....	.129	.092	282	2.42	.87	611	6.40	10.50	7.7	0-7
29314	Reagan silty clay loam, subsoil.....	.088	.063	44	2.17	.73	144	10.86	19.80	7.8	7-19
29352	Reagan silty clay loam, surface.....	.153	.104	388	.....	.85	597	5.87	10.40	7.7	0-7
29353	Reagan silty clay loam, subsoil.....	.083	.086	58	.....	.....	341	11.09	20.20	7.8	7-19
29354	Reagan silty clay loam, shallow phase, surface.....	.093	.071	218	.....	.....	255	.....	15.03	.....	0-7

TABLE 14. Analyses of soils of Midland County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
29355	Reagan silty clay loam, shallow phase, subsoil.....	.066	.087	181	.....	.....	100	.....	19.20	7.9	7-19
Average	Reagan silty clay loam, surface.....	.125	.089	296	2.42	.86	488	6.14	11.98	7.7	.....
Average	Reagan silty clay loam, subsoil.....	.079	.079	94	2.17	.79	195	10.98	19.73	7.8	.....
29360	Reeves chalk, surface.....	.048	.033	105	.92	.22	133	6.16	2.74	7.4	0-7
29361	Reeves chalk, subsoil.....	.008	.023	74	.92	.17	151	6.73	2.59	7.7	7-19
29339	Reeves loam, surface.....	.078	.060	314	.96	.60	590	3.00	5.30	7.9	0-7
29340	Reeves loam, subsoil.....	.060	.076	294	1.85	.61	436	4.96	8.52	7.8	7-19
20585	Reeves silty clay loam, deep phase, surface..	.109	.070	235	2.18	.57	715	4.06	6.83	7.9	0-10
20586	Reeves silty clay loam, deep phase, subsoil..	.077	.080	25	2.16	.65	294	6.93	12.93	8.1	10-36
29376	Reeves silty clay loam, depression phase, surface.....	.199	.199	391	1.96	.71	357	8.03	14.07	7.2	0-7
29377	Reeves silty clay loam, depression phase, subsoil.....	.098	.183	597	2.03	.65	432	6.74	11.45	7.6	7-19
Average	Reeves silty clay loam, surface.....	.154	.135	313	2.07	.64	536	6.05	10.45	7.6	.....
Average	Reeves silty clay loam, subsoil.....	.088	.132	311	2.10	.65	363	6.84	12.19	7.9	.....
29341	Richfield clay loam, shallow phase, surface..	.082	.058	51	1.88	.67	796	.53	1.06	7.4	0-7
29342	Richfield clay loam, shallow phase, subsoil..	.068	.068	77	1.83	.68	537	2.36	4.23	7.7	7-19
29335	Richfield fine sandy loam, surface.....	.053	.040	42	1.36	.41	335	.41	.62	8.2	0-7
29336	Richfield fine sandy loam, subsoil.....	.056	.041	101	1.26	.43	429	1.45	2.35	8.3	7-19
29392	Richfield fine sandy loam, surface.....	.049	.034	34	1.33	.....	333	.....	2.15	7.8	0-7
29393	Richfield fine sandy loam, subsoil.....	.063	.034	52	1.30	.....	437	.....	.90	7.6	7-19
Average	Richfield fine sandy loam, surface.....	.051	.037	38	1.35	.41	334	.41	1.39	8.0	.....
Average	Richfield fine sandy loam, subsoil.....	.060	.038	77	1.28	.43	433	1.45	1.63	8.0	.....
29382	Richfield loam, surface.....	.087	.046	38	1.38	.58	538	.49	.86	7.3	0-7
29383	Richfield loam, subsoil.....	.053	.034	25	1.57	.53	417	.36	.65	7.3	7-19
29366	Springer clay loam, shallow phase, surface...	.091	.088	71	.....	.61	504	.56	1.07	6.9	0-7
29367	Springer clay loam, shallow phase, subsoil...	.101	.074	19	.....	.....	431	.....	1.31	7.0	7-12
29311	Springer fine sand, surface.....	.009	.014	23	.56	.08	87	.08	.06	7.1	0-7
29312	Springer fine sand, subsoil.....	.014	.017	9	.96	.10	79	.10	.15	7.3	7-19
29362	Springer fine sand, surface.....	.006	.022	20	.35	.09	84	.10	.05	7.0	0-7
29363	Springer fine sand, subsoil.....	.013	.020	11	.47	.10	99	.11	.10	7.0	7-19
Average	Springer fine sand, surface.....	.035	.041	38	.46	.26	225	.25	.39	7.0	.....
Average	Springer fine sand, subsoil.....	.043	.037	13	.72	.10	203	.11	.52	7.1	.....
20589	Springer fine sandy loam, surface.....	.020	.019	20	.54	.19	224	.20	.25	7.7	0-10
20590	Springer fine sandy loam, subsoil.....	.035	.024	19	.85	.28	238	.28	.48	7.3	10-36
29315	Springer fine sandy loam, surface.....	.032	.019	27	1.17	.25	267	.24	.42	7.4	0-7
29316	Springer fine sandy loam, subsoil.....	.033	.021	16	1.29	.....	365	.....	.53	7.1	7-19
29447	Springer fine sandy loam, surface.....	.011	.021	11	.95	.36	285	.22	.48	7.1	0-7
29448	Springer fine sandy loam, subsoil.....	.020	.020	4	1.09	.44	324	.27	.58	7.1	7-19
29449	Springer fine sandy loam, surface.....	.022	.016	10	.76	.36	267	.22	.45	7.1	0-7
29450	Springer fine sandy loam, subsoil.....	.010	.021	7	1.17	.42	249	.20	.46	7.2	7-19

TABLE 14. Analyses of soils of Midland County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Dept Inches
29337	Springer fine sandy loam, upland phase, surface.....	.042	.038	36	1.27	.39	411	.33	.63	7.4	0-7
29338	Springer fine sandy loam, upland phase, subsoil.....	.049	.031	21	1.31	.43	356	.35	.68	7.3	7-19
29343	Springer fine sandy loam, heavy shallow phase, surface.....	.053	.040	62	1.59	.55	562	.49	.85	7.5	0-7
29344	Springer fine sandy loam, heavy shallow phase, subsoil.....	.050	.053	31	1.76	.66	501	.51	.92	7.3	7-19
29378	Springer fine sandy loam, deep phase, surface.....	.027	.023	29	.84	.19	240	.17	.20	7.1	0-7
29379	Springer fine sandy loam, deep phase, subsoil.....	.028	.024	18	.77	.23	232	.18	.30	7.3	7-19
29384	Springer fine sandy loam, shallow phase or rock, surface.....	.032	.028	19	.79	.21	229	.14	.20	7.1	0-7
29385	Springer fine sandy loam, shallow phase or rock, subsoil.....	.032	.....	8	1.10	.....	201	.....	.34	7.2	7-19
29389	Springer fine sandy loam, shallow phase, surface.....	.069	.031	74	1.36	.....	239	.....	(7.71)	8.0	0-7
29391	Springer fine sandy loam, shallow phase, subsoil.....	.049	.035	54	1.37	.38	132	(5.97)	(10.54)	7.9	7-19
29445	Springer fine sandy loam, surface.....	.027	.030	21	.82	.....	296	.....	.46	7.3	0-7
29446	Springer fine sandy loam, subsoil.....	.027	.017	7	.91	.91	225	.....	.55	7.0	7-19
Average	Springer fine sandy loam, surface.....	.034	.028	29	1.03	.32	299	.24	.43	7.2	.....
Average	Springer fine sandy loam, subsoil.....	.033	.029	17	1.14	.47	286	.28	.52	7.2	.....
20587	Springer loam, shallow phase, surface.....	.042	.032	23	1.02	.28	258	.28	.53	7.1	0-8
20588	Springer loam, shallow phase, subsoil.....	.050	.042	18	1.23	.46	337	.38	.58	7.1	8-15
29370	Springer loam, shallow phase, surface.....	.065	.053	8	1.69	.61	510	.41	.84	7.1	0-7
29371	Springer loam, shallow phase, subsoil.....	.063	.053	32	1.50	.47	380	.30	.56	6.8	7-19
29374	Springer loam, shallow phase, surface.....	.051	.046	22	1.40	.....	418	.....	.62	7.3	0-7
29375	Springer loam, shallow phase, subsoil.....	.045	.034	4	1.48	.....	349	.....	.71	7.1	7-19
Average	Springer loam, surface.....	.053	.044	18	1.37	.45	395	.35	.66	7.2	.....
Average	Springer loam, subsoil.....	.053	.043	18	1.40	.47	355	.34	.62	7.0	.....
29364	Springer sandy loam, surface.....	.027	.020	14	.86	.20	195	.13	.20	6.6	0-7
29365	Springer sandy loam, subsoil.....	.027	.034	9	.79	.26	240	.17	.30	7.0	7-19
29368	Springer sandy loam, surface.....	.032	.029	16	.....	.....	270	.....	.40	7.1	0-7
29369	Springer sandy loam, subsoil.....	.037	.032	9	.....	.....	399	.....	.55	7.1	7-19
Average	Springer sandy loam, surface.....	.030	.025	15	.86	.20	233	.13	.30	6.9	.....
Average	Springer sandy loam, subsoil.....	.032	.033	9	.79	.26	320	.17	.43	7.1	.....

TABLE 15. Classes of constituents of surface soils of Midland County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
29351	Ector gravelly clay loam.....	3	3	4	2	2	1	2	3	2
29386	Frio loam.....	3	.....	2	2	2	1	1	1	1
Average	Frio silt loam.....	3	3	1	2	2	1	1	1	1
Average	Randall clay.....	3	2	1	1	1	1	2	3	2
Average	Reagan fine sandy loam.....	4	4	4	2	2	1	2	2	1
Average	Reagan loam.....	3	3	3	3	3	2	1	1	1
Average	Reagan silty clay loam.....	2	3	2	1	1	1	1	1	1
29360	Reeves chalk.....	4	4	3	3	3	3	1	2	2
29339	Reeves loam.....	3	3	2	3	2	1	1	1	1
Average	Reeves silty clay loam.....	2	2	2	1	2	1	1	1	1
29341	Richfield clay loam.....	3	3	4	1	2	1	2	3	2
Average	Richfield fine sandy loam.....	4	4	4	2	2	2	2	3	1
29382	Richfield loam.....	3	4	4	2	2	1	2	3	2
Average	Springer fine sand.....	4	4	4	4	3	2	3	4	2
Average	Springer fine sandy loam.....	4	4	5	3	3	2	3	4	2
Average	Springer loam.....	4	4	5	2	2	2	3	3	2
Average	Springer sandy loam.....	5	5	5	3	4	2	4	5	2

TABLE 16. Pot experiments on soils of Midland County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels		
		With complete fertilizer	With-out phosphoric acid	With-out nitrogen	With-out potash	Phosphoric acid	Nitrogen	Potash
29331	Frio silt loam, surface, corn.....	22.2	19.9	29.5	28	34	676	
	Frio silt loam, surface, kafir.....	4.4	13.7	4.8	13	36	75	
29332	Frio silt loam, subsoil, corn.....	3.3	7.5	17.5	4	13	323	
	Frio silt loam, subsoil, kafir.....	1.5	2.9	1.6	2	6	21	
29317	Randall clay, surface, corn.....	46.0	19.5	50.0	127	24	1042	
	Randall clay, surface, kafir.....	43.8	9.8	49.8	109	17	522	
29318	Randall clay, subsoil, corn.....	46.5	44.7	13.1	44.6	142	14	941
	Randall clay, subsoil, kafir.....	48.8	42.6	4.3	48.0	107	10	460
29313	Reagan silty clay loam, surface, corn.....	22.1	10.9	12.6	23.4	14	20	525
	Reagan silty clay loam, surface, kafir.....	21.8	15.8	13.7	15.1	18	22	191
29314	Reagan silty clay loam, subsoil, corn.....	13.8	7.4	8.0	15.4	10	12	293
	Reagan silty clay loam, subsoil, kafir.....	24.2	10.8	4.3	28.2	12	9	218
29333	Reagan fine sandy loam, surface, corn.....	11.2	10.0	24.6	12	15	382	
	Reagan fine sandy loam, surface, kafir.....	18.1	12.2	16.1	16	16	166	
29334	Reagan fine sandy loam, subsoil, corn.....	2.2	7.3	15.0	3	10	245	
	Reagan fine sandy loam, subsoil, kafir.....	3.7	5.1	21.3	7	8	152	
29335	Richfield fine sandy loam, surface, corn.....	12.1	10.2	27.9	13	15	170	
	Richfield fine sandy loam, surface, kafir.....	11.3	5.6	20.5	12	13	213	
29336	Richfield fine sandy loam, subsoil, corn.....	5.5	9.9	20.9	7	13	294	
	Richfield fine sandy loam, subsoil, kafir.....	5.2	2.6	23.9	6	5	167	
29311	Springer fine sand, surface, corn.....	27.0	14	8.6	30.3	21	12	198
	Springer fine sand, surface, kafir.....	15.6	7.8	3.0	9.8	10	7	38
	Springer fine sandy loam, surface, cotton.....	24.8	20.8	.....	27	.....	.....	.....
29312	Springer fine sand, subsoil, corn.....	32.0	8.5	5.3	27.4	11	7	131
	Springer fine sand, subsoil, kafir.....	.....	7.4	2.0	11.8	8	6	46
	Springer fine sand, subsoil, cotton.....	17.2	14.3	.....	18	.....	.....	.....
29315	Springer fine sandy loam, surface, corn.....	31.5	14.7	7.9	29.5	16	11	328
	Springer fine sandy loam, surface, kafir.....	29.0	16.7	4.4	23.2	15	8	112
	Springer fine sandy loam, surface, cotton.....	22.0	15.7	.....	19	.....	.....	.....
29316	Springer fine sandy loam, subsoil, corn.....	37.0	6.4	9.2	30.3	8	11	399
	Springer fine sandy loam, subsoil, kafir.....	33.5	9.9	4.6	27.1	8	10	169
	Springer fine sandy loam, subsoil, cotton.....	20.0	9.6	.....	10	.....	.....	.....

by Springer fine sandy loam which occupies 22.9 per cent of the area. Upland soils include the Springer, Richfield, Reagan, and Reeves series; flat stream bottom soils include the Frio and Randall series.

Description of Soils of Midland County

Upland Soils:

Reagan soils—Light-brown, calcareous, friable topsoil with light-brown or yellowish, calcareous, friable subsoil. Cover 54.2 per cent of area.

Reeves soils—Light-brown to gray, calcareous, friable topsoil with light-brown or yellowish, calcareous, friable subsoil containing some gypsum. Cover 3.0 per cent of area.

Richfield soils—Dark-brown to black, noncalcareous, friable topsoil with dark-brown to dark-gray, noncalcareous, crumbly subsoil. Cover 3.5 per cent of area.

Springer soils—Light-brown or reddish-brown, noncalcareous topsoil with brownish-red, cloddy but friable noncalcareous subsoil. Cover 34.6 per cent of area.

Flat Stream Bottoms:

Randall soils—Nearly black or dark-gray, noncalcareous topsoil with dark-gray, noncalcareous subsoil. Cover 0.7 per cent of area.

Composition of Soils

Table 14 gives the composition of the various soil types and Table 15 the classes of constituents of the surface soils. The soils are low to moderate in nitrogen (Classes 5, 4, 3) and in total and active phosphoric acid. Most of the soils are moderate to high in total and acid-soluble potash, several of the soils falling in Class 1. With the exception of the Reeves chalk (Class 3) the soils are all high in active potash. Most of the soils are high (Classes 1, 2) in lime, basicity, and pH.

Pot Experiments

Results of pot experiments are given in Table 16. All of the soils used responded well to nitrogen, all but the Randall clay responded to phosphoric acid, and none of them responded significantly to potash.

Fertilizers

The need of fertilizers carrying nitrogen and phosphoric acid is indicated for these soils, but the value of potash fertilization is questionable. Lime is not needed.

SOILS OF POTTER COUNTY

Potter County lies in the northwest part of the Texas Panhandle. The northern part of the county lies within the geographical division known as the Rolling Plains; the southern part lies on the High Plains. Twenty-five types and phases of soil in 12 series were mapped. The most extensive soil is Pullman silty clay loam, followed by Potter silty clay loam. These types occupy 14.1 per cent and 10.1 per cent of the area, respectively. Upland soils include the brown soils of the Enterprise, Richfield,

Pullman, Potter, Zita, and Fritch series, and the red Amarillo and Weymouth series. Flat stream bottom soils include the Randall, Spur, Miller, and Yahola series. Rough broken land without named soil types occupies 35.0 per cent of the area. Dune sand and river wash occupy 0.5 per cent and 2.0 per cent of the area, respectively.

Description of Soils of Potter County

Upland Soils:

Amarillo soils—Red, brown, or reddish-brown, noncalcareous, friable topsoil with a red, noncalcareous, crumbly subsoil. Cover 6.9 per cent of area.

Enterprise soils—Reddish-brown, loose, noncalcareous topsoil with yellowish-red noncalcareous subsoil. Covers 5.2 per cent of area.

Potter soils—Brown or light-brown, calcareous, friable topsoil with light-brown or yellowish, calcareous, crumbly subsoil. Cover 15.5 per cent of area.

Pullman soils—Brown or dark-brown, noncalcareous, friable topsoil with dark-brown or chocolate-brown, noncalcareous, crumbly subsoil. Covers 21.3 per cent of area.

Richfield soils—Dark-brown to black noncalcareous, friable topsoil with dark-brown to dark-gray, noncalcareous, crumbly subsoil. Cover 0.8 per cent of area.

Weymouth soils—Similar to Potter soils, but more red in color. Cover 6.4 per cent of area.

Alluvial Soils:

Miller soils—Red, calcareous, friable topsoil with red, calcareous, crumbly subsoil. Covers 0.7 per cent of area.

Randall soils—Nearly black or dark-gray, noncalcareous topsoil with dark-gray, noncalcareous subsoil. Covers 0.5 per cent of area.

Spur soils—Brown or chocolate-brown, calcareous, friable topsoil with brown, calcareous, crumbly subsoil. Covers 1.9 per cent of area.

Yahola soils—Red, calcareous, friable topsoils, with red, calcareous subsoils lighter in texture than the topsoils. Covers 0.8 per cent of area.

Composition of Soils

Table 17 gives the analyses of the different soil types and Table 18 the classes of constituents of the surface soils. The soils are moderate to high in nitrogen (Classes 3, 2) and moderate to low in total phosphoric acid. The Amarillo, Potter, and Pullman fine sandy loams are low in active phosphoric acid; the other soils are moderate to high in this respect. The soils are high (Classes 1, 2) in total, acid-soluble, and active potash and in lime and pH. Basicity in many of the soils falls one class lower than the lime in the same soils, while in the Miller and Potter soils it falls in Class 1.

Pot Experiments

Results of pot experiments are given in Table 19. Most of the soils respond well to nitrogen in pot experiments, but do not respond to phosphoric acid and potash.

TABLE 17. Analyses of soils of Potter County.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
31796	Amarillo fine sandy loam, surface.....	.063	.027	48	1.56	1.62	231	.....	.46	7.7	0-7
31797	Amarillo fine sandy loam, subsoil.....	.060	.028	16	1.64	.....	180	.....	.55	7.3	7-19
31804	Fritch fine sandy loam, surface.....	.088	.058	129	1.82	.38	435	.36	.75	7.4	0-7
31805	Fritch fine sandy loam, subsoil.....	.068	.059	99	1.74	.39	332	.36	.75	7.3	7-19
31800	Miller clay loam, surface.....	.053	.066	151	1.59	.83	202	4.61	10.50	8.7	0-7
31801	Miller clay loam, subsoil.....	.052	.082	161	1.82	.83	204	4.19	8.75	8.9	7-19
31329	Potter clay loam, surface.....	.165	.092	306	.....	.57	204	3.91	6.33	8.1	0-7
31330	Potter clay loam, subsoil.....	.122	.095	5	1.53	.46	35	15.35	26.80	8.1	7-19
31817	Potter clay loam, surface.....	.164	.089	289	1.94	.....	381	.....	(.71)	8.2	0-7
31818	Potter clay loam, subsoil.....	.146	.097	9	1.73	.....	101	.....	16.51	8.1	7-13
31819	Potter clay loam, deep subsoil.....	.088	.094	5	1.46	.....	40	.....	33.45	8.0	13-19
31826	Potter clay loam, surface.....	.195	.112	48	1.81	.....	269	.....	13.91	8.0	0-7
31827	Potter clay loam, subsoil.....	.126	.115	11	1.60	.....	137	.....	31.50	8.1	7-19
Average	Potter clay loam, surface.....	.175	.098	214	1.88	.57	285	3.91	10.12	8.1	.....
Average	Potter clay loam, subsoil.....	.131	.102	8	1.62	.46	91	15.35	24.94	8.1	.....
Average	Potter clay loam, deep subsoil.....	.088	.094	5	1.46	.....	40	.....	33.45	8.0	.....
31841	Potter fine sandy loam, surface.....	.109	.040	79	1.36	.38	273	3.66	6.20	8.1	0-7
31842	Potter fine sandy loam, subsoil.....	.096	.036	10	1.16	.26	120	10.63	19.54	8.1	7-13
31843	Potter fine sandy loam, deep subsoil.....	.061	.026	5	1.43	.23	81	11.61	21.86	8.1	13-19
11390	Potter fine sandy loam, probably, surface.....	.103	.048	7	1.65	.38	43	6.56	11.50	7.9	0-10
11391	Potter fine sandy loam, probably, subsoil.....	.070	.091	6	1.72	.60	69	10.40	19.20	.....	10-22
Average	Potter fine sandy loam, surface.....	.106	.043	43	1.51	.43	158	5.11	8.85	8.0	.....
Average	Potter fine sandy loam, subsoil.....	.083	.063	8	1.44	.38	95	10.52	19.41	8.1	.....
Average	Potter fine sandy loam, deep subsoil.....	.061	.026	5	1.43	.23	81	11.61	21.86	8.1	.....
31844	Pullman clay loam, surface.....	.119	.06	118	1.99	.49	482	.42	.58	7.4	0-3
31845	Pullman clay loam, subsoil.....	.098	.063	85	1.96	.56	493	.55	.95	7.4	3-7
31846	Pullman clay loam, deep subsoil.....	.083	.053	59	2.09	.68	445	.59	.93	7.4	7-19
31331	Pullman fine sandy loam, surface.....	.075	.038	59	1.49	.23	271	.23	.52	7.5	0-7
31332	Pullman fine sandy loam, subsoil.....	.055	.028	29	1.45	.29	224	.27	.53	7.4	7-19
31798	Pullman fine sandy loam, surface.....	.069	.034	40	1.42	.....	240	.....	.44	7.8	0-7
31799	Pullman fine sandy loam, subsoil.....	.086	.042	23	1.59	.....	321	.....	.80	7.6	7-19
31820	Pullman fine sandy loam, surface.....	.083	.039	50	1.50	.30	279	.31	.57	7.5	0-7
31821	Pullman fine sandy loam, subsoil.....	.071	.026	31	1.30	.30	231	.28	.25	7.3	7-12
31822	Pullman fine sandy loam, deep subsoil.....	.044	.027	24	1.52	.25	167	.27	.25	7.1	12-19
Average	Pullman fine sandy loam, surface.....	.073	.035	49	1.49	.72	255	.27	.50	7.6	.....
Average	Pullman fine sandy loam, subsoil.....	.068	.031	25	1.50	.30	239	.28	.53	7.4	.....
Average	Pullman fine sandy loam, deep subsoil.....	.044	.027	24	1.52	.25	167	.27	.25	7.1	.....
31811	Pullman silty clay loam, surface.....	.117	.096	214	2.21	.70	566	.57	1.00	7.0	0-5
31812	Pullman silty clay loam, subsoil.....	.095	.077	124	2.18	.92	536	.72	1.49	7.5	5-7
31813	Pullman silty clay loam, deep subsoil.....	.081	.071	135	2.29	.83	617	.74	1.60	7.7	7-19
31814	Pullman silty clay loam, surface.....	.150	.115	322	2.27	.53	462	.44	.94	6.7	0-5
31815	Pullman silty clay loam, subsoil.....	.105	.090	141	2.39	.75	591	.64	1.33	7.1	5-7

TABLE 17. Analyses of soils of Potter County. (Continued.)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
31816	Pullman silty clay loam, deep subsoil. ....	.086	.072	129	2.45	.81	594	.76	1.56	7.8	7-19
31828	Pullman silty clay loam, surface. ....	.138	.111	259	.....	.....	566	.....	1.03	6.9	0-7
31829	Pullman silty clay loam, subsoil. ....	.083	.069	133	.....	.....	643	.....	1.48	7.7	7-19
31830	Pullman silty clay loam, surface. ....	.157	.145	404	2.11	.....	637	.....	.90	6.2	0-5
31831	Pullman silty clay loam, subsoil. ....	.098	.074	140	2.17	.....	537	.....	1.33	6.6	5-7
31832	Pullman silty clay loam, deep subsoil. ....	.090	.071	139	.....	.....	548	.....	1.46	7.5	7-19
31323	Pullman silty clay loam, surface. ....	.116	.086	201	2.23	.....	538	.....	1.23	6.8	0-7
31324	Pullman silty clay loam, subsoil. ....	.074	.068	171	2.41	.79	525	.79	1.52	8.0	7-19
31325	Pullman silty clay loam, surface. ....	.145	.108	259	2.26	.....	513	.....	.89	6.8	0-7
31326	Pullman silty clay loam, subsoil. ....	.090	.071	106	2.41	.....	525	.....	1.48	7.8	7-19
31786	Pullman silty clay loam, surface. ....	.140	.079	269	1.29	.57	380	.55	1.05	7.7	0-7
31787	Pullman silty clay loam, subsoil. ....	.081	.067	151	2.44	.81	600	.74	1.66	7.7	7-19
31788	Pullman silty clay loam, surface. ....	.128	.085	180	2.28	.61	653	.52	.94	7.3	0-7
31789	Pullman silty clay loam, subsoil. ....	.077	.064	158	2.20	.82	567	1.15	2.23	8.1	7-19
31808	Pullman silty clay loam, surface. ....	.123	.098	304	2.17	.....	650	.....	1.16	7.6	0-5
31809	Pullman silty clay loam, subsoil. ....	.112	.087	133	2.12	.....	487	.....	1.35	7.4	5-7
31810	Pullman silty clay loam, deep subsoil. ....	.079	.091	172	2.19	.....	544	.....	1.73	7.9	7-19
31321	Pullman silty clay loam, shallow phase, surface. ....	.146	.064	99	2.01	.60	443	.60	1.10	7.5	0-7
31322	Pullman silty clay loam, shallow phase, subsoil. ....	.084	.042	54	2.18	.72	410	.86	1.53	7.9	7-19
31790	Pullman silty clay loam, shallow phase, surface. ....	.173	.088	240	.....	.47	429	.53	1.07	7.3	0-2
31791	Pullman silty clay loam, shallow phase, subsoil. ....	.140	.067	96	.....	.66	494	.46	1.02	7.0	2-7
31792	Pullman silty clay loam, shallow phase, deep subsoil. ....	.091	.048	25	.....	.82	495	.63	1.34	7.6	7-14
31793	Pullman silty clay loam, shallow phase, deep subsoil. ....	.063	.041	57	.....	.72	404	1.49	2.56	8.1	14-19
31823	Pullman silty clay loam, shallow phase, surface. ....	.126	.071	184	.....	.....	407	.....	.58	6.7	0-3
31824	Pullman silty clay loam, shallow phase, subsoil. ....	.108	.054	92	.....	.....	446	.....	.44	6.9	3-17
31825	Pullman silty clay loam, shallow phase, deep subsoil. ....	.088	.053	61	.....	.....	506	.....	1.10	7.2	7-19
Average	Pullman silty clay loam, surface. ....	.140	.096	249	2.11	.58	532	.54	1.03	7.0	.....
Average	Pullman silty clay loam, subsoil. ....	.098	.071	128	2.28	.78	536	.75	1.39	7.4	.....
Average	Pullman silty clay loam, deep subsoil. ....	.086	.068	110	2.31	.82	551	.71	1.47	7.6	.....
31327	Randall clay, surface. ....	.112	.109	238	2.30	.91	648	.79	1.48	7.1	0-7
31328	Randall clay, subsoil. ....	.060	.068	236	2.15	.83	538	.79	1.52	7.5	7-19
31794	Randall clay, surface. ....	.130	.087	221	2.39	.....	794	.....	1.35	6.6	0-7

TABLE 17. Analyses of soils of Potter County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
31795	Randall clay, subsoil.....	.053	.070	184	2.34	.....	708	.....	1.31	7.1	7-19
Average	Randall clay, surface.....	.121	.098	230	2.35	.91	721	.79	1.42	6.9	.....
Average	Randall clay, subsoil.....	.057	.069	210	2.25	.83	623	.79	1.42	7.3	.....
31835	Richfield silty clay loam, surface.....	.162	.098	300	2.23	.60	672	.56	1.08	7.2	0-4
31836	Richfield silty clay loam, subsoil.....	.132	.094	164	2.31	.74	613	.60	1.18	7.0	4-7
31837	Richfield silty clay loam, deep subsoil.....	.113	.077	121	2.38	.81	639	.69	1.35	7.1	7-14
31838	Richfield silty clay loam, deep subsoil.....	.093	.067	121	2.42	.84	586	.73	1.45	7.5	14-19
31806	Spur clay loam, surface.....	.115	.098	392	1.86	.62	520	1.28	2.21	8.0	0-7
31807	Spur clay loam, subsoil.....	.090	.099	462	1.90	.68	589	2.70	4.55	8.3	7-19
31833	Spur fine sandy loam, surface.....	.100	.055	182	1.50	.56	311	1.14	1.02	8.1	0-7
31834	Spur fine sandy loam, subsoil.....	.059	.045	195	1.48	.36	343	3.06	5.19	8.3	7-19
31839	Weymouth clay loam, surface.....	.121	.075	207	1.82	.76	383	2.68	4.53	8.2	0-7
31840	Weymouth clay loam, subsoil.....	.067	.067	188	1.87	.65	338	2.49	4.43	8.2	7-19
31802	Yahola fine sandy loam, surface.....	.074	.074	296	1.33	.45	407	1.83	4.50	8.6	0-7
31803	Yahola fine sandy loam, subsoil.....	.048	.064	265	1.30	.50	270	2.94	7.04	8.5	7-19

TABLE 18. Classes of constituents of surface soils of Potter County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
31796	Amarillo fine sandy loam.....	3	4	4	2	1	2	.....	4	1
31804	Fritch fine sandy loam..	3	3	3	1	3	1	3	3	2
31800	Miller clay loam.....	4	3	3	2	1	2	1	1	1
Average	Potter clay loam.....	2	3	2	1	2	2	1	1	1
Average	Potter fine sandy loam..	3	4	4	2	3	3	1	1	1
31844	Pullman clay loam.....	3	2	3	1	2	1	2	4	2
Average	Pullman fine sandy loam.....	3	4	4	2	2	2	3	4	1
Average	Pullman silty clay loam	2	3	2	5	2	1	2	3	2
Average	Randall clay.....	2	3	2	1	1	1	2	3	2
31835	Richfield silty clay loam.....	2	2	2	1	1	1	2	3	2
31806	Spur clay loam.....	3	3	2	1	2	1	2	2	1
31833	Spur fine sandy loam..	3	3	3	2	2	2	2	3	1
31839	Weymouth clay loam..	2	3	2	1	2	2	1	2	1
31802	Yahola fine sandy loam	3	3	2	2	2	1	2	2	1

TABLE 19. Pot experiments on soils of Potter County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels			
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash	
31329	Potter clay loam, surface, corn.....	.....	9.2	.....	23.0	17	.....	469	
"	Potter clay loam, surface, kafir.....	.....	24.4	.....	42.2	33	.....	304	
31330	Potter clay loam, subsoil, corn.....	.....	.....	.....	9.5	.....	.....	135	
"	Potter clay loam, subsoil, kafir.....	.....	.....	.....	37.8	.....	.....	205	
31331	Pullman fine sandy loam, surface, corn.....	.....	.....	.....	42.5	.....	.....	372	
"	Pullman fine sandy loam, surface, kafir.....	.....	.....	.....	42.1	.....	.....	184	
"	Pullman fine sandy loam, surface, corn.....	.....	.....	.....	44.5	.....	.....	159	
31332	Pullman fine sandy loam, subsoil, corn.....	.....	.....	25.2	.....	.....	32	.....
"	Pullman fine sandy loam, subsoil, kafir.....	.....	.....	7.4	.....	.....	11	.....
"	Pullman fine sandy loam, subsoil, corn.....	.....	.....	4.2	.....	.....	7	.....
31321	Pullman silty clay loam, surface, corn.....	40.7	18.2	33.7	39.2	40	58	571	
31322	Pullman silty clay loam, subsoil, corn.....	.....	3.1	.....	.....	6	.....	.....
31323	Pullman silty clay loam, surface, corn.....	.....	22.0	.....	.....	45	.....	.....
"	Pullman silty clay loam, surface, kafir.....	.....	27.7	.....	.....	79	.....	.....
"	Pullman silty clay loam, surface, sorghum.....	.....	19.1	.....	.....	33	.....	.....
31324	Pullman silty clay loam, subsoil, corn.....	.....	.....	15.9	.....	.....	26	.....
"	Pullman silty clay loam, surface, kafir.....	.....	.....	7.2	.....	.....	10	.....
"	Pullman silty clay loam, surface, corn.....	.....	.....	4.2	.....	.....	6	.....
31325	Pullman silty clay loam, surface, corn.....	.....	31.0	23	40.0	67	35	589	
"	Pullman silty clay loam, surface, kafir.....	.....	39.2	19.2	37.7	115	39	349	
31325	Pullman silty clay loam, surface, corn.....	.....	27.5	10.5	37.3	53	19	181	
31326	Pullman silty clay loam, subsoil, corn.....	.....	13.5	9.2	34.1	23	14	615	
"	Pullman silty clay loam, subsoil, kafir.....	.....	29.0	8.0	362	37	16	319	
"	Pullman silty clay loam, subsoil, corn.....	.....	16.4	4.8	25.5	24	9	255	
31327	Randall clay, surface, corn.....	.....	36.7	25.0	48.6	75	36	846	
"	Randall clay, surface, kafir.....	.....	46.2	18.4	50.3	136	34	458	
"	Randall clay, surface, corn.....	.....	33.2	5.7	34.8	70	10	294	
31328	Randall clay, subsoil, corn.....	.....	19.0	10.5	.....	32	17	.....
"	Randall clay, subsoil, kafir.....	.....	9.2	7.5	.....	25	12	.....
"	Randall clay, subsoil, corn.....	.....	19.5	3.5	.....	22	6	.....
31833	Spur fine sandy loam, surface, corn.....	.....	12.7	.....	22.8	.....	.....	.....
"	Spur fine sandy loam, surface, kafir.....	.....	26.0	.....	34.7	.....	.....	.....

Fertilizers

Fertilizers carrying nitrogen are probably needed on most of these soils, but phosphoric acid, potash, and lime are not needed. Crop production in this county is largely controlled by climatic conditions, rather than by incapacity of the soil to provide plant food elements. The use of fertilizers in this county is not recommended in the absence of favorable field experiments.

Saline Soils

The composition of soluble salts in samples of different depths in a soil in Potter County is given in Table 20. The total quantity of salts is somewhat lower than that in many saline soils (See Tables 13 and 27) but may still be sufficiently high to be injurious to plant growth. Particular attention should be called to two zones of accumulation of sodium sulphate, the first at a depth of from 19 inches to 67 inches (Nos. 23596 and 23597), and the second at a depth of from 99 inches to 131 inches (No. 23599). The concentration of sodium sulphate is several times higher at these depths than it is in samples from other depths. Practically all of the calcium sulphate occurs at a depth of 41 inches to 99 inches, which is slightly lower than the zone of maximum accumulation of sodium sulphate (19 inches to 67 inches).

TABLE 20. Composition of soluble salts in some soils of Potter County (parts per million).

Laboratory No.		Depth Inches	Calc. Sulp.	Mag. Carb.	Mag. Sulp.	Sod. Carb.	Sod. Sulp.
23594	Surface soil.....	0-7	.....	83	.....	37	164
23595	Subsoil.....	7-19	.....	34	.....	117	183
23596	Subsoil.....	19-41	.....	11	.....	15	420
23597	Subsoil.....	41-67	730	.....	54	.....	671
23598	Subsoil.....	67-99	183	.....	48	.....	55
23599	Subsoil.....	99-131	.....	31	.....	17	472
23600	Subsoil.....	131-163	58	.....	102	.....	165

SOILS OF VAN ZANDT COUNTY

Van Zandt County is in northeastern Texas, at the extreme western limit of the geographical division known as the East Texas Timber Country. Thirty soil types and phases in 18 series were mapped. The most extensive soil type is the Susquehanna fine sandy loam, followed by Bowie fine sandy loam and Norfolk fine sand. These soils occupy 25.2, 12.1, and 10.4 per cent of the area, respectively. Upland soils with friable subsoils include the Kirvin, Bowie, Ruston, Caddo, and Norfolk series, while those with dense subsoils include the Lufkin and Susquehanna series. Terrace soils include the Cahaba and Kalmia series. Flat stream bottom soils include Ochlockonee, Bibb, and Hannahatchie series. Blackland Prairie soils include Durant, Crockett, and Wilson series of the uplands and Trinity and Johnston series along the flat stream bottoms.

Description of Soils of Van Zandt County

Upland Soils, East Texas Timber Country:

Bowie soils—Topsoil gray to light-brown with yellow subsurface, subsoil yellow mottled with gray and red, permeable. Covers 12.1 per cent of area.

Caddo soils—Topsoil gray with yellow subsurface, subsoil yellow mottled with gray in lower part, slowly permeable. Cover 2.4 per cent of area.

Kirvin soils—Light-brown to grayish or slightly reddish topsoil, with red, slowly permeable subsoil. Cover 5.0 per cent of area.

Lufkin soils—Gray topsoil, becoming hard on drying, with gray, dense, very slowly permeable subsoil. Cover 3.1 per cent of area.

Nacogdoches soils—Red topsoil with ironstone fragments in many places with red, slowly permeable subsoil. Cover 0.4 per cent of area.

Norfolk soils—Gray topsoil with yellow subsurface, and yellow, very permeable, sandy subsoil. Cover 14.8 per cent of area.

Ruston soils—Light brown to grayish topsoil with brown, yellowish or reddish subsurface and reddish-yellow, reddish-brown, or light red, very permeable subsoil. Cover 4.1 per cent of area.

Susquehanna soils—Light brown to gray topsoil with yellow subsurface and red and gray mottled, dense, very slowly permeable subsoil. Cover 25.2 per cent of area.

Upland Soils, Blackland Prairie:

Crockett soils—Black to brown or spotted, noncalcareous, moderately friable topsoil, with reddish or yellowish subsoil. Cover 11.0 per cent of area.

Wilson soils—Black to dark gray topsoil, very tight when dry, with brown or dark gray, dense, tough subsoil. Cover 4.2 per cent of area.

Flat to Undulating Old Stream Benches, above Overflow:

Cahaba soils—Light brown topsoil with reddish or yellowish subsurface, with light-red, very permeable subsoil. Cover 0.4 per cent of area.

Kalmia soils—Light-brown or gray topsoil with yellow subsurface, with yellow, very permeable subsoil. Cover 0.4 per cent of area.

Flat Stream Bottoms:

Johnston soils—Black noncalcareous topsoil with heavy gray to black noncalcareous subsoil. Cover 1.8 per cent of area.

Ochlockonee soils—Grayish-brown to brown topsoil with grayish-brown to brown subsoil. Cover 11.9 per cent of area.

Trinity soils—Black to dark-brown, friable, permeable calcareous topsoil with black or dark-gray, heavy but permeable and crumbly, calcareous subsoil. (Blackland Prairie area). Cover 1.6 per cent of area.

Bibb soils—Gray or slightly mottled topsoil with gray to slightly mottled gray and brown subsoil. Cover 0.3 per cent of area.

Composition of Soils

Table 21 gives the analyses of the different soils and Table 22 the classes of constituents of the surface soils. The soils of Van Zandt

TABLE 21. Analyses of soils of Van Zandt County.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
29463	Bowie fine sandy loam, surface.....	.017	.016	10	.93	.10	116	.14	.21	7.5	0-7
29464	Bowie fine sandy loam, subsoil.....	.022	.017	9	1.02	.19	120	.16	.31	7.3	7-19
29465	Bowie fine sandy loam, deep subsoil.....	.033	.018	3	1.06	.33	153	.21	.49	7.0	18-24
29466	Bowie fine sandy loam, deep subsoil.....	.034	.023	4	1.01	.36	144	.19	.47	6.4	24-36
29523	Bowie fine sandy loam, surface.....	.014	.027	42	.93	.08	271	.20	.26	7.5	0-7
29524	Bowie fine sandy loam, subsoil.....	.024	.020	4	1.08	.14	136	.22	.24	7.5	7-19
9171	Bowie fine sandy loam, probably, surface.....	.027	.026	23	.....	.04	68	.06	.10	.....	0-12
9172	Bowie fine sandy loam, probably, subsoil.....	.029	.038	14	.....	.04	46	.05	.05	.....	12-24, 30
Average	Bowie fine sandy loam, surface.....	.019	.023	25	.93	.07	152	.13	.19	7.5	.....
Average	Bowie fine sandy loam, subsoil.....	.025	.025	9	1.05	.12	101	.14	.20	7.4	.....
Average	Bowie fine sandy loam, deep subsoil.....	.033	.018	3	1.06	.33	153	.21	.49	7.0	.....
9311	Caddo fine sandy loam, probably, surface.....	.033	.036	23	.....	.06	114	.38	.16	.....	0-8
9312	Caddo fine sandy loam, probably, subsoil.....	.025	.034	8	.....	.07	103	.38	.00	.....	8-20
29458	Crockett very fine sandy loam, surface.....	.083	.027	9	1.24	.20	106	.19	.46	5.9	0-6
29470	Crockett very fine sandy loam, subsoil.....	.070	.034	6	1.13	.27	109	.29	.58	5.8	6-12
29471	Crockett very fine sandy loam, deep subsoil.....	.065	.028	6	1.19	.41	125	.47	1.03	6.3	12-24
29459	Crockett very fine sandy loam, deep subsoil.....	.046	.027	6	1.60	.40	130	.56	1.33	6.9	24+
29533	Crockett very fine sandy loam, surface.....	.069	.029	9	1.08	.....	96	.....	.35	5.8	0-7
29534	Crockett very fine sandy loam, subsoil.....	.082	.028	23	1.03	.19	134	.24	.30	5.4	7-14
Average	Crockett very fine sandy loam, surface.....	.076	.028	9	1.16	.20	101	.19	.41	5.9	.....
Average	Crockett very fine sandy loam, subsoil.....	.076	.031	15	1.08	.23	122	.27	.44	5.6	.....
Average	Crockett very fine sandy loam, deep subsoil.....	.066	.028	6	1.19	.41	125	.47	1.03	6.3	.....
29478	Kalmia fine sandy loam, surface.....	.027	.022	24	.81	.08	101	.13	.10	6.0	0-7
29479	Kalmia fine sandy loam, subsoil.....	.016	.018	10	.88	.05	55	.06	.05	6.0	7-19
29475	Kirvin fine sandy loam, surface.....	.057	.037	16	.83	.12	226	.18	.40	6.8	0-7
29476	Kirvin fine sandy loam, subsoil.....	.037	.027	5	1.01	.38	229	.24	.52	5.5	7-19
29477	Kirvin fine sandy loam, deep subsoil.....	.024	.018	4	1.08	.24	109	.19	.40	5.5	19-30
29472	Lufkin very fine sandy loam, surface.....	.044	.030	18	.42	.07	116	.12	.15	6.5	0-7
29473	Lufkin very fine sandy loam, subsoil.....	.038	.018	10	1.04	.18	82	.22	.35	6.0	7-19
29474	Lufkin very fine sandy loam, deep subsoil.....	.043	.019	8	1.10	.25	86	.40	.79	6.0	19-30
29488	Norfolk fine sand, surface.....	.014	.019	71	.56	.06	96	.07	.09	6.5	0-7
29484	Norfolk fine sand, subsoil.....	.009	.028	42	.58	.06	90	.11	.01	6.6	7-19
29489	Norfolk fine sand, deep subsoil.....	.010	.025	37	.66	.08	94	.04	.09	6.6	19-30
29485	Norfolk fine sandy loam, surface.....	.033	.019	28	.51	.06	116	.10	.25	6.9	0-7
29486	Norfolk fine sandy loam, subsoil.....	.020	.020	29	.54	.11	116	.05	.06	5.8	7-20
29487	Norfolk fine sandy loam, deep subsoil.....	.041	.023	6	.70	.23	119	.06	.11	5.4	20-40
9309	Norfolk fine sandy loam, probably, surface.....	.032	.026	16	.51	.06	91	.10	.15	.....	0-6
9310	Norfolk fine sandy loam, probably, subsoil.....	.021	.030	9	.42	.05	75	.09	.00	.....	6-18
Average	Norfolk fine sandy loam, surface.....	.033	.023	22	.51	.06	104	.10	.20	6.9	.....
Average	Norfolk fine sandy loam, subsoil.....	.021	.025	19	.48	.08	96	.07	.03	5.8	.....
Average	Norfolk fine sandy loam, deep subsoil.....	.041	.023	6	.70	.23	119	.06	.11	5.4	.....
29494	Ochlocknee very fine sandy loam, surface.....	.078	.031	13	1.44	.18	143	.19	.40	7.1	0-7

TABLE 21. Analyses of soils of Van Zandt County. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
29495	Ochlockonee very fine sandy loam, subsoil...	.029	.030	3	1.45	.13	92	.11	.20	5.8	7-19
29496	Ochlockonee very fine sandy loam, deep subsoil.....	.019	.021	5	1.24	.12	85	.09	.20	6.1	19-30
29480	Ruston fine sandy loam, surface.....	.039	.028	21	.58	.09	129	.15	.16	6.2	0-7
29481	Ruston fine sandy loam, subsoil.....	.044	.025	5	.85	.28	161	.12	.33	5.6	7-13
29482	Ruston fine sandy loam, deep subsoil.....	.019	.013	4	.72	.16	156	.14	.21	5.8	13-72
29483	Ruston fine sandy loam, deep subsoil.....	.013	.018	5	1.04	.14	90	.09	.22	5.5	72-90
29490	Ruston fine sandy loam, surface.....	.022	.019	9	.54	.06	113	.08	.10	6.2	0-7
29491	Ruston fine sandy loam, subsoil.....	.017	.018	5	.61	.10	75	.20	.13	6.1	7-14
29492	Ruston fine sandy loam, deep subsoil.....	.036	.035	4	.93	.44	261	.20	.49	6.2	14-60
29493	Ruston fine sandy loam, deep subsoil.....	.025	.036	2	.84	.29	186	.18	.42	6.1	60+
Average	Ruston fine sandy loam, surface.....	.031	.024	15	.56	.08	121	.12	.13	6.2	.....
Average	Ruston fine sandy loam, subsoil.....	.031	.022	5	.73	.19	118	.16	.23	5.9	.....
Average	Ruston fine sandy loam, deep subsoil.....	.028	.024	4	.83	.30	209	.17	.35	6.0	.....
29467	Susquehanna fine sandy loam, surface.....	.034	.021	4	1.01	.47	347	.39	.96	5.7	0-7
29468	Susquehanna fine sandy loam, subsoil.....	.069	.023	59	.84	.17	227	.17	.41	6.5	7-18
29469	Susquehanna fine sandy loam, deep subsoil..	.029	.022	6	1.20	.37	164	.35	.86	5.9	18-36
29462	Wilson very fine sandy loam, surface.....	.069	.026	15	1.28	.24	99	.43	.89	6.2	0-7
29461	Wilson very fine sandy loam, subsoil.....	.110	.038	42	1.32	.25	157	.38	.68	6.1	7-14
29460	Wilson very fine sandy loam, deep subsoil....	.017	.030	8	1.40	.37	149	.78	1.43	8.4	14-48
29525	Wilson very fine sandy loam, surface.....	.085	.037	39	1.04	.21	142	.33	.44	5.8	.....
29526	Wilson very fine sandy loam, subsoil.....	.057	.024	11	.96	.24	69	.49	.90	6.6	.....
Average	Wilson very fine sandy loam, surface.....	.077	.032	27	1.16	.23	121	.38	.67	6.0	.....
Average	Wilson very fine sandy loam, subsoil.....	.084	.031	27	1.14	.25	113	.44	.79	6.4	.....
Average	Wilson very fine sandy loam, deep subsoil...	.017	.030	8	1.40	.37	149	.78	1.43	8.4	.....

TABLE 22. Classes of constituents of surface soils of Van Zandt County.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
Average	Bowie fine sandy loam.	5	5	5	3	5	3	4	5	2
9311	Caddo fine sandy loam	4	4	5	.....	5	3	3	5	.....
Average	Crockett very fine sandy loam.....	3	4	5	3	3	3	4	4	3
29478	Kalmia fine sandy loam	5	5	5	3	5	3	4	5	3
29475	Kirvin fine sandy loam.	4	4	5	3	4	2	4	4	2
29472	Lufkin very fine sandy loam.....	4	4	5	4	5	3	4	5	2
29488	Norfolk fine sand.....	5	5	4	4	5	4	5	5	2
Average	Norfolk fine sandy loam.....	5	5	4	4	5	3	5	5	2
29494	Ochlockonee very fine sandy loam.....	3	4	5	2	4	3	4	4	2
Average	Ruston fine sandy loam	4	5	5	4	5	3	4	5	2
29467	Susquehanna fine sandy loam.....	4	5	5	3	2	2	3	3	3
Average	Wilson very fine sandy loam.....	3	4	5	3	3	3	3	3	3

County in general are low in plant food, particularly with respect to nitrogen and phosphoric acid. Only the Crockett, Ochlockonee, and Wilson fine sandy loams fall in Class 3 with respect to nitrogen. All other soils fall in Classes 4 and 5. No soil falls outside of Classes 4 and 5 with respect to total and active phosphoric acid. The soils are better with respect to total and active potash, most of them falling in Classes 3 and 4. They are low (Classes 4, 5) in acid-soluble potash, lime, and basicity, and in general very slightly acid in pH.

Pot Experiments

Results of pot experiments are given in Table 23. Most of the soils respond markedly to phosphoric acid and nitrogen, and some of them respond well to potash.

Fertilizers

The need for fertilizers carrying nitrogen, phosphoric acid, and (usually) potash, is indicated for most of the soils. Lime may be needed for certain legume crops, or after the soils have been in cultivation for a longer period of time, particularly if acid-forming nitrogenous fertilizers such as ammonium sulfate or urea are used.

SOILS OF THE TRANS-PECOS AREA

The Trans-Pecos area lies in the extreme western part of Texas, and includes all that part of the state lying west of the Pecos River, except a small portion of Val Verde County. Brewster, Culberson, El Paso, Hudspeth, Jeff Davis, Pecos, Presidio, Reeves, and Terrell Counties comprise the area. Twenty-six types and phases of soils in 9 series were mapped. The most extensive soil is the Reeves gravelly loam, followed by the Reeves silty clay loam; these soils occupy 15.0 and 12.0 per cent of the area, respectively. Basins and plains include the Reeves, Reagan, and

TABLE 23. Pot experiments on soils of Van Zandt County.

Laboratory number	Type name	Weight crop in grams				Corn possibility of plant food withdrawn, in bushels		
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash
29523	Bowie fine sandy loam, surface, corn.	10.2	.....	10.3	22	20	149
"	Bowie fine sandy loam, surface, milo.	18.0	10.5	23.1	23	13	173	
29524	Bowie fine sandy loam, subsoil, corn.	6.5	7.0	20.9	8	15	166	
"	Bowie fine sandy loam, subsoil, milo.	7.5	4.5	26.9	8	8	67	
9311	Caddo fine sandy loam, probably, surface, corn.	35.4	20.6	.....	29	.....	.....
"	Caddo fine sandy loam, probably, surface, corn.	38.0	9.2	.....	12	.....	.....
"	Caddo fine sandy loam, probably, surface, sorghum.	21.4	14.4	.....	15	.....	.....
"	Caddo fine sandy loam, probably, surface, sorghum.	36.3	10.1	.....	9	.....	.....
9312	Caddo fine sandy loam, probably, subsoil, corn.	11.6	.....	8.0	.....	13	.....
"	Caddo fine sandy loam, probably, subsoil, sorghum.	3.7	.....	2.4	.....	14	.....
29533	Crockett very fine sandy loam, surface, corn.	7.3	15.6	27.9	12	36	152	
"	Crockett very fine sandy loam, surface, milo.	8.4	6.5	17.0	11	10	42	
29534	Crockett very fine sandy loam, subsoil, corn.	17.3	20.0	28.4	32	51	190	
"	Crockett very fine sandy loam, subsoil, milo.	16.7	10.5	24.4	19	20	89	
9310	Norfolk fine sandy loam, probably, surface, corn.	40.3	.....	28.8	.....	.....	78
"	Norfolk fine sandy loam, probably, surface, corn.	27.4	.....	10.5	.....	.....	27
"	Norfolk fine sandy loam, probably, surface, sorghum.	23.0	.....	6.5	.....	.....	18
"	Norfolk fine sandy loam, probably, surface, sorghum.	18.2	.....	12.4	.....	.....	29
9310	Norfolk fine sandy loam, probably, subsoil, corn.	38.1	.....	32.4	.....	.....	56
"	Norfolk fine sandy loam, probably, subsoil, corn.	10.0	.....	3.8	.....	.....	12
"	Norfolk fine sandy loam, probably, subsoil, sorghum.	17.7	.....	12.5	.....	.....	18
"	Norfolk fine sandy loam, probably, subsoil, sorghum.	7.3	.....	4.2	.....	.....	10
29525	Wilson very fine sandy loam, surface, corn.	18.0	11.5	25.8	43	46	237	
"	Wilson very fine sandy loam, surface, milo.	24.0	16.0	38.7	29	19	87	
29526	Wilson very fine sandy loam, subsoil, corn.	7.1	10.2	15.0	13	28	119	
"	Wilson very fine sandy loam, subsoil, milo.	8.5	41.0	8.5	12	66	23	

Verhalen series. Terrace soils are of the Anthony series. Flat stream bottom soils include the Gila, Rio Grande, and Toyah series, and some undifferentiated soils. Mountains and roughlands include the Ector series from limestone, and the Brewster series from igneous rocks, and the undifferentiated rough and stony land. Rough stony land mainly from limestone occupies 17.9 per cent of the area; that mainly from igneous rocks occupies 10.0 per cent.

A detailed survey of Reeves County has been published, and the chemical composition of the soils of that county has been discussed in Bulletin

430. A chemical study of some soils of El Paso County has been discussed in Bulletin 337.

Description of Soils of the Trans-Pecos Area

Upland Soils:

Brewster soils—Red or brown, noncalcareous, friable, mostly very stony topsoil, with red or brown, noncalcareous, crumbly, stony subsoil. Cover 3.8 per cent of area.

Ector soils—Light-brown or brown, calcareous, friable, stony topsoil with light-brown or yellowish, calcareous, stony subsoil. Cover 10.4 per cent of area.

Reagan soils—Brown or light-brown, calcareous, friable topsoil, with light-brown or yellowish calcareous, crumbly subsoil. Cover 13.1 per cent of area.

Reeves soils—Light-brown to gray, calcareous friable topsoil, with light-brown or yellowish calcareous friable subsoil containing some gypsum. Cover 35.4 per cent of area.

Verhalen soils—Brown or reddish-brown, calcareous, friable topsoil with red or reddish-brown, calcareous, crumbly subsoil. Cover 5.9 per cent of area.

Flat Old Stream Benches, above Overflow:

Anthony soils—Light-brown, very calcareous, friable, topsoil, with yellow, calcareous, friable subsoil. Cover 0.5 per cent of area.

Flat Stream Bottoms:

Gila soils—Light-brown or grayish, calcareous, friable, topsoil containing some salt, with a light-brown, or grayish, calcareous, friable subsoil containing some salt. Cover 0.6 per cent of area.

Rio Grande soils—Light-brown or brown, calcareous, friable topsoil with light-brown, calcareous, friable subsoil. Cover 0.3 per cent of area.

Toyah soils—Brown or dark-brown, calcareous, friable topsoil, with brown or light-brown, calcareous, friable subsoil. Cover 1.1 per cent of area.

Composition of Soils

Table 24 gives the analyses of the principal soil types and Table 25 the classes of the constituents of the surface soils. Most of the soils are moderate to low (Classes 3, 4) in nitrogen. The Reagan fine sandy loam and gravelly loam and the Reeves fine sand are low (Class 4) in total phosphoric acid, while the rest of the soils are moderate to high. The Reagan silty clay loam and Rio Grande loamy very fine sand are low in active phosphoric acid, with the other soils moderate to high, six of them falling in Class 1. Most of the soils fall in Class 1 with respect to total potash, lime, basicity, and pH, and in slightly lower classes with respect to acid-soluble and active potash.

TABLE 24. Analyses of soils of Trans-Pecos Area.

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
29021	Gila fine sandy loam, surface.....	.054	.067	706	2.40	.41	334	3.50	5.96	8.5	0-7
29022	Gila fine sandy loam, subsoil.....	.031	.101	728	2.36	.28	195	3.56	6.28	8.3	7-19
29027	Gila silt loam, surface.....	.083	.141	654	2.31	.65	645	5.45	8.86	8.5	0-7
29028	Gila silt loam, subsoil.....	.040	.126	498	2.42	.71	576	6.19	10.66	8.7	7-19
29000	Pecos silty clay loam, surface.....	.101	.148	410	1.83	.64	197	7.62	13.96	7.9	0-7
29001	Pecos silty clay loam, subsoil.....	.062	.142	590	1.83	.62	316	11.78	20.69	7.8	7-19
29015	Reagan fine sandy loam, surface.....	.061	.034	430	2.88	.38	661	2.03	2.81	8.5	0-7
29016	Reagan fine sandy loam, subsoil.....	.047	.044	324	2.76	.49	800	4.24	6.64	8.5	7-19
29019	Reagan gravelly loam, surface.....	.099	.048	460	2.68	.41	279	5.26	7.25	8.4	0-7
29020	Reagan gravelly loam, subsoil.....	.067	.075	55	2.22	.32	60	11.56	19.63	.....	7-19
29013	Reagan silty clay loam, surface.....	.125	.090	49	2.40	1.04	666	12.51	21.40	8.1	0-7
29014	Reagan silty clay loam, subsoil.....	.064	.062	209	2.36	.96	315	13.68	23.39	8.4	7-19
29017	Reagan silty clay loam, shallow phase, surface.....	.162	.078	140	2.64	.78	537	7.04	12.14	8.4	0-7
29018	Reagan silty clay loam, shallow phase, subsoil.....	.106	.052	36	2.32	.72	319	11.84	21.81	8.2	7-19
Average	Reagan silty clay loam, surface.....	.144	.084	95	2.52	.91	602	9.78	16.77	8.2	.....
Average	Reagan silty clay loam, subsoil.....	.085	.057	123	2.34	.84	317	12.76	22.60	8.3	.....
29025	Reeves fine sand, surface.....	.028	.029	123	1.88	.16	221	3.51	6.06	8.4	0-7
29026	Reeves fine sand, subsoil.....	.027	.033	18	1.48	.09	7	12.79	22.01	8.4	7-19
29023	Reeves fine sand, surface.....	.021	.027	84	2.31	.19	318	.28	.38	8.1	0-7
29024	Reeves fine sand, subsoil.....	.017	.017	60	2.28	.14	221	.27	.55	8.2	7-19
Average	Reeves fine sand, surface.....	.025	.028	104	2.10	.18	270	1.90	3.22	8.2	.....
Average	Reeves fine sand, subsoil.....	.022	.025	39	1.88	.12	114	6.53	11.28	8.3	.....
28996	Reeves fine sandy loam, surface.....	.071	.110	207	1.82	.56	400	8.45	15.46	8.1	0-7
28997	Reeves fine sandy loam, subsoil.....	.053	.097	104	1.76	.57	338	12.09	21.04	8.0	7-19
28990	Reeves silty clay loam, deep phase, surface.....	.110	.119	42	1.96	.70	275	17.79	31.92	8.5	0-7
28991	Reeves silty clay loam, deep phase, subsoil.....	.079	.106	24	1.87	.71	211	20.69	36.57	8.5	7-19
28992	Reeves silty clay loam, surface.....	.082	.105	55	1.94	.68	356	14.63	25.08	8.0	0-7
28993	Reeves silty clay loam, subsoil.....	.076	.103	12	1.90	.72	312	17.73	31.17	7.9	7-19
28998	Reeves silty clay loam, surface.....	.095	.104	37	1.65	.63	328	22.44	40.80	8.6	0-7
28999	Reeves silty clay loam, subsoil.....	.079	.104	8	1.48	.63	389	26.09	46.45	8.3	7-19
29029	Reeves silty clay loam, deep phase, surface.....	.077	.136	338	2.14	.90	436	6.61	11.54	8.6	0-7
29030	Reeves silty clay loam, deep phase, subsoil.....	.081	.122	132	2.14	.92	306	9.06	16.15	8.2	7-19
Average	Reeves silty clay loam, surface.....	.091	.116	118	1.92	.73	349	15.37	27.34	8.4	.....
Average	Reeves silty clay loam, subsoil.....	.079	.109	44	1.85	.75	305	18.39	32.59	8.3	.....
29011	Rio Grande loamy very fine sand, surface.....	.034	.088	28	2.57	.39	270	6.57	10.76	8.8	0-7
29012	Rio Grande loamy very fine sand, subsoil.....	.023	.084	521	2.68	.33	288	5.27	9.30	9.0	7-19
29009	Rio Grande very fine sandy loam, surface.....	.066	.128	367	1.38	.74	385	7.05	11.06	8.9	0-7
29010	Rio Grande very fine sandy loam, subsoil.....	.059	.094	521	2.50	.74	505	6.39	10.27	8.5	7-19
28988	Toyah clay loam, surface.....	.034	.165	499	4.32	.40	654	.97	1.41	8.5	0-7

SOILS OF VARIOUS TEXAS COUNTIES AND TRANS-PECOS AREA

TABLE 24. Analyses of soils of Trans-Pecos Area. (Continued)

Laboratory Number	Type Name	Nitrogen Per Cent	Total Phos. Acid 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	pH	Depth Inches
28989	Toyah clay loam, subsoil .....	.040	.148	319	4.02	.38	802	1.78	2.97	8.8	7-19
28994	Verhalen clay, surface.....	.067	.123	92	2.75	.96	331	8.34	14.50	.....	0-7
28995	Verhalen clay, subsoil .....	.089	.131	117	2.77	1.01	455	7.95	13.64	.....	7-19
29007	Verhalen clay, surface .....	.063	.109	493	3.14	.99	628	5.59	9.91	8.4	0-7
29008	Verhalen clay, subsoil .....	.063	.109	499	3.12	1.01	571	5.77	10.49	8.5	7-19
Average	Verhalen clay, surface .....	.065	.116	293	2.95	.98	480	6.97	12.21	8.4	.....
Average	Verhalen clay, subsoil .....	.076	.120	308	2.95	1.01	513	6.86	12.07	8.6	.....
28986	Verhalen clay loam, surface.....	.080	.064	155	3.38	.41	444	.42	.69	7.7	0-7
28987	Verhalen clay loam, subsoil.....	.076	.063	79	3.40	.58	340	.59	1.02	7.6	7-19

TABLE 25. Classes of constituents of surface soils of Trans-Pecos Area.

Laboratory Number		Nitrogen	Total Phos. Acid	Active Phos. Acid	Total Potash	Acid Soluble Potash	Active Potash	Acid Soluble Lime	Basicity	pH
29021	Gila fine sand.....	4	3	1	1	2	2	1	1	1
29027	Gila silt loam.....	3	2	1	1	2	1	1	1	1
29000	Pecos silty clay loam...	3	2	1	1	2	3	1	1	1
29015	Reagan fine sandy loam	3	4	1	1	3	1	1	2	1
29019	Reagan gravelly loam..	3	4	1	1	2	2	1	1	1
Average	Reagan silty clay loam.	2	3	4	1	1	3	1	1	1
29025	Reeves fine sand.....	5	4	3	1	4	2	2	2	1
28996	Reeves fine sandy loam	3	2	2	1	2	2	1	1	1
Average	Reeves silty clay loam.	3	2	3	1	2	2	1	1	1
29011	Rio Grande loamy very fine sand.....	4	3	5	1	3	2	1	1	1
29009	Rio Grande very fine sandy loam.....	3	2	2	2	2	2	1	1	1
28988	Toyah clay loam.....	4	1	1	1	3	1	2	3	1
Average	Verhalen clay.....	3	2	2	1	1	1	1	1	1
28986	Verhalen clay loam....	3	3	3	1	2	1	2	3	1

Pot Experiments

Results of pot experiments are given in Table 26. The soils do not show significant responses to fertilization with nitrogen, phosphoric acid, or potash. The corn possibility with respect to phosphoric acid is low, but this may be because heavy crops were not produced on the soils for reasons other than the capacity of the soils to provide plant food.

Fertilizers

The analyses and pot experiments indicate that no response from fertilization will be secured on most of the soils. Lime is already present in large quantities in most of the soils.

Saline Soils

The soluble salts found in some saline soils in the Trans-Pecos Region are given in Table 27. Chlorides make up a large part of the salts, especially when the quantity of soluble salts is very high. Sulphates are very high in a few soils, notably No. 1373 and its subsoil, and No. 29003 and its subsoil. These soils probably contain considerable quantities of gypsum not in solution. All of the soils listed except possibly No. 10975 are to be classed as saline, rather than alkali, soils because the quantity of sodium carbonate is not high in any of them.

DIFFERENCES IN COMPOSITION AT DIFFERENT DEPTHS

The composition of a soil in horizons at different depths sometimes varies markedly. Zones of accumulation of sodium sulfate in a soil from Potter County (Table 20) have already been discussed (page 42). Calcium carbonate content may and often does vary much more markedly at different depths. In Galveston County, (Table 10) a zone of accumulation of lime occurs in the deep subsoils of the Lake Charles series. This occurs at different depths and to different degrees with different samples. In Lake Charles clay No. 32659, there is a slight accumulation

TABLE 26. Pot experiments on soils of Pecos County in Trans-Pecos Area.

Laboratory number	Type name	Weight crop in grams				Corn possibility ² of plant food withdrawn, in bushels		
		With complete fertilizer	Without phosphoric acid	Without nitrogen	Without potash	Phosphoric acid	Nitrogen	Potash
17500	Arno silty clay loam, probably, surface, corn.....	18.7	15.0	21.3	19.3	19	42	45
"	Arno silty clay loam, probably, surface, sorghum.....	7.5	8.3	6.5	1.5	10	9	20
"	Arno silty clay loam, probably, surface, corn.....	22.7	.....	.....	14.7	.....	.....	245
"	Arno silty clay loam, probably, surface, sorghum.....	0.2	.....	.....	2.7	.....	.....	38
"	Arno silty clay loam, probably, surface, cotton.....	22.6	.....	.....	21.6	.....	.....	325
"	Arno silty clay loam, probably, surface, cowpeas.....	9.0	.....	.....	15.6	.....	.....	403
17501	Arno silty clay loam, probably, subsoil, corn.....	8.1	7.9	7.4	10.9	9	35	246
"	Arno silty clay loam, probably, subsoil, sorghum.....	12.2	13.0	8.5	6.9	18	11	78
"	Arno silty clay loam, probably, subsoil, corn.....	9.0	5.3	10.7	8.3	.....	51	208
"	Arno silty clay loam, probably, subsoil, sorghum.....	9.9	10.0	11.0	3.4	.....	49	36
22141	Reeves silty clay loam, probably, surface, corn.....	19.0	15.4	.....	22.1	32	.....	428
"	Reeves silty clay loam, probably, surface, sorghum.....	2.0	0.6	.....	2.6	3	.....	21
"	Reeves silty clay loam, probably, surface, alfalfa.....	18.3	15.3	.....	15.0	30	.....	169
"	Reeves silty clay loam, probably, surface, alfalfa.....	1.5	3.0	.....	5.2	5	.....	41
22142	Reeves silty clay loam, probably, subsoil, corn.....	10.0	3.7	.....	12.2	5	.....	202
"	Reeves silty clay loam, probably, subsoil, sorghum.....	18.6	5.1	.....	9.2	11	.....	81
"	Reeves silty clay loam, probably, subsoil, alfalfa.....	14.0	7.6	.....	12.8	12	.....	129
"	Reeves silty clay loam, probably, subsoil, alfalfa.....	3.9	1.5	.....	1.8	2	.....	19
4291	Reeves silty clay loam, surface, corn...	15.1	13.0	.....	.....	17	.....	.....
"	Reeves silty clay loam, surface, sorghum.....	1.2	6.5	.....	.....	12	.....	.....
"	Reeves silty clay loam, surface, corn...	29.0	14.0	.....	.....	11	.....	.....
4291	Reeves silty clay loam, surface, sorghum.....	3.9	3.9	5.0	.....	8	9	.....
"	Reeves silty clay loam, surface, corn...	34.9	.....	4.8	.....	.....	7	.....
"	Reeves silty clay loam, surface, sorghum.....	13.2	.....	4.0	.....	.....	9	.....

TABLE 27. Composition of soluble salts in some soils of Trans-Pecos Area (parts per million).

Laboratory Number		Depth Inches	Calcium Sulphate	Calcium Chloride	Magnesium Carbonate	Magnesium Sulphate	Magnesium Chloride	Sodium Carbonate	Sodium Sulphate	Sodium Chloride
1373	Surface soil.....	0-12	25450	.....	.....	600	1563	.....	.....	53670
1374	Surface soil.....	0-12	17725	.....	.....	.....	3975	.....	.....	9610
1375	Dry alkali bed.....	0-12	14225	.....	.....	4500	2915	.....	.....	10770
1376	Subsoil to 1373.....	12-24	11855	.....	.....	2370	.....	.....	.....	8020
1379	Subsoil to 1373.....	24-36	12700	.....	.....	750	1016	.....	.....	8125
1382	Subsoil to 1373.....	36-48	11355	.....	.....	1500	424	.....	.....	5280
8254	Subsoil.....	6-18	.....	.....	36	205	.....	.....	83	267
8255	Yellowish brown loam, surface.....	0-12	235	.....	.....	37	283	.....	.....	237
8256	Subsoil to 8255.....	12-24	168	31	.....	.....	333	.....	.....	118
8264	Yellowish brown loam, surface.....	0-12	.....	.....	5	126	121	.....	.....	176
8265	Subsoil to 8264.....	12-24	229	228	.....	.....	404	.....	.....	.....
10887	Brown sandy loam, surface.....	0-8	969	26334	.....	.....	3610	.....	.....	21740
10888	Subsoil to 10887.....	8-16	2485	893	.....	.....	556	.....	.....	5110
10974	Yellowish gray silty clay, surface.....	.....	459	.....	.....	483	.....	.....	572	950
10975	Yellowish gray silty clay, surface.....	.....	73	.....	.....	283	.....	.....	1206	1109
10976	Yellowish gray silty clay, surface.....	.....	1035	.....	.....	792	.....	.....	242	2595
10977	Yellowish brown silty clay, surface.....	.....	1588	319	.....	.....	970	.....	.....	4283
10978	Yellowish gray silty clay, surface.....	.....	.....	.....	46	149	.....	.....	111	248
10979	Yellowish gray silty clay, surface.....	.....	280	.....	.....	268	.....	.....	240	41
11238	Light brown clay loam, surface.....	0-12	146	.....	.....	249	5	.....	.....	289
11239	Subsoil to 11238.....	12-24	85	.....	.....	126	76	.....	.....	148
11240	Brownish gray clay loam, surface.....	0-12	.....	.....	16	60	.....	.....	550	165
11241	Subsoil to 11240.....	12-24	.....	.....	67	54	.....	.....	344	143
11702	Light gray fine sandy loam, surface.....	0-18	500	.....	.....	590	.....	.....	689	2661
11703	Subsoil to 11702.....	8-16	.....	.....	83	.....	.....	46	259	376
12524	Yellowish brown sandy clay, surface.....	0-19	5368	.....	.....	1029	.....	.....	353	2186
12525	Subsoil to 12524.....	20-40	10232	.....	.....	590	.....	.....	397	783
12526	Light yellow sandy clay, surface.....	0-22	3674	.....	.....	550	272	.....	.....	2059
12527	Subsoil to 12526.....	22-34	10371	.....	.....	616	.....	.....	312	783
12705	Brown loam, surface.....	.....	4637	18667	.....	.....	2952	.....	.....	1618
17332	Brown clay, surface.....	.....	9196	.....	.....	1147	.....	.....	9683	14190
17333	Gray brown clay, surface.....	.....	.....	.....	.....	322	.....	.....	4614	4516
17500	Bottom or valley land.....	0-12	.....	.....	7	98	.....	.....	385	412
17501	Bottom or valley land.....	12-24	97	.....	.....	107	.....	.....	289	528
22926	Surface soil.....	.....	567	.....	.....	295	.....	.....	506	384
22927	Subsoil to 22926.....	.....	5237	.....	.....	1443	.....	.....	5808	751
22928	Subsoil to 22926.....	.....	.....	.....	27	149	.....	.....	1433	134
25693	Surface soil.....	0-7	.....	.....	56	.....	.....	225	.....	1196
25694	Surface soil.....	0-7	2979	.....	.....	108	531	.....	.....	5217
25695	Surface soil.....	0-7	3294	.....	.....	817	.....	.....	394	5831
25696	Surface soil.....	.....	239	.....	79	.....	.....	70	.....	703
25697	Surface soil.....	0-7	56	2	.....	.....	31	.....	.....	36
25698	Surface soil.....	0-7	.....	.....	29	.....	.....	109	.....	807
28971	Surface soil.....	0-10	.....	.....	73	72	.....	.....	341	665
28972	Subsoil.....	18-30	.....	.....	62	104	.....	.....	115	1601
29002	Toyah loam.....	0-7	.....	.....	142	.....	.....	9	85	124
29003	Bed of salt lake in salt basin, surface.....	0-7	14606	.....	.....	5081	921	.....	.....	37643
29004	Subsoil to 29003.....	7-19	15458	4148	.....	.....	1063	.....	.....	4798
29005	Reeves silty clay loam, deep phase, surface.....	0-7	53	.....	140	.....	.....	.....	286	157
29006	Subsoil to 29005.....	7-19	190	.....	162	.....	38	.....	.....	185
29034	Surface soil.....	.....	1829	.....	.....	498	.....	.....	842	2995
29035	Subsoil.....	6	175	.....	.....	146	.....	.....	1740	964
29036	Subsoil.....	12	381	.....	.....	256	.....	.....	1932	1325

below 60 inches; in the very fine sandy loam No. 32665, there is a considerable accumulation below 23 inches; in the very fine sandy loam No. 32677, there is a very marked accumulation below 40 inches. The basicity of a Houston black clay surface soil (No. 33764, Table 4) was 7.58 per cent, of the first subsoil (7"-18", No. 33765), 5.10 per cent, and of the deep subsoil (18"-30", No. 33766), 24.00 per cent. Nitrogen, active phosphoric acid, and active potash all decrease markedly in the lower depths of most soils, as is shown in all tables in this bulletin giving the composition of the soils. This fact is of great practical importance, because the soil left on an area after the topsoil has been removed by erosion is of much lower fertility than the original soil which was washed away.

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SUMMARY

Chemical analyses and results of pot experiments on samples of typical soils from six counties and the Trans-Pecos Region are given with condensed descriptions of the soil series. A new classification of constituents, 5 classes based upon chemical composition, is given, and its relation to previous methods of interpretation is discussed. Most of the soils are low (Classes 4 and 5) in nitrogen and phosphoric acid. They are better supplied (Classes 2 and 3) with potash. Some of the soils are low in lime and basicity (Classes 4 and 5), while others are basic and even highly calcareous (Class 1). Some of the soils are slightly acid, but most of them are neutral to alkaline.