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Co-operative Fertilizer Experiments with Corn, Cotton, Rice, Cauliflower, Peanuts, Onions, Tomatoes and Potatoes, 1908-9-10.

BY

G. S. FRAPS, Chemist.

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Co-operative Fertilizer Experiments With Corn, Cotton, Rice, Cauliflower, Peanuts, Onions, Tomatoes and Potatoes--1908-9-10.

BY

G. S. FRAPS, Chemist.

Co-operative fertilizer experiments were begun in 1907 by this Division of the Texas Agricultural Experiment Station, only a few experiments with nitrate of soda being undertaken then, however. In 1908, a larger number of experiments was instituted, and since then the work has been vigorously prosecuted.

We have several objects in view in conducting these experiments. One is to ascertain what fertilizers or plant foods give the best results under ordinary farming conditions on the various types of Texas soils. It is very important that information of this kind should be secured, both for the benefit of farmers in general, and for the particular farmer who undertakes the experiment. The rational and intelligent use of fertilizers is certainly more likely to be profitable than hit-or-miss systems. The information which we have collected concerning the chemical properties and composition of our soils will enable us to make wide applications of the results of these and other experiments.

A second, and more scientific, object in instituting these fertilizer experiments is to ascertain the relation between the needs of the soil as shown by field experiments, and the needs as shown by pot experiments and chemical analyses. This is a relation which must be definitely established if our analyses and pot experiments are to become of the greatest possible practical significance.

NATURE AND SIGNIFICANCE OF FERTILIZERS.

A full discussion of the nature and use of commercial fertilizers is presented in Bulletin 112 of this station. Only a few facts pertaining to the experiments under discussion will be given here.

The object of a fertilizer is to supply plant food to the soil in such forms that plants can take it up. All soils contain plant food, but they do not all contain a sufficient quantity, or in such forms as to be easily consumed by plants. Plants vary in their need for food and in their capacity to secure it. Soils vary in their content of plant food and their ability to supply it to the plant. Hence arises great diversity in the effects of applications of plant food.

The adaptation of fertilizers to soils and plants means the use of such as will supply the necessary food, on the one hand without too great excess of waste, on the other hand without a deficiency of some needed element.

The three important forms of plant food are phosphoric acid, potash,

and nitrogen. Our soil analyses show that, as a rule, Texas soils are often deficient in phosphoric acid, less often so in nitrogen and least so in potash.

Phosphoric acid was supplied, in our experiments, by the use of acid phosphate, which contained about 14 per cent available phosphoric acid, that is, suitable for plants.

Nitrogen was supplied by cottonseed meal, which contains about 7 per cent nitrogen, with about 1.5 per cent potash and 2.5 per cent phosphoric acid. The presence of phosphoric acid and potash in the cottonseed meal complicates matters a little, but it is the form of nitrogen very generally used in Texas. Dried blood, sulphate of ammonia, and nitrate of soda also contain nitrogen.

Potash was supplied as kainit, which contains 12 per cent potash, or sulphate or muriate of potash, containing 50 per cent of potash approximately.

CONTROLLING CONDITIONS OF CROP GROWTH.

Plant food is not the only condition which controls the growth of the crop and the corresponding yield. In fact it may, at times, be of a relatively small importance.

The size of the crop depends on the condition least favorable to its growth. The controlling condition may be excess or deficiency of water, too low or too high a temperature, too much or too little light, the depth of the soil, the physical character or condition of the soil, the quantity available of any given plant food, acidity of the soil, insect pests, or plant diseases, kind of seed, etc.

The controlling condition may not be constant. At one period during the growth of the crop, excess of water may control. At another time deficiency of, say, phosphoric acid, may control. Later on, drought may set in, and deficiency of water become the controlling condition.

The conditions of plant life are not independent, but affect one another. An excess of water interferes with the elaboration of plant food. The physical condition or character of the soil affects the amount of water it retains. A liberal supply of plant food may economize water, and so on.

The practical farmer must study the limiting conditions, and endeavor to raise the limit to a higher one. A knowledge of the limiting condition, thus, is of prime importance.

A study of the relation of Texas soils to water is, we believe, of great importance. Moisture and other climatic conditions, are the great controlling conditions. Methods of removing surplus waters, and of storing and conserving water in the soil, should be learned and practiced by the farmer.

RELATION OF FERTILIZERS TO MAINTENANCE OF FERTILITY.

In order to maintain fertility, it is essential that a good supply of active plant food be kept in the soil. Phosphoric acid and potash are comparatively cheap, and may be profitably purchased, but nitrogen is expensive, and it is not practical to purchase all the nitrogen sufficient for ordinary farm crops. In other words, the bulk of the nitrogen must be secured otherwise than in commercial fertilizers. Nitrogen in the

fertilizer may be applied to supplement that in the soil, but to purchase nitrogen is too expensive as a means of maintaining soil fertility when ordinary farm crops are grown. Hence it is necessary to secure means of obtaining the nitrogen from other sources. The improper use of commercial fertilizers may, indeed, impoverish the soil in nitrogen. (See Bulletin No. 112.)

The nitrogen may be secured from the air by the use of leguminous crops. These plants have the power of fixing free atmospheric nitrogen. The maintenance of soil fertility requires the growth of these crops.

INTERPRETATION OF FIELD EXPERIMENTS WITH FERTILIZERS.

Field experiments, of whatever kind, require care in their interpretation. Variations in the soil, its depth or physical character, local variations in fertility, the attacks of birds or insects, injury by storm, the situation with respect to drainage, may influence the plots unequally. It is known that plots on a field apparently of uniform fertility, and treated exactly alike, do not produce exactly the same yield, and further, that these variations are not always in the same direction each year. Underground conditions may be one cause of this, such as differences in fertility, or differences in depth, and in character of subsoil, causing differences in moisture conditions of not always the same effect in different seasons.

Whatever the cause of such variations, they do exist, and often cause otherwise unaccountable results in field experiments. Their existence must always be kept in mind in connection with such experiments.

THE CO-OPERATIVE FERTILIZER EXPERIMENTS.

When announcement was made in the press of our intention to carry out these experiments, we received a large number of applications from those wishing to take part in the work. We accepted as many as we could handle with the means at our disposal. Each year we have been obliged to disappoint a number of those wishing to conduct the experiments, as many as nearly three hundred one year. We hope that those who desire to do so will later on have opportunity to take part in this work.

Detailed accounts of the various co-operative experiments will be presented in the succeeding pages, together with a discussion of them, and conclusions drawn from them. Only the *successful* experiments are reported. Each year a number of experiments failed, from various causes, but the chief cause of failure in the past three years was drought.

The writer wishes to express his appreciation of the work of those who have carried out these experiments, both to those who succeeded and to those whose crops were injured or destroyed. The work is of value not only to those who carried it out, but to farmers in general. Many of those who co-operated with us have done so for two or three years, and we believe this shows the work to have been of service to them.

Acknowledgment must also be made to the German Kali Works, for some muriate of potash; to the Nitrate of Soda Propaganda, for nitrate of soda; to the New Orleans Acid and Fertilizer Company, for one ton of Bull Dog Acid Phosphate; to the Fidelity Cotton Oil and Fertilizer Company, of Houston, for various courtesies in connection with this

work; to the Coe-Mortimer Company, of New York, for Thomas phosphate; and to H. Dittlinger & Company, of New Braunfels, for certain lots of hydrated lime. All this was of material assistance in extending our experiments.

EXPERIMENTS WITH CORN.

Fertilizer experiments with cotton and corn have now been carried on for three years. The objects of these experiments are to ascertain the needs of various types of soils for fertilizers, to determine the relation between deficiency and chemical composition, and to study the application of plant tests to needs of the soil.

EXPERIMENTS IN 1908.

The following instructions were sent out in 1908, together with the fertilizer mixtures:

Plan for Fertilizer Test with Corn and Cotton.—Select a piece of land about three-quarters of an acre where the soil is uniform. For each application of fertilizer select four rows of cotton or corn 280 feet long, or 8 rows 140 feet long, or 16 rows 70 feet long. If the rows are 4 feet apart each application of fertilizer will then be made approximately on one-tenth of an acre of land. We will assume that four rows of cotton or corn 280 feet long were selected, 4 feet apart.

I. To the first four rows apply 20 pounds of acid phosphate.

II. To the second four rows apply nothing.

III. To the third four rows apply a mixture of 20 pounds of acid phosphate and three pounds cottonseed meal.

IV. To the fourth four rows apply a mixture of 20 pounds acid phosphate and 10 pounds cottonseed meal.

V. To the fifth four rows apply a mixture of 20 pounds acid phosphate, three pounds cottonseed meal and two pounds kainit.

VI. To the sixth four rows apply a mixture of 20 pounds acid phosphate, three pounds cottonseed meal and five pounds kainit.

The fertilizer should be mixed well, and applied in the rows about a week before the seed is planted. The entire field should receive the same treatment, and if any of the plots are damaged by storms, insects, or anything else, the facts should be noted and considered. The only difference between the plots should be the quantity of fertilizer. The crop from each plot should be harvested and weighed separately.

The difference between plot II and the others shows the effect of the various fertilizers.

The difference between I and II shows the effect of acid phosphate (containing phosphoric acid) alone.

The difference between I and III shows the effect of nitrogen in cottonseed meal. The difference between III and IV shows the effect of increasing the nitrogen.

The difference between III and V shows the effect of potash (kainit). The difference between V and VI shows the effect of increasing the potash.

Quantity of Fertilizer.—The quantity of fertilizer used corresponded to 200 pounds acid phosphate per acre, 30 or 100 pounds cottonseed meal, and 20 or 50 pounds kainit. This would correspond to 28 pounds

phosphoric acid, 2.1 or 7 pounds nitrogen, and 3.6 or 7.2 pounds potash. This does not allow for the potash or phosphoric acid in the cottonseed meal. These *are* light applications of fertilizer, *but* were selected in order to bring the experiments into relation with ordinary cotton fertilizers, containing 8 or 10 per cent phosphoric acid, 1.65 per cent nitrogen and 2 per cent potash.

Mixture No. 4 corresponds to a mixture of 1 part cottonseed meal to 2 parts acid phosphate. The mixture applied to No. 5 would contain 7.2 per cent phosphoric acid, 0.8 per cent nitrogen and 1.4 per cent potash. The application of nitrogen in this series is small.

RESULTS OF THE TESTS, 1908.

Chas. J. Moores, Texarkana, Bowie County.—The yield of shelled corn is in Table No. 1. The last plot was next to a fence-row with trees beyond, the low yield being probably caused by the shade.

The acid phosphate was most effective in the experiment. The addition of cottonseed meal to the acid phosphate was not profitable.

H. G. Landis, Plainview, Hale County.—The fertilizer was applied and cotton planted May 8th, but the cotton was a failure owing to heavy rains, and on June 12th, June corn was planted on the same plots. The corn was somewhat tangled by a storm and was not cultivated as much as could be desired. Results are in Table 1. Rows 280 feet long. This experiment is inconclusive. Acid phosphate was the only application which made a gain.

TABLE NO. 1—Weight of Corn in Pounds per Plot in Co-operative Experiments, 1908

Plot No.		Texarkana, Bowie county.	Plainview, Hale county.	Thornton, Limestone county.
		Shelled corn, lbs.	Shelled corn, lbs.	Lbs.
1	20 lbs. acid phosphate	77	148	200
2	No addition	60	112	116
3	20 lbs. acid phosphate, 3 lbs. cottonseed meal	80	109	161
4	20 lbs. acid phosphate, 10 lbs. cottonseed meal	85	109	151
5	20 lbs. acid phosphate, 3 lbs. cottonseed meal, ½ lb. muriate of potash	70	104	139
6	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 1¼ lbs. muriate of potash	40	115	164
	Apparent effect of:			
	Acid phosphate	+17	—36	—84
	Three pounds cottonseed meal	+3	—39	—39
	Ten pounds cottonseed meal	+8	—39	—49
	One-half pound muriate of potash	—10	* +5	* —21
	One and one-fourth pounds muriate of potash	—40	* +6	* +3

*The crop was not as large as with acid phosphate alone, so that the potash actually caused no gain. It decreased the apparent loss due to cottonseed meal.

John Griffin, Thornton, Limestone County.—The corn was planted very thick. Results are in Table 1. Number 1 and 6 were outside rows, which may have caused them to do better. No. 4 showed the best growth of stalk but did not make the corn. Acid phosphate was the only application which made a gain. Mr. Griffin also made an experiment with cotton in 1909.

Mr. Griffin's soils are low in phosphoric acid, good in nitrogen, and

fair in lime and potash. They are low in active phosphoric acid. In the fertilizer experiment, acid phosphate was the only application which made a gain. In the cotton experiment, 1909, only the first pickings were weighed, the other pickings being mixed by mistake. The results of the cotton experiment so far as it goes were similar to the corn experiment, only the acid phosphate giving results.

Description of Soil.—Probably Orangeburg fine sandy loam. For analysis, see Table 3. No. 1257, depth 0"-6", located in Thornton, Limestone County, on the old Kidd farm. Occupied by J. B. Griffin. Considered good, produces one-third bale cotton, 25 bushels corn per acre. Represents 80 per cent farm, 50 to 60 per cent of county. Corn, cotton, peanuts, millet, are the principal crops grown. It is a reddish brown, friable loam, which behaves well in both wet and dry seasons. It has a southeast slope.

No. 1258.—Uncultivated soil. Depth to clay subsoil is 10".

CONCLUSIONS FROM 1908 EXPERIMENTS.

Only three experiments with corn were reported. Acid phosphate produced increased yields with all three.

Cottonseed meal increased the crop in only one experiment. In the other two it caused apparently a decrease. This may have been due to the increased growth of leaves caused by the nitrogen of the meal increasing the requirements of the plant for water, and causing it to suffer from the dry weather which followed.

Muriate of potash did not produce any increase in any of the experiments, but produced an average decrease. None of the six plots which received potash gave as large yields as the acid phosphate plot. Potash is used more largely by the leaves and stalk than any other portion of the plant, and may possibly have acted in production of increased foliage, with consequent greater suffering from drought.

The results of these experiments might well have been different under more favorable conditions.

EXPERIMENTS ON CORN, 1909.

The season of 1909 was also a very dry one, and corn suffered severely. A number of our experiments were destroyed by the drought, and the results of the other experiments might well have been different had seasonal conditions been otherwise.

Acid phosphate, as a general rule, produced results. Cottonseed meal increased the growth of stalk, but the larger plant required more water, so that the production of corn was in many cases actually less when it was added to the acid phosphate. The seasonal conditions were against the favorable use of nitrogen. These observations do not, of course, apply to all the experiments.

Plan of Work.—The same instructions for work were used as in 1908.

RESULTS.

David C. Barr, Raywood, Liberty County.—Moderate, prairie soil, low, black, with clay subsoil, cultivated two years, produces 12 to 15 bushels corn, 10 to 15 sacks rice. The crop had to be replanted but made a fine stand with the exception of No. 1. The results are in Table 2. All the fertilizing constituents gave results.

This soil is fairly well supplied with nitrogen, lime, and potash. It is low in phosphoric acid. It is also probably low in active phosphoric acid.

Description of Soil.—Probably Lufkin clay. For analysis, see Table 3.

No. 2375—Depth, 0″-8″, located in Raywood, Liberty county, on farm of D. C. Barr. Sample taken in northeast corner of Section 166. Washington county survey. This soil is level and has fair drainage. Fifteen to 20 bushels corn and 12 to 18 sacks of rice were produced per acre. Rice and corn are principally grown. In wet seasons water stands on this land; on drying out, the soil gets hard on the surface.

No. 2376—Depth, 8″-18″. Subsoil to No. 2375.

J. D. Randolph, Austin, Travis County.—Light sandy loam, second bottom soil with red clay subsoil; 30 years in cultivation. Produces 20 bushels corn, one-quarter bale cotton. The crop was thoroughly cultivated. Acid phosphate alone gave results.

G. B. Thaggard, Texarkana, Bowie County.—Light gray sandy soil, moderate upland, with good drainage, produces 12 bushels corn, or one-half bale cotton. In cultivation 3 years. Harvest was very light, due to severe drought. Peas had been grown on this patch the previous year. Acid phosphate and cottonseed meal both gave results, in spite of the drought.

S. W. Harper, Sanger, Denton County.—Poor, gravelly, red, upland soil with clay subsoil, 35 years in cultivation, produces 10 to 15 bushels corn. Stand secured was 95 per cent, excepting on plots 5, 85 per cent, and 6, 90 per cent. Had not had a good rain since November, 1908, nearly a year. Acid phosphate and cottonseed meal both gave results. Potash gave results on one plot and none on the other.

Mr. Harper also conducted an experiment with Irish potatoes in 1910, in which acid phosphate and cottonseed meal gave results, and potash did not.

This soil is fair in lime, high in potash, fair in nitrogen, and low in phosphoric acid. It is also low in active phosphoric acid.

Description of Soil.—No. 3124, depth, 0″-6″, Sanger, Denton county. Considerated moderate to poor land. On northwest corner of prairie farm, 75 yards south and 60 yards east from corner. Two hundred and fifty pounds cotton, 7 or 8 bushels corn, and 10 bushels oats are usually produced on an acre. Corn, cotton, wheat and oats are grown. The yields are fair in wet seasons but poor in dry. The land is rolling and drainage is good.

No. 3125—Subsoil to 3124, depth 6″-15″.

R. Windsor, Buffalo, Leon County.—Light red sandy, hilly soil, with red stiff clay subsoil; in cultivation 30 years and producing 15 bushels corn and one-third bale cotton. Prolonged drought during the experiment. Stand, fair.

Acid phosphate alone gave results. Mr. Windsor also carried out a

corn experiment in 1910, in which acid phosphate gave results, one application of cottonseed meal increased the yield, and one did not, and potash had no effect.

This soil is fair in lime and potash, low in nitrogen and phosphoric acid. This soil is unusually high in active phosphoric acid, and it is questionable if the soil sample represents the field correctly, the surface soil being very high in active phosphoric acid, and the subsoil low.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3367—Depth 0″-7″. Farm of R. Windsor, nine miles south of Buffalo, Leon county, on preemption section, G. W. Weims survey. Sample taken on rise in center of field close to an old peach tree. The soil is well drained, rolling and considered moderately fertile. It is locally known as "sandy land." Fifteen bushels of corn and one-third bale of cotton are produced per acre.

Corn, cotton and peas are the chief crops. This is a light reddish sandy soil with good underdrainage, which packs, crumbles, does not crack or wash, and dirt does not wash onto it. It has been cultivated 54 years, represents two-thirds of farm, and is an average of the county. No fertilizers or manure have ever been applied. Crab grass and weeds plowed under helped mechanically.

No. 3368—Depth 7″-19″. Subsoil to No. 3367. This is a light red clay.

T. O. Plunkett, Marshall, Harrison County.—Dark sandy soil with stiff red clay subsoil, 12 to 15 years in cultivation. Moderate production 15 bushels corn or one-quarter bale cotton. On account of the unusual drought the test cannot be considered a fair one.

Acid phosphate alone gave results. In another test in 1910 on corn none of the fertilizer applications gave results, the yields being irregular.

Mr. Plunkett's soil is a little low in lime, well supplied with potash, and low in nitrogen and phosphoric acid. It is low in active phosphoric acid, and evidently needs phosphatic fertilizers, and rotation of crops with legumes to supply nitrogen.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3359—Depth 0″-4″. Located two miles northwest of Marshall, Harrison county, on farm of Tom O. Plunkett, on north half of Samuel Harper survey, 150 yards north from tenant house. This soil is almost level upland soil and is known as dark sandy loam. It is considered of moderate fertility and produces one-third bale of cotton to the acre. Corn and cotton are the principal crops. No fertilizer has been used on this soil. The native vegetation is lezpedeza and wild sage. The soil packs when very wet, crumbles on drying and washes very little. This soil has been cultivated since the Civil War, but has been idle for several years. No green crops have been plowed under and no manure has ever been applied. The soil represents 50 acres of farm.

No. 3360—Depth 4″-13″. Subsoil to No. 3359.

Jas. S. Duncan, Mount Pleasant, Titus County.—Dark loam, upland soil, with sandy clay subsoil, cultivated eight years in corn and cotton, produces 1,500 pounds seed cotton. The difference of production in the plots was due to the weight of ears and not in the number. Plots 3, 4, 5 and 6 had a greater growth of fodder and shuck. The weather was very dry, hence it is not considered a fair test. The acid phosphate alone gave results.

E. T. Josey, Huntsville, Walker County.—Light colored sandy upland soil with clay subsoil, 20 years in cultivation and produces 29 bushels corn. The corn was injured by a severe hail storm on May 15. Acid phosphate alone gave results.

G. T. Plexco, Whitesboro, Grayson County.—Dark red sandy loam soil, with red clay subsoil. Good upland prairie, cultivated 25 years in corn, cotton and oats, and produces 20 to 40 bushels corn, 20 to 50 bushels oats, and one-quarter to three-quarters bale cotton.

Plot No. 1 was next to cotton, which gave it some advantage. Season a dry one. Stand perfect. Acid phosphate alone gave results. Soil probably Orangeburg fine sandy loam.

S. B. Blair, Marquez, Leon County.—Light red sandy loam upland soil, with red clay subsoil, in cultivation 16 years and producing 15 bushels corn and one-third bale cotton. Bedded in fall, cut down with disc harrow, fertilizer applied, and listed with turning plows and middles run out. Corn planted March 18 and replanted April 2. Got a fairly good stand and cultivated five times. Acid phosphate and perhaps cottonseed meal and potash gave results.

The experiment in 1910 of Mr. Blair gave practically the same results. Acid phosphate produced an increase, the light application of cottonseed meal gave no results, but the heavy application gave a decided increase. The potash had the same effect as an increase in the quantity of cottonseed meal.

Mr. Blair's soil is low in lime, potash, nitrogen and phosphoric acid. It is better supplied with active phosphoric acid than many of the soils tested, having an average corn possibility of 20 bushels per acre. Nitrogen is thus probably needed more than phosphoric acid. Like many other Texas soils, this soil needs a rotation of crops in which legumes are grazed off or plowed under, to supply the soil with nitrogen and with vegetable matter. Phosphatic fertilizers should be used, with perhaps an application of potash also.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3250—Depth 0″-4″ to 6″, located in Marquez, Leon county, on farm of S. B. Blair. Sample taken in north field of 25-acre plat. The soil is considered moderately fertile and produces 15 bushels of corn and one-third bale cotton per acre. Corn and cotton are the chief crops. The land is slightly rolling and the darinage fair. Crops drown out and soil runs together in wet weather. It gets very hard and dry in dry seasons. The soil represents nine-tenths of farm and three-quarters of county.

No. 3251—Depth 4″ to 6″ to 15″. Subsoil to No. 3250.

S. L. Horne, Frankston, Anderson County.—White sandy upland soil with red clay subsoil, cultivated eight years in corn and cotton and produces 15 to 20 bushels corn. Moles destroyed crop and had to replant April 20. No rain from June 15 to August 31. Acid prosphate alone gave results. In an experiment on potatoes in 1910, Mr. Horne found phosphoric acid, potash and nitrogen, all three, of advantage.

Mr. Horne's soil is low in lime, in phosphoric acid and in nitrogen. It is good in potash, for this grade of soil. The active phosphoric acid is 29 parts per million, corresponding to an average corn possibility of 20 bushels corn per acre. This soil needs rotation of crops, legumes

turned under or grazed off, supplemented with phosphatic fertilizers for corn, and with potash in addition for potatoes.

N. K. Wright, Sadler, Grayson County.—Black sandy rolling upland soil, with yellowish red clay subsoil, 20 years in cultivation. Produces 15 to 20 bushels corn. All the fertilizer ingredients gave results.

D. S. Clark, Mexia, Limestone County.—Light sandy soil, moderate, upland, produces 15 bushels corn, 500 pounds seed cotton. Drainage good. In cultivation probably 15 years. No rain from June 1st to August 8th. Acid phosphate alone gave results. His experiment in 1910 with corn gave the same results.

Mr. Clark's soil is fair in nitrogen and potash, a little low in lime, and low in phosphoric acid and in active phosphoric acid. It needs rotation of crops, legume treatment, and fertilization with phosphoric fertilizers.

Description of Soil.—Probably Orangeburg sand.

Description of Soil.—No. 3256—Depth 0"-7". Located one and one-half miles east of Mexia, farm of D. S. Clark. Soil sampled on spot to left of road leading through field from lot just north of garden. H. & T. C. Railroad survey. This is an upland soil, locally known as "Mesquite." It is considered moderately fertile and produces 15 bushels corn and 500 pounds seed cotton per acre. Corn and cotton are the principal crops grown. The natural vegetation is weeds and crab grass. The soil crusts in dry seasons. In wet seasons it runs together and packs. The drainage is good, dirt does not wash off or onto it. This land has been cultivated 20 to 25 years and represents 100 acres on the farm. No green crops have ever been plowed under.

No. 3257—Depth 7" to 18". Subsoil to No. 3256.

CONCLUSIONS FROM THE 1909 CORN EXPERIMENTS.

Thirteen successful experiments were reported. Almost all of these tests suffered from dry weather. Acid phosphate increased the yields in every case.

Cottonseed meal, 3 pounds, increased the yield in five of the thirteen experiments. Ten pounds per plot increased the yield in six experiments. We may consider that cottonseed meal caused an average increase in five experiments. In three of the five experiments, ten pounds cottonseed meal caused a much greater increase than three pounds. Cottonseed meal caused an increase in five experiments, and an apparent *decrease* in eight. The explanation of this is probably that given in discussing the 1908 experiments. The greater yield of foliage induced by the cottonseed meal caused the corn to suffer more from the drought and so decreased the crop.

Kainit (containing potash) increased the yield of corn in six of the thirteen experiments. Two of these increases are decidedly large (Raywood and Marquez). The average increase is very small at Sanger, and at Mexia the increase is apparent rather than real, since neither of the plots with the complete fertilizer yielded as much as the one with acid phosphate alone at Mexia, and the plot with the most potash did not yield as much as the acid phosphate plot at Frankston, though Frankston should, perhaps, be counted as a gain for potash.

TABLE NO. 2—Weight per Plot of Corn in 1909 Experiments.

Plot No.		Raywood, Liberty Co.	Austin, Travis Co.	Texarkana, Bowie Co.	Sanger, Denton Co.	Buffalo, Leon Co.	Marshall, Harrison Co.	Mt. Pleasant, Titus Co.	Huntsville, Walker Co.	Whitesboro, Grayson Co.	Marquez, Leon Co.	Frankston, AndersonCo.	Sadler, Grayson Co.	Mexia, Limestone Co.	
														Weight per plot	Hills missing
1	20 lbs. acid phosphate	195	202	19	39	192	141	248	210	158	152	146	53	58	.....
2	Nothing	98	196	13	15	172	106	117	160	92	128	111	23	27	2
3	20 lbs. acid phosphate, 3 lbs. cottonseed meal.	205	198	30	45	172	133	211	220	120	152	127	59	50	12
4	20 lbs. acid phosphate, 10 lbs. cottonseed meal.	255	163	25	58	185	149	216	135	117	188	140	60	50	15
5	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 2 lbs. kainit	245	182	18	44	147	133	201	150	110	196	161	63	49	20
6	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 5 lbs. kainit	246	164	21	50	96	121	179	140	124	184	145	66	59	5
7	20 lbs. cottonseed meal	.....	.....	32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	500 lbs. stock-pen manure	.....	.....	127	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Apparent effect of:														
	Acid phosphate	97	6	6	24	20	35	131	50	66	24	35	30	31	.....
	3 lbs. cottonseed meal	10	—4	11	6	—20	—8	—34	10	—38	.....	—19	6	—8	.....
	10 lbs. cottonseed meal	50	—39	6	19	—7	8	—32	—85	—75	36	—6	7	—8	.....
	2 lbs. kainit	40	—16	—12	—1	—25	—0	—10	—70	—10	44	* 34	4	* —1	.....
	5 lbs. kainit	41	—34	—9	5	—86	—12	—32	—80	* +4	32	* 18	7	* 9	.....

*The crop was not as large as with acid phosphate alone, so that the potash actually caused no gain. It decreased the apparent loss due to cotton seed meal.

EXPERIMENTS ON CORN IN 1910.

The season of 1910 was also a dry one, though it was a better season for corn than for cotton.

INSTRUCTIONS FOR THE TESTS.

The following instructions were sent out both for corn and cotton in 1910. Some special tests were also made, under special instructions. These will be discussed later on.

Select a piece of land about three-quarters of an acre where the soil is uniform. For each application of fertilizer select four rows of cotton or corn 280 feet long, or eight rows 140 feet long, or sixteen 70 feet long. If the rows are four feet apart, each application of fertilizer will then be made on approximately one-tenth acre of land. We will assume that four rows of cotton or corn 280 feet long were selected, four feet apart. We prefer corn to cotton for the purpose of the experiment.

1. To the first four rows apply 20 pounds acid phosphate (Bag No. 1).
2. To the second four rows apply Mixture No. 2 (20 pounds acid phosphate and six pounds cottonseed meal).
3. To the third four rows apply nothing.
4. To the fourth four rows apply Mixture No. 4 (20 pounds acid phosphate and 12 pounds cottonseed meal).
5. To the fifth four rows apply Mixture No. 5 (20 pounds acid phosphate, six pounds cottonseed meal and one-half pound muriate of potash).
6. To the sixth four rows apply Mixture No. 6 (20 pounds acid phosphate, six pounds cottonseed meal and one and one-quarter pounds muriate of potash).
7. If you can do so, apply four loads manure to a seventh four rows.

The fertilizer should be mixed well, and applied in the drill about a week before the seed is planted. The entire field should receive the same treatment, and if any of the plots are damaged by storms, insects, or anything else, the fact should be noted and considered. The only difference between the plots should be the fertilizer.

The date of maturity should be stated and the crop from each plot should be harvested and weighed separately. The stand should also be reported.

The difference between 1 and 3 shows the effect of acid phosphate (containing phosphoric acid) alone.

The difference between 1 and 2 shows the effect of nitrogen in cottonseed meal. The difference between 2 and 4 shows the effect of increasing the nitrogen.

The difference between 2 and 5 shows the effect of potash. The difference between 5 and 6 shows the effect of increasing the potash.

The difference between plot 3 and the others shows the effect of the various fertilizers.

This experiment should show which of these fertilizers would prove probably most profitable for cotton and corn under your conditions and it would give you an intelligent basis for fertilizing next season. We will discuss the matter fully with you when the work is completed.

The quantity of fertilizer used corresponds to 200 pounds acid phosphate per acre, 60 or 120 pounds cottonseed meal, and 5 or 12.5 pounds muriate of potash. The application of cottonseed meal was thus larger than in the 1908 or 1909 experiments. The application would correspond to 28 pounds phosphoric acid, 4.2 or 8.4 pounds nitrogen, and 2.5 or 6.3 pounds of potash per acre. Mixture No. 5 would be equal to 28 pounds phosphoric acid, 4.2 pounds nitrogen, and 2.5 pounds of potash per acre, or the equivalent of 280 pounds per acre of a fertilizer containing 10 per cent phosphoric acid, 1.5 per cent nitrogen, and 1 per cent potash. Mixture No. 6 would equal 28 pounds phosphoric acid, 4.2 pounds nitrogen, and 6.3 pounds potash, or the equivalent of 280 pounds per acre of a fertilizer containing 10 per cent phosphoric acid, 1.5 per cent nitrogen, and 2 per cent potash. Mixture No. 2 would correspond to a fertilizer containing 10 per cent phosphoric acid and 3.3 per cent nitrogen at the rate of 280 pounds per acre, or to one containing 8 per cent phosphoric acid and 2.7 per cent nitrogen at the rate of 350 pounds per acre.

The application of nitrogen is thus light except with Mixture No. 2, and that of potash is light except with Mixture No. 6.

DESCRIPTION OF THE EXPERIMENTS.

G. S. Smith, Stephenville, Erath County.—Light colored upland sandy soil with red clay subsoil, one and one-half miles east of Stephenville, in cultivation about 20 years in cotton and corn and produces 20 bushels corn. Corn planted about March 10th, harvested August 27th. Four rows per plot 4 feet apart and 280 feet long. The land was flat-broken about four and one-half inches deep, harrowed, planted, and harrowed deep, plowed deep, and plowed with six small sweeps through the middle with diverse cultivator. The crop is very short on account of the drought. One hundred and thirty feet on the end of each plot was damaged by sand storm and report is on the remaining 150 feet. The plot which received four loads of manure suffered more from the drought than the others. He is unable to account for the difference in yields of plots 2 and 4 unless it is due to difference in the soil.

Acid phosphate alone produced results. Results in 1910, on cotton, were irregular.

This soil is fair in potash and low in nitrogen, phosphoric acid and active phosphoric acid. It needs vegetable matter, applications of phosphates and nitrogen. A rotation of crops should be adopted, in which legumes are plowed under or grazed off.

Description of Soil.—No. 3377—Depth 0″-6″. Located one and one-half miles east of Stephenville, Erath county, on lower Grandberry road, farm of George S. Smith, known as the H. B. Smith farm, John Blain survey. Sample taken about center of farm. This is upland soil and considered poor. It produces one-half bale of cotton and 20 bushels corn per acre. Corn and cotton are the principal crops. No fertilizer has been applied to this land. The native vegetation is post oak, black jack and sedge grass. The soil is a reddish sand with good surface drainage. It gets mellow when wet but becomes very hard if not stirred after a heavy rain. It does not pack badly or crack, but dries into clods. The underdrainage is poor. It does not wash much and dirt does not wash

onto it. The land has been under cultivation for 20 years. It represents 30 acres of this farm, and about one-tenth of the county. No green crop has ever been ploughed under, but once a fair covering of manure was applied, which increased the yield one-third. Humus seems very beneficial.

No. 3378—Depth 6″-18″. Subsoil to 3377. This soil is a bright red clay.

T. B. Breeding, Argyle, Denton County.—Gray sandy upland soil with light red clay subsoil, in cultivation to cotton and corn 30 years, and produces 15 bushels corn or 600 pounds seed cotton. Located 10 miles south of Denton. Corn was planted April and harvested August 24th. The fertilizer was applied in the hill, four rows per plot, 4 feet apart and 280 feet long. Flat broke January 15th about 4 inches and checked 4 feet, all cultivated three times. Nos. 5 and 6 were damaged more than the others by sand storm. No rain on this since about June 8th.

Acid phosphate and cottonseed meal gave results.

The soil is low in lime, potash, nitrogen and phosphoric acid. It is low in active phosphoric acid also. This soil needs rotation of crops with legumes plowed under or grazed off, to supply nitrogen and vegetable matter, and also applications of acid phosphate, for corn or cotton.

Description of Soil.—Probably Orangeburg fine sand. No. 3373—Depth 0″-6″. Located four miles southeast of Argyle, Denton county, on Lewisville and Argyle public road; farm of T. B. Breeding. Sample taken on north side of public road opposite residence of T. B. Breeding. The plot is 280 feet north and south by 112 feet east and west. Lizenby survey, abstract 767. This is a rolling soil of moderate fertility, locally known as "sandy land." It is a light reddish brown sand and produces one-third bale of cotton and 15 bushels of corn per acre. Cotton is the principal crop, although corn is sometimes grown. This land has never been artificially fertilized. The native vegetation is broom sage, green briars, post oak and black jack. This plot does not seep, but other parts of field do. The soil stands drouth extremely well. It does not pack or crack, but crumbles and washes a little. Dirt does not wash onto it. It has been cultivated 25 years and represents one-half of the farm and probably one-fifth of county. No manure has been applied, but weeds plowed under seemed to refresh cotton. The land has a southern slope and the subsoil is redder and the soil poorer at the north end.

No. 3374—Depth 6″-18″. Subsoil to No. 3373.

D. S. Clark, Mexia, Limestone County.—Light colored upland sandy soil with red clay subsoil, 12 miles south of Groesbeck, in cultivation to corn and cotton for about 15 years. Corn planted March 18th and harvested September 10th. Two rows 3 feet 2 inches apart, 540 feet long. Land flat broke, fertilizer bedded on, cultivated flat, laid by on ridge. All plots were damaged by chinch bugs, and also by dry weather. The fertilized plots suffered more from the dry weather than the others. No rain from June 4th until July 7th.

Acid phosphate alone produced results. This is the same as in 1909. For description of soil, see 1909 corn experiments.

Tom O. Plunkett, Marshall, Harrison County.—Dark sandy loam upland soil with clay subsoil, 15 years in cultivation, not cultivated for two years, produces one-half bale cotton or 20 bushels corn. Corn

TABLE NO. 3—Percentage Composition of Soils. Corn, 1909.

	J. B. Griffin, Thornton.		David C. Barr, Raywood.		S. W. Harper, Sanger.		R. Windsor, Buffalo.		T. O. Plunkett, Marshall.		S. B. Blair, Marquez.		D. S. Clark, Mexia.	
	1257	1258 Subsoil	2375	2376 Subsoil.	3124	3125 Subsoil.	3367	3368 Subsoil.	3359	3360 Subsoil.	3250	3251 Subsoil.	3256	3257 Subsoil.
Phosphoric acid	.04	.02	.03	.017	.045	.030	.017	.037	.029	.051	.012	.017	.024	.027
Nitrogen	.10	.10	.14	.082	.086	.069	.047	.055	.041	.031	.034	.040	.075	.056
Potash	.23	.29	.28	.320	.870	.510	.160	.490	.310	.420	.110	.260	.260	.350
Lime	.29	.38	.63	.610	.330	.450	.170	.250	.120	.120	.140	.130	.150	.....
Magnesia	.35	.24	.47	.450	.340	.560	.060	.330	.090	.230	.080	.210	.230	.100
Sulphur trioxide	.....	.....	.12	.060	.040	.020	.090	.090	.100	.080	.110	.130	.110	.100
Alumina Oxide of iron	5.41	9.22	5.36	13.79	10.21	13.34	3.50	19.60	2.25	1.32	2.16	7.45	4.32	7.50
Manganese	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Insoluble and soluble silica	88.34	80.06	78.55	77.37	83.02	77.41	82.01	65.88	95.07	82.01	96.10	87.29	91.49	86.30
Loss on ignition	3.60	7.39	.....	6.22	.....	.....	1.95	7.27	1.92	3.27	1.36	2.80	2.31	2.86
Moisture	1.48	4.00	.....	3.11	.....	.....	.34	2.63	.40	2.26	.17	.98	.93	1.85
Parts per million:														
Active phosphoric acid	14.00	18.00	.....	.....	8.00	7.00	188.00	10.00	12.00	7.00	34.00	8.00	9.00	7.00
Active potash	114.00	124.00	.....	.....	105.00	104.00	155.00	.....	123.00	96.00	.....	88.00	54.00	52.00

planted March 15th and harvested September 3rd. One row per plot, 4 feet apart and 1,120 feet long. Cultivated five times. Only one-half stand was secured and on account of the dry season the test is not considered satisfactory.

For description of soil, see 1909 corn experiment. In 1909 acid phosphate alone produced results.

J. K. Culp, Chandler, Henderson County.—Red sandy loam surface soil with red sandy loam subsoil becoming clay at the depth of two feet. Upland uniform soil six to eight years in cultivation and considered very productive. One-half mile south of Chandler, produces one-half bale cotton and 20 bushels corn. Corn planted March 1st and weighed about September 5th. Four rows 4 feet apart, 280 feet long. Crop was injured by bugs and drought. The weather was so dry that the results must be considered as unsatisfactory. The crop on the plot without fertilizer was a total failure and was cut down. This exaggerates the apparent effect of the fertilizer applications, and makes the fertilizer applications appear to give better results than the quality of the soil warrants.

All the fertilizer applications gave results.

Description of Soil.—Probably Orangeburg fine sandy loam. This soil is low in phosphoric acid, potash, nitrogen and lime, and in active phosphoric acid. Yet it is considered as productive, and produces one-half bale of cotton per acre. However, it only makes 20 bushels corn. The average corn possibility for the active phosphoric acid is 12.5 bushels per acre, the maximum is 31. This soil may be expected to decline in productiveness rapidly, unless steps are taken to prevent it. Legumes should be planted to be grazed off or turned under, and acid phosphate and perhaps potash salts should also be used as fertilizers.

No. 3379—Depth 0″-10″. Farm of J. K. Culp, north of Chandler, Henderson county. On southeast corner of east line of land. The soil is upland, a little rolling and is considered good. It is locally known as "sandy land." It produces one-half bale cotton, 20 bushels corn, and 25 bushels oats per acre. Corn, oats, peas, cotton and truck are grown. The native vegetation is crab grass, burrs and careless weed. The soil is a white sand which dries out quickly but holds moisture well. It packs a little, crumbles, and does not crack on drying. It washes very little and dirt does not wash onto it. Place owned only a short time, so complete information about fertilizers and manures cannot be given. The land has been cultivated from 8 to 20 years. The sample represents 12 or 15 acres on the farm.

No. 3380—Depth 10″-20″. Subsoil to No. 3379. This is a whitish sand.

W. M. Farmer, Rockdale, Milam County.—Light red upland sand with sandy subsoil becoming clay at the depth of 18 inches. The land was just cleared last year and produced 20 bushels corn. Corn planted March 11, and harvested August 22nd. Four rows per plot, 4 feet apart and 280 feet long. Ground was laid off and planted flat and then middles plowed out good and deep, cultivation shallow and flat.

All the fertilizer applications gave results.

The soil is fair in lime and potash, low in nitrogen and phosphoric acid, though better supplied with these than many of the other soils

TABLE NO. 4—Percentage Composition of Soils. Corn Experiments, 1910.

	G. B. Smith, Stephenville		T. B. Breeding, Argyle.		J. K. Culp, Chandler.		W. M. Farmer, Rockdale.		D. I. Crawford, Bethel.		M. G. Atwood, Hillsboro.		W. Rucker, Lingleville.		E. Bishop, Gilmer.		W. T. Bird, Como.	
	3377	Subsoil 3378	3373	Subsoil 3374	3379	Subsoil 3380	3411	Subsoil 3412	3254	Subsoil 3255	3252	Subsoil 3253	3381	Subsoil 3382	3262	Subsoil 3263	3385	Subsoil 3386
Phosphoric acid	.012	.022	.023	.035	.018	.016	.037	.024	.012	.015	.032	.049	.027	.027	.022	.022	.027	.020
Nitrogen	.035	.055	.023	.038	.031	.027	.053	.024	.031	.030	.064	.079	.043	.045	.057	.039	.055	.035
Potash	.230	.770	.140	.420	.120	.110	.120	.110	.090	.220	.240	.360	.140	.180	.100	.250	.680	.070
Lime			.130	.230	.110		.170	.109	.110	.110	.210	.500	.140	.230	.210	.170	.090	.080
Magnesia	.120	.550	.090			.040	.090	.060	.060	.150	.250	.390	.170	.460	.060	.210	.100	.130
Sulphur trioxide	.050	.050	.010	.030	.040	.050	.024	.036	.080	.130	.120	.120	.070	.080	.080	.070	.060	.050
Alumina and oxide of iron	2.300	11.580	2.150	12.240	.810	1.070	1.163		1.170	4.580	5.260	8.130	2.223	8.013	1.730	7.500	3.013	4.810
Insoluble and soluble silica	95.510	76.840	96.240	80.480	97.930	97.760	96.960	98.150	97.660	91.950	8.691	82.230	95.000	84.410	93.890	84.870	93.710	91.890
Loss on ignition	1.240	4.350	.9700	4.030	.850	.770	1.430	.540	.810	1.620	3.050	4.060	1.550	2.770	2.070	2.980	1.750	1.860
Moisture	.660	5.200	.2600	2.900	.130	.150	.290	.140	.200	1.190	1.550	3.080	.590	3.130	.660	3.400	.860	.970
Parts per million:																		
Active phosphoric acid	14.00	6.00	21.00	19.00	16.0	12.0	27.0	12.0	13.0	7.0	17.0	9.0	18.0	18.0	38.0	9.0	18.0	9.0
Active potash	216.00	273.00	89.00	85.00	127.0	73.0	104.0	71.0	54.0	46.0	62.0	72.0	21.0	172.0	106.0	136.0	179.0	67.0

we have studied. It is low in active phosphoric acid, having an average corn possibility of 20 bushels corn per acre. A rotation of crops should be adopted.

Description of Soil.—Probably Norfolk fine sand. No. 3411—Depth 0″-6″. Located one and one-half miles northwest of Rockdale, Milam county, on W. M. Farmer's place. The field is in the S. C. Robinson survey and lies in extreme west of tract joining Tom Murray on north side and Spence Malone on west side.

The soil is well drained upland and considered moderately fertile. It is "new ground" and only one crop (pop corn) has been grown. Land next to it produces 20 bushels of corn per acre. No fertilizer, green crop or manure has been applied. The soil is a gray sand, boggy in very wet seasons and holds moisture well. It does not pack or crack, but crumbles. The underdrainage is good and the land does not wash; very little dirt washes onto it. The sample represents two acres on the farm.

No. 3412—depth 6″-18″. Subsoil to No. 3411. The soil is a whitish sand.

J. D. Boyd and D. I. Crawford, Bethel, Tarrant County.—Sandy loam upland with yellow-red clay subsoil at a depth of 6 inches to 24 inches, Fifty years in cultivation, but rested some. Produces 10 bushels corn. Corn planted March 19th and harvested August 26th. Four rows per plot, 6 feet 6 inches apart and 24 feet long. Plowed with cultivator three times. No. 4 had a bad stand; was near the middle, and the birds got some of it. A flood in April and then frost followed by dry weather damaged the crop. Plot No. 1 was only two rows and had only five pounds acid phosphate instead of ten pounds. (The yield is doubled in the table.)

All the fertilizer applications apparently gave results.

This soil is low in phosphoric acid, nitrogen, potash and lime, also in active phosphoric acid and active potash. It needs rotation of crops, grazing off or plowing under of legumes, the use of phosphates and potash in fertilizers.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3254—Depth 0″-7 to 11″. On farm of D. I. Crawford, Bethel, Tarrant county, on King survey, 14 miles south of Malakoff and one mile northeast of Concord church, known as the Crawford place. The soil is well drained and considered moderately fertile and is known as "sandy land." Corn and cotton are chiefly grown. The native vegetation is black jack and hickory and sedge grass.

In wet seasons cotton takes rust and corn has a red tinge to blades in wet seasons. The soil packs and runs together, crumbles; it does not wash much; dirt does not wash onto it; it crumbles where the subsoil is close. This land has been cultivated 60 years and represents nearly all of farm and county. Cowpeas were plowed under last fall, but effect can not be noticed yet. Years ago, barnyard manure was used and the yield doubled. The surface soil is full of black gravel.

No. 3255.—Depth 11″-22″. Subsoil to No. 3254. The subsoil has rusty spots in it.

TABLE NO. 5—Co-operative Experiments with Corn, 1910.

Plot Number.		Stephenville, Erath county.		Argyle, Denton county.		Mexia, Limestone county.		Marshall, Harrison county.		Chandler Henderson, county.		Rockdale, Milam county.		Bethel, Tarrant county.		Buffalo, Leon county.		Hillsboro, Hill county.	
		Lbs. per plot in shuck	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand
1	20 lbs. acid phosphate	51	89	68	95	65	100	†110	50	216	.....	156	100	88	95	266	100	‡ 144	100
2	20 lbs. acid phosphate, 6 lbs. cottonseed meal	54	89	90	95	50	80	78	50	228	.....	180	100	148	95	300	100	‡ 162	100
3	No fertilizer	35	89	41	96	42	90	121	50	**	.....	133	100	60	95	234	100	150	100
4	20 lbs. acid phosphate, 12 lbs. cottonseed meal	43	94	76	95	51	75	†104	50	†375	.....	212	100	144	80	†240	100	171	100
5	20 lbs. acid phosphate, 6 lbs. cottonseed meal, ½ lb. muriate of potash	32	94	84	95	49	85	99	50	468	.....	205	100	140	95	218	100	159	100
6	20 lbs. acid phosphate, 6 lbs. cottonseed meal, 1½ muriate of potash	43	96	65	92	57	90	100	50	504	.....	205	100	180	95	264	100	157	100
7	Four loads manure	59	82	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	Large spadeful manure per hill	.....	.....	100	99	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	100 lbs. cowpen manure	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	Two loads barnyard manure	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	177	96
8	No addition	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Apparant effect of:																		
	Acid phosphate	16	.....	27	.....	23	.....	—11	.....	200	.....	23	.....	28	.....	32	.....	—6	.....
	16 lbs. cottonseed meal	3	.....	22	.....	—18	.....	—32	.....	12	.....	24	.....	60	.....	34	.....	8	.....
	12 lbs. cottonseed meal	—8	.....	8	.....	—14	.....	—6	.....	148	.....	56	.....	56	.....	—26	.....	17	.....
	½ lb. muriate of potash	—22	.....	—6	.....	—1	.....	* +21	.....	240	.....	25	.....	—8	.....	—82	.....	—3	.....
	1¼ lbs. muriate of potash	—11	.....	—25	.....	+8	.....	* +22	.....	276	.....	25	.....	32	.....	—36	.....	—5	.....

*Damaged more than the others by sand storm. ‡A large pecan tree near plots is believed to have affected Nos. 1 and 2. †About 30 feet (1-10) washed up by heavy rain. **Total failure.

TABLE NO. 6—Percentage Composition of Soils. Corn Experiments, 1910.

	Louis Ely, Avery.		J. M. Slagle, Troup.		C. C. Williams, Detroit.		H. J. Klorres, Velasco.		J. Stephens, Bagwell.		S. A. Wofford, Beeville.		P. Koelemay, Jefferson.	
	3389	3390	3361	3362	3611	3612	3387	3388	3403	3404	3363	3364	2409	2410
Phosphoric acid	.015	.017	.030	.032	.030	.120	.065	.027	.042	.022	.020	.017	.037	.03
Nitrogen	.030	.032	.044	.030	.053	.091	.128	.055	.032	.031	.115	.087	.150	.13
Potash	.120	.150	.290	.380			.370	.820	.190	160	.460	.050	.370	.43
Lime	.130	.130	.140	.150	.270	9.980	.250	.250	.060	.070	.800	.830	.460	.54
Magnesia	.080	.140	.150	.210	.160	.120	.530	1.310	.160	.150	.440	.520	.430	.54
Sulphur trioxide			.050	.080					.010	.030	.120	.140	.120	.10
Alumina and oxide of iron	2.435	5.473	2.170	6.720	6.050	17.840	3.465	10.990	2.580	3.820	6.620	9.180	9.530	11.68
Manganese														
Insoluble and soluble silica	95.630	90.640	95.500	87.700	89.270	46.740		78.470	95.140	94.950	81.870	76.890	76.710	74.06
Loss on ignition	1.380	2.090	1.460	2.140	2.090	7.340	4.810	4.120	1.100	2.830	5.000	5.180	6.720	7.02
Moisture	.420	.740	.460	2.590	1.840	6.820	1.690	3.020	.370	.480	4.820	5.980	5.020	5.51
Parts per million:														
Active phosphoric acid	12.00	8.00	4.00	8.00	8.00	11.00	25.00	12.00	11.00	14.00	27.00	18.00	6.00	24.00
Active potash	114.00	67.00	121.00	138.00	83.00	106.00	140.00	134.00	56.00	74.00	516.00	216.00	150.00	112.00

R. Windsor, Buffalo, Leon County.—Upland, sandy soil, slightly mixed with red clay, red clay subsoil, 55 years in cultivation and produces 20 bushels corn or one-third bale cotton. Corn planted March 18th and harvested September 7th. Four rows per plot, 4 feet apart and 280 feet long. The land was plowed four feet deep, then leveled, cultivated four times with sweeps. All the plots were damaged by rain on January 4th. Acid phosphate gave results. Cottonseed meal is doubtful. Good yields were secured.

For description of soil, see 1909 corn experiments. In 1909 acid phosphate alone gave results.

N. G. Atwood, Hillsboro, Hill County.—Dark gray, fine sand with clay subsoil, first branch bottom; length of time in cultivation unknown. Produces about 20 bushels corn. Corn planted March 14th and harvested September 9th. Four rows per plot, 3 feet apart and 280 feet long. After planting, harrowed with section harrow and plowed twice with heel sweeps on cultivator and harrowed twice. Plot No. 7 was damaged by small wash and plots Nos. 1 and 2 by large pecan tree growing near them, which was nearest to No. 1. Cottonseed meal alone gave results.

This soil is fairly well supplied with potash and lime, and although the phosphoric acid is low, the lime may help it to be less deficient. Nitrogen is fair. Active phosphoric acid is low. According to the experiment, cottonseed meal alone gives results, but the phosphate plot was damaged by a tree near it, and we are inclined to believe that the soil is certainly in need of phosphoric acid to give good results.

Description of Soil.—No. 3252—Depth 0″-9″. Located four and one-half miles northeast of Hillsboro, Hill county, on the farm of M. G. Atwood. Sample taken 400 yards east of the house on the Hanby survey, in bend of Jacks branch, 200 yards west of Brokett's barn. This is considered a soil of moderate fertility and is known as sandy bottom land. Twenty bushels of corn and one-half bale of cotton are produced per acre. Corn and cotton are the principal crops. No fertilizer has been used and no manure until last winter for crop of 1910. Native vegetation is crab grass. The soil does reasonably well in both wet and dry seasons. It packs a little, crumbles, does not crack on drying. It is drained by a branch and washes a little close to hill. Does not know how long soil has been cultivated. It represents 20 acres on farm. No green crops have been plowed under. Some of soil is loose and some much tighter. The land overflows one year in eight or ten.

No. 3253. Subsoil to No. 3252.

P. L. Moore, Guy's Store, Leon County.—Black clay prairie upland soil with clay subsoil. In cultivation about 20 years, but laid out for six years until last year; produces 15 to 20 bushels of corn. Located 300 yards south of Guy's store. Corn planted April 1st and harvested September 8th. Two rows per plot, 3 feet 6 inches apart, and 280 feet long. Run weeder ten days after planting; plowed with cultivator twice then plowed with turning plow. All the plots were injured by drought. Cottonseed meal alone gave results. The acid phosphate plot was on the outside of the corn plot, with weeds about three feet from it. This may account for its low yield.

S. B. Blair, Marquez, Leon County—Medium light sandy loam upland soil with medium red clay subsoil; about 40 years in cultivation and

produces 15 bushels of corn or one-third bale of cotton. Located three and one-half miles northeast of Marquez. Corn planted March 15th and harvested September 13th. Plowed three times with sweep, laid by with large sweep in middle, after that scratcher was run in middle. The condition of plots very good on June 28th, but all plots were affected by a 20 days drought in June.

Results are the same as in 1909 (which see). The acid phosphate gave results, and also the heavy application of cottonseed meal and the potash. For description of soil, see 1909 corn experiments.

W. Rucker, Lingleville, Erath County.—Dark sandy upland soil with clay subsoil; 14 years in cultivation, and produces about 15 bushels of corn. Located 10 miles west of Lingleville. Corn planted March 10th and harvested September 14th. Four rows per plot, 4 feet apart and 280 feet long. It was a very dry season for corn and plots Nos. 1 and 2 especially seemed to suffer from it. None of the applications produced results.

The soil is fair in lime and potash, low in phosphoric acid and nitrogen, and low in active phosphoric acid, with an average corn possibility with phosphoric acid of 12.5 bushels per acre; maximum 31 bushels. Only one of the plots with fertilizer gave a greater yield than the one without fertilizer. Probably another season would give different results, as the soil is no doubt low in phosphoric acid and nitrogen.

Description of Soil.—No. 3381—Depth 0″-7″. Located 10 miles northwest of Lingleville, Erath county, on the farm of W. Rucker. The land is in the west part of Erath county and is situated on the headwaters of the Armstrong—southeast block of the Schafer survey. The soil is level upland, well drained and considered moderately good. It is known as "postoak sandy loam." The land produces one-fourth bale of cotton and 10 to 15 bushels of corn per acre. Corn, cotton, peas and oats are the principal crops. Crab grass is the principal native vegetation. This is a light brown sandy soil, which behaves very well in wet and moderately good in dry seasons. The soil does not pack but crumbles; cracks into small cracks on drying. It washes and dirt washes onto it when it rains heavily. It represents all of the farm and a large part of the county. The drainage from 25 acres drains towards place from which sample was taken. No green crops and no manure have been applied to the soil.

No. 3382—Depth 7″-19″. Subsoil to No. 3381.

Eugene Bishop, Gilmer, Upshur County.—Dark sandy upland soil with stiff red clay subsoil; original growth dogwood; in cultivation six years, and produces about 25 bushels of corn. Located four and one-half miles northeast of Gilmer. Corn planted about March 15th and harvested September 27th. Four rows per plot, 3 feet 6 inches apart and 300 feet long. First plowed deep, plowed shallow three times and hoed once. Abut 30 feet on plots Nos. 1 and 6 was washed up by a heavy rain. The corn was all killed to the ground by a frost on April 27th, but came up to a good stand. The yield was bad on all plots on account of dry weather. There was no rain after June 4th until harvest.

This soil is fair in potash and lime and nitrogen, low in phosphoric acid, fair in active phosphoric acid with an average corn possibility of 20 bushels per acre with active phosphoric acid; maximum 38. Acid phosphate alone produced results.

Description of Soil.—No. 3262—Depth 0″-8″. Four and one-half miles northeast of Gilmer, Upshur county, on Eugene Bishop's farm. Soil taken on south side of residence; it fronts the Gilmer and Pittsburg road. The soil is slightly rolling upland and considered good; it produces one-half bale of cotton and 25 to 30 bushels of corn per acre. Corn and cotton are the principal crops. No fertilizers are used. The native vegetation is oak, pine and hickory. The soil is not of a wet nature and drains readily; it does not pack or crack on drying. It crumbles and washes a little. The land represents three-fourths of the farm and one-half of the county. No green crops and no manure have been applied.

No. 3263—Depth 8″-20″. Subsoil to No. 3262.

W. T. Bird, Como, Hopkins County.—A gray clay upland soil with gray subsoil; in cultivation four or five years, and produces 20 bushels of corn. Located three miles east of Como. Corn planted March 15th, replanted April 15th, and harvested September 28th. Four rows per plot, four feet apart; plowed every eight or ten days until laid by. All plots were damaged by hot winds. Cottonseed meal alone produced results.

Mr. Bird's soil is high in potash, low in lime, fair in nitrogen and low in phosphoric acid and in active phosphoric acid. The failure of acid phosphate to apparently produce results may have been due to soil irregularities.

Description of Soil.—No. 3385—Depth 0″-6″. Located on W. T. Bird's farm, three miles east of Como, Hopkins county, and 13 miles east of Sulphur Springs, and known as the old Sam Harris place. It is on the Jas. Webb survey. The soil is a well lying upland and considered of moderate fertility. It produces one-third bale cotton and 15 to 20 bushels of corn per acre. Corn and cotton are the principal crops. Commercial fertilizers were used once, and they paid very well. The soil is a light loam locally known as "dirt land." The native vegetation is wild collards. The soil runs together in wet seasons and will get tight and hard if not plowed at right time. It dries into clods and cracks on drying if not plowed. The land does not wash and dirt does not wash onto it. It has been cultivated 10 or 12 years, and represents 75 to 80 acres on farm and several hundred acres in the county. No green crops have been plowed under, but manure gave good results. The soil must be broken deep and kept stirred after rains.

No. 3386—Depth 6″-12″. Subsoil to No. 3385. A light brown subsoil.

Louis Ely, Avery, Red River County.—Light colored upland sandy soil with yellow clay subsoil; nine years in cultivation, and produces 20 bushels of corn or one-half bale of cotton. Located one-half mile south of Avery. Corn planted March 21st and harvested October 11th. Two rows per plot, 4 feet apart, 560 feet long. Plowed six times and hoed three times. All plots were injured by drouth. All the fertilizer applications produced results.

This soil is fair in lime and potash, low in phosphoric acid and nitrogen. It should, like many others of these soils, have a rotation of crops on it, in which legumes are plowed under or grazed off, with applications of acid phosphate and perhaps potash.

Description of Soil.—Probably Norfolk fine sand. No. 3389—Depth

0″-6″. Located one and one-half miles south of Avery, Red River county on Lydie and Avery road on farm of Louis Ely. The land is in the northeast corner of the John Harty survey.

This is upland soil of moderate fertility, level, with some mounds, and locally known as light sandy land. It produces one-half bale of cotton, 20 bushels of corn and 30 bushels of oats per acre. Corn and cotton are the chief crops. The native vegetation is crab grass and rag weeds. This land drowns out in wet seasons. The best crops are produced in dry seasons. The soil packs, crumbles, gets hard, and does not crack on drying. There is very little surface drainage and no underdrainage. This land has been cultivated ten years and represents one-half of farm and one-fourth of county. Crab grass is the only green crop that has been plowed under and that seemed to mellow the land. No manure has been applied. Ten loads per acre on similar land helped potatoes and doubled the yield of other crops. This is known as red oak and hickory land. Some pinoaks are on the plot, but none near test.

No. 3390—Depth 6″-18″. Subsoil to No. 3389. Light sandy soil, varying in color and texture.

J. M. Slagle, Troupe, Smith County.—Light colored upland loam, with clay subsoil; about 15 years in cultivation, and produces 20 bushels of corn. Located one and one-half miles southeast of Troup depot. Corn planted March 10th and harvested October 13th. Fertilizer applied in drill 10 days before planting. Four rows per plot, 4 feet 6 inches apart, and 280 feet long. All plots were damaged some by dry weather. Cottonseed meal produced results. Potash is doubtful.

This soil is fair in lime, excellent in potash, but low in nitrogen and phosphoric acid and very low in active phosphoric acid. This is a very productive soil considering the low active phosphoric acid.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3361—Depth 0″-8″. Located one-half mile southeast of Troupe, Smith county, on the farm of J. M .Slagle; on 10-acre block joining negro school and church lot on southeast. Eason Gee section. This is level, well drained upland, considered of moderate fertility. It produces 25 bushels of corn and one-half bale of cotton per acre. It is known as chocolate land. Corn and cotton are the principal crops. The native vegetation consists of oak and hickory. The soil is easily managed when wet and stands drouth well. It does not pack, crack or wash, nor does dirt wash onto it; the soil crumbles on drying. The land has been cultivated 20 years. There are 100 acres of this soil on this farm, and one-half of the county is similar to it. No green crop or fertilizer has been applied; five tons of manure per acre last year doubled the yield of corn.

No. 3362—Depth 8″-20″. Subsoil to No. 3361.

C. C. Williams, Detroit, Red River County.—Dark red sandy surface soil with blue to red clay subsoil, producing 20 to 30 bushels of corn; about eight years in cultivation; one mile north of Detroit. Corn planted April 1st and harvested September 23d. Six rows per plot, 5 feet apart, 187 feet long. All plots damaged by chinch bugs and dry weather. Land near by produced 50 per cent of what it ordinarily does. All the applications produced results.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3611—Depth 0″-10″. Located three-fourths mile northwest of Detroit,

Red River county, on the Caton place, C. C. Williams. Sample taken on south side of farm, part of section 95, R. R. survey.

This is a yellowish red sandy upland soil, considered moderately fertile. It is well drained and produces one-fourth bale of cotton and 20 bushels of corn per acre. Cotton, corn, fruit and vegetables are grown. Place just purchased so owner knows nothing of history. Crab grass, cockleburs and some sage occupy the land. The soil packs a little, but does not crumble or crack on drying. It is well underdrained and stands drouth well. It does not wash nor does dirt wash onto it. The land has been cultivated six to eight years; represents all of farm (10 acres) and is an average for county. No green crops and no manure have been applied. Owner has worked land four or five years.

No. 3612—Depth 10"-20". Subsoil to No. 3611. Dark brown clay.

CORN EXPERIMENTS, INCLUDING THOMAS PHOSPHATE—1910.

H. J. Kloores, Velasco. Brazoria County.—Dark sandy loam soil with dark clay subsoil; in cultivation about 18 years, and produces 15 to 25 bushels of corn. Corn planted March 8th and harvested September 1st. Fertilizer applied in furrow opened with middle buster, sowed with hand and mixed with cultivator. Two rows per plot, 4 feet apart and 518 feet long. A long dry spell in the early spring injured the crop, especially on the fertilized plots. "I ascribe the good yield of the first plot to the fact that peanuts were planted in an adjoining patch, which came up early and gave the corn plenty of room."

Acid phosphate, muriate of potash and Thomas phosphate gave results.

Mr. Kloores also conducted experiments on cotton in 1908 and potatoes in 1909. The cotton results are irregular. In the potato experiment cottonseed meal alone gave results, but the experiment was not considered satisfactory.

This soil contains a fair amount of lime, is well supplied with nitrogen and potash and fairly well with phosphoric acid. It is low in active phosphoric acid.

Description of Soil.—Probably Houston clay. No. 3387—Depth 0"-7". Located northeast of Velasco, Brazoria county, on the farm of H. J. Kloores. Soil taken from Big Slough hill, 10 feet from fence at north end of plum orchard. This is hill land, well drained and considered fertile. It is a black clay soil and produces 15 to 25 bushels of corn and one-half bale of cotton per acre. It is known as Big Slough soil. Corn and cotton are grown. No fertilizer has been applied. The soil gets too wet in the wet season and dries out quickly in dry. Soil does not pack or crack; crumbles, washes a little by big rains, and dirt does not wash onto it. The land is occupied by crab grass. It has been cultivated 17 years and represents five acres on the farm. No green crop and no manure has been used. The soil is easy to wet but dries out quickly.

No. 3388—Depth 7"-20". Subsoil to No. 3387. Brown loam subsoil.

Joe Stephens, Bagwell, Red River County.—Sandy loam upland soil, inclined to be hilly, with red clay subsoil; in cultivation from 12 to 15 years, and made 40 bushels of corn and 1000 pounds seed cotton when fresh, but now makes 18 bushels of corn or 500 pounds seed cotton. Corn planted March 21st and harvested September 20th. Four rows

per plot, 3 feet 6 inches apart and 280 feet long. All plots were damaged some by dry weather. The plants grew faster where the cottonseed meal was used, and the stalks were larger, but the corn was injured more by the drouth and appeared to suffer quicker than the other.

Acid phosphate alone gave results.

This soil is low in lime, fair in potash, low in nitrogen and phosphoric acid, though not as low as some of the others. It is low in active phosphoric acid and also in active potash.

Description of Soil.—Probably Orangeburg fine sandy loam. No. 3403—Depth 0″-6″. Two miles northwest of Bagwell, Red River county, in John Robin survey, on the farm of Joe Stephens. This is a rolling, well drained, red sandy upland soil and considered moderately fertile. It is known as sandy land. Cotton, corn and sweet potatoes are grown. The land will produce one-fourth bale of cotton, 15 bushels of corn and 15 bushels of oats per acre. No fertilizer has been used. The native vegetation consists of cockleburs and crab grass. The soil is very slow drying and stays loamy and moist in dry seasons. The soil does not pack, crack, crumble, nor does dirt wash onto it. It washes to some extent, however. The land has been cultivated 10 to 15 years. No green crops have been plowed under. Several loads (to the acre) of manure produced good results.

No. 3404—Depth 6″-15″. Subsoil to No. 3403. Reddish sandy subsoil.

S. W. Wofford, Beeville, Bee County.—Black upland soil with clay subsoil, 12 years in cultivation and producing 20 bushels corn and one-half bale cotton. Two and one-half miles northeast of Beeville. Corn planted February 23rd, harvested August 12th. Fertilizer was not received until corn was planted, when a furrow was plowed by rows with a turning plow; fertilizer distributed. Four rows per plot, three and one-half feet apart and 280 feet long. Harrowed several times, one cultivation every ten days or as near that as conditions would allow until the corn was blown down on May 2nd.

Cottonseed meal gave no returns. Phosphoric acid and muriate of potash were both effective.

This soil is well supplied with lime, potash and nitrogen, but low in total phosphoric acid. It is also comparatively low in active phosphoric acid, having an average corn possibility of 20 bushels per acre, and a maximum of 39 bushels.

Description of Soil.—No. 3363—Depth 0″-9″. Located two and one-half miles northeast of Beeville, Bee county, on farm of S. A. Wofford. Sample taken from field west of windmill. This is well drained, rolling upland soil, considered good soil and produces 20 bushels corn and one-half bale cotton per acre. It is locally known as black land. Corn and cotton are the principal crops. No fertilizers have been applied. The native vegetation is mesquite grass. The soil does not pack, but dries into clods and cracks on drying. The underdrainage is good. It does not wash and dirt does not wash onto it. The land has been cultivated 12 years, and represents one-half of farm.

No. 3364—Depth 9″-22″. Subsoil to No. 3363.

Peter Koelemay, Nederland, Jefferson County.—Yellowish black clay surface soil with similar subsoil, produces 10 to 20 bushels corn, 12 years in cultivation. Slopes 4 feet to the mile, used for rice three years.

TABLE NO. 7—Co-operative Experiments With Corn, 1910.

Plot Number.		Guy's Store, Leon county.		Marquez, Leon county.		Lingleville, Erath county.		Gilmer, Upshur county.		Como, Hopkins county.		Avery, Red River county.		Troup, Smith county.		Detroit, Red River county.	
		Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand	Lbs. per plot	Stand.
1	20 lbs. acid phosphate	48	90	84	65	198	95	270	95	125	.....	196	90	271	90	110	90
2	20 lbs. acid phosphate, 6 lbs. cottonseed meal	83	90	84	51	194	95	256	100	165	.....	196	90	279	90	116	90
3	No fertilizer	65	90	56	61	206	95	240	100	152	.....	184	90	296	90	103	95
4	20 lbs. acid phosphate, 12 lbs. cottonseed meal	79	90	148	55	204	95	269	100	195	.....	360	90	318	90	151	95
5	20 lbs. acid phosphate, 6 lbs. cottonseed meal, ½ lb. muriate of potash	77	90	144	71	208	95	238	100	110	.....	228	90	331	90	126	95
6	20 lbs. acid phosphate, 6 lbs. cottonseed meal, 1¼ lbs. muriate of potash	78	90	140	67	204	95	229	90	175	.....	360	90	255	90	117	90
7	4 loads manure	.....	.....	208	61	198	95	.....	.....	150	.....	368	90	326	90	.....	.....
7	Large spadeful manure per hill	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	100 lbs. cowpen manure	.....	.....	.....	.....	190	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	Two loads barnyard manure	.....	.....	.....	.....	182	95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	No addition	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Apparent effect of:																
	Acid phosphate	—17	.....	28	.....	—8	.....	30	.....	—27	.....	12	.....	—25	.....	7	.....
	16 lbs. cottonseed meal	35	.....	.....	.....	—4	.....	—14	.....	40	.....	.....	.....	8	.....	6	.....
	12 lbs. cottonseed meal	31	.....	64	.....	6	.....	—1	.....	70	.....	164	.....	47	.....	41	.....
	½ lb. muriate of potash	—6	.....	60	.....	14	.....	—18	.....	—55	.....	32	.....	52	.....	10	.....
	1¼ lbs. muriate of potash	—5	.....	56	.....	10	.....	—29	.....	10	.....	164	.....	—24	.....	1	.....

Laguna corn planted April 8th. Seed furnished by Chamber of Commerce, Beaumont.

Acid phosphate had a decided effect. Thomas phosphate had some effect. For analyses of soil see under potato experiments.

This soil is well supplied with lime, potash and nitrogen, but is low in phosphoric acid and in active phosphoric acid. The following are the results of a pot experiment with corn in 1910 on the subsoil (2410).

Additions	Grams Corn Per Pot
Phosphoric acid, potash, nitrogen	36.0
Phosphoric acid, potash nitrogen, lime	40.5
Phosphoric acid, nitrogen	38.5
Phosphoric acid, potash	31.5
Potash, nitrogen	8.0

The subsoil in pots is thus strongly in need of phosphatic fertilizers, although it contains more active phosphoric acid than the surface soil.

No. 2409—Surface soil. Depth 0″-4″. From Nederland, Jefferson County, on farm of Koelemay Bros. This is a well drained upland soil and produces 2,800 pounds of rice and 15 bushels corn per acre.

No. 2410—Depth 4″-15″. Subsoil to No. 2409.

TABLE NO. 8—Co-operative Fertilizer Experiment with Corn (Special), 1910.

Plot No.		Velasco, Brazoria county.		Bagwell, Red River county.		Beeville, Bee county.		Nederland, Jefferson county.	
		Weight corn	Stand	Weight corn	Stand	Weight corn	Stand	Weight corn	Stand
1	20 lbs. acid phosphate	339	100	160		129	95	70	
2	20 lbs. acid phosphate, 6 lbs. cottonseed meal	284	100	164		130	95		
3	No application	280	100	104		108	95	50	
4	20 lbs. acid phosphate, 12 lbs. cottonseed meal	307	100	136		126	95	54	
5	20 lbs. Thomas phosphate	288	100	120		145	95	52	90
6	20 lbs. acid phosphate, 6 lbs. cottonseed meal, 1½ lbs. muriate of potash	311	100	140		135	95	58	
7	20 lbs. acid phosphate, 3 lbs. muriate of potash							48	
	Apparent effect of:								
	Acid phosphate	59		54		21		20	
	6 lbs. cottonseed meal	−55		4		1			
	12 lbs. cottonseed meal	−32		−24		−3		−16	
	1½ lbs. muriate of potash	27		−24		5		−22	
	Thomas phosphate	4		−44		−15		2	

CONCLUSIONS FROM THE 1910 CORN EXPERIMENTS.

The season of 1910 was somewhat better for corn than the previous seasons, although a number of the experiments suffered from dry weather.

Twenty-one experiments are reported. Fifteen reported increases due to acid phosphate, and six, decreases, the latter being located at Marshall, Hillsboro, Lingleville, Como and Troup. The test at Marshall was not considered satisfactory on account of the dry weather. The acid phosphate plot at Hillsboro was injured by a large pecan tree. The

acid phosphate plot at Lingleville appeared to suffer more from the drouth than the others (except No. 2). No reason is given for the effect at Como or Troup, though these crops were damaged by hot dry winds, or drouth.

Cottonseed meal (6 pounds or 12 pounds, both) produced increases in 12 of 21 tests. Eleven of the experiments may be considered to show need of nitrogen as shown by the effect of cottonseed meal.

These increases are large, on an average. The application of 12 pounds of cottonseed meal, where it is effective, produces a much greater increase than the six pounds. In 10 of the 21 experiments, cottonseed meal had practically no effect, or else caused an apparent decrease. This decrease may have been due to stimulation of the growth of foliage and consequent greater injury by drouth than in previous seasons.

Potash produced apparent increases in the crop in 11 tests, but the increase is apparent rather than actual at Marshall, Lingleville and Velasco, since the crop with acid phosphate or with no fertilizer was greater than the crop which received the complete fertilizer.

This leaves eight experiments in which potash was successful, and the increase was slight in two of these. The test at Marshall was claimed to be unsatisfactory on account of the dry weather.

TABLE NO. 9—Average Results of Corn Co-operative Experiments, 1910.

	Number of		Net average increase + or decrease —
	Increases.	Decreases.	
Acid phosphate	11	6	+20
6 lbs. cottonseed meal	11	4	+11
12 lbs. cottonseed meal	12	5	+38
½ lb. muriate of potash	8	9	+15
1¼ lb. muriate of potash	10	7	+29

From these experiments it would seem that though the use of potash as a fertilizer is at present not necessary on many Texas soils, there are some soils on which its use is profitable in a good season. One-half pound of muriate of potash gives as good results as one and one-quarter pounds in most of the experiments.

TABLE NO. 10—Summary of Corn Experiments.

	1908	1909	1910	Total
Number of experiments—total	3	13	21	37
Number showing gain by acid phosphate	3	13	15	31
Number showing gain by cottonseed meal	1	5	11	17
Number showing gain by potash	.....	4	8	12
Average weight of ear corn gained when a gain occurred; in pounds per plot				
By acid phosphate (20 lbs.)	44	43	39	.....
By cottonseed meal (3 lbs.)	3	46	.....	.....
By cottonseed meal (6 lbs.)	.....	.....	19	.....
By cottonseed meal (10 lbs.)	8	24	.....	.....
By cottonseed meal (12 lbs.)	.....	.....	64	.....
By muriate of potash (½ lb.)	.....	20	53	.....
By muriate of potash (1¼ lbs.)	.....	17	71	.....

In nine of the 21 experiments, manure was applied to one of the plots. In six of these tests the manure gave better results than any of the fertilizer applications, and in one other case it was nearly as great. In the other two experiments it had little effect. We believe this favorable action of the manure to be due not only to the plant food it carries, but to its favorable action upon the physical character of the soil. Many Texas soils need the vegetable matter such as is carried by manure, or by green crops or crop residues turned under.

Thomas phosphate was used in four of the tests. Its effect was considerably less than that of acid phosphate in each case.

GENERAL RESULTS OF THE CORN EXPERIMENTS 1908-9-10.

The experiments were conducted three years, two seasons being somewhat unfavorable, and the other not altogether favorable, though in some sections of the State there were good seasons in all years.

The results of the experiments are summarized in Table 10. We find that acid phosphate produced increases of ear corn in at least 31 of the 37 experiments. It is, under our present conditions, most generally effective on corn, especially in a dry season.

Cottonseed meal produced favorable results in 17 of the 37 experiments. Under more favorable seasonal conditions it would probably have made a better showing. Under conditions which would have allowed a larger production, the draft of the plant for nitrogen would have been heavier and the showing different. Where cottonseed meal did give results, 10 or 12 pounds gave better results than three or six pounds.

Potash gave results in 12 of the 37 tests, or about one in three. Where it was effective the average increase was quite large, but the larger application was not as profitable as the smaller one. Perhaps in more favorable seasons potash would have made a better showing.

THE CHEMICAL COMPOSITION OF THE SOILS.

The chemical composition of many of the soils used in the co-operative fertilizer experiments is presented in tables preceding. Most of these soils were low in phosphoric acid and many were low in nitrogen.

Nitrogen.—In Table 11 we show the percentages of nitrogen found in the soils and subsoils, dividing them into two groups, those which gave gains in the field experiments and those which did not. The quantity of nitrogen which can be taken up by plants depends as well upon the activity of the bacteria in the soil, which transforms the inert nitrogen into active forms, as on the quantity of nitrogen present. This bacterial activity depends upon a number of factors, as the nature of soil, temperature, moisture conditions, cultivation, etc. (See Bulletin 106 of this station.) We cannot expect, therefore, the total nitrogen of the soil to be in any exact degree of relation to the need of the soil for nitrogenous fertilizers, on account of these other significant factors.

We find, on examination of the table, that there are ten soils in each group which we subjected to analysis. There are two soils omitted from the first group, that from Chandler, because the crop with no application was cut down, and that from Troup, in which there was evidently a

mistake, as the crop is larger than the productiveness of the soil previously reported would warrant.

We find that the soils in the first group were less productive, on an average, than those in the second, though, of course, we must not forget that nitrogen may not have been the controlling factor. The soils which did not give gains with nitrogen contain, on an average, nearly 50 per cent more nitrogen in the surface soil than those which responded to the nitrogen as represented by cottonseed meal and 12 per cent more nitrogen in the subsoil. As we have already stated, the dry seasons had something to do with the effect of the nitrogen, and there are also irregularities in plot experiments. To judge from these figures, however, soils are less liable to respond to nitrogen the more nitrogen they contain.

TABLE NO. 11.--Corn 1908-10.—Relation to Total Nitrogen of Soil.

		Weight of corn on plots.		Per cent nitrogen.	
		No. nitrogen.	Average gain due to nitrogen.	In surface soil.	In subsoil.
1909	Barr, Raywood, corn	98	+30	.140	
	Harper, Sanger, corn	15	+12	.086	.069
	Blair, Marquez, corn	122	+15	.034	.040
	Breeding, Argyle, corn	41	+15	.023	.038
	Farmer, Rockdale, corn	133	+40	.053	.024
	Crawford, Bethel, corn	60	+58	.031	.030
	Atwood, Hillsboro, corn	150	+12	.064	.079
	Baird, Como, corn	152	+55	.057	.039
	Ely, Red River, Avery corn	184	+82	.030	.030
	Slagle, Troupe, corn	296	+28	.044	.030
	Williams, Detroit, corn	116	+24	.050	.150
	Average	124.3	33.7	.056	.053
	P. Koelemay, Nederland	50	—16	.150	.130
	Griffin, Thornton	116	—44	.100	.100
	Windsor, Buffalo	172	—13	.050	.060
	Plunkett, Marshall	106		.040	.030
	Clark, Mexia	27	—8	.075	.056
	Kloores, Velasco	280	—44	.128	.055
	Stevens, Bagwell	104	—10	.032	.031
	Wofford, Beeville	108	—1	.115	.087
	Smith, Stephenville	35	—5	.035	.055
	Rucker, Lingleville	206	+1	.043	.045
	Bishop, Gilmer	240	—8	.055	.035
	Average	131	—13.5	.075	.062

Phosphoric Acid.—In Table 12 we show the relation between the active phosphoric acid in surface and subsoil and the effect of acid phosphate in the plot experiments. Let us remember that we must allow for irregularities due to seasonal conditions inherent in plot experiments.

Where less than 10 parts per million of active phosphoric acid were present two of the soils showed gains with phosphoric acid, and one did not. The latter soil gave a very high yield for a soil which contains such low quantities of phosphoric acid, and we are inclined to believe there is some mistake in the sample. The average gain with the two plots is 23 pounds per plot, or about four bushels per acre. With more favorable weather conditions the yield would undoubtedly have been larger.

With soils containing 10 to 20 parts per million of phosphoric acid, six of the nine soils gave increases with phosphoric acid, the average increase being 38 pounds per plot, or about six bushels per acre. The average

yield without phosphate on the six plots which gave increases is 101 pounds per acre, or about 17 bushels corn per acre.

There were four soils containing 20 to 30 parts per million of active phosphoric acid, and all four responded to applications of acid phosphate, on an average 32 pounds per plot, or a little over five bushels. The average yield without phosphate is 141 pounds per plot, or about 24 bushels per acre.

TABLE NO. 12—Active Phosphoric Acid of Soil as Related to Crop.

	Total phosphoric acid.	Active phosphoric acid.		Crop without acid phosphate—lbs.	With acid phosphate—lbs.	Gain per plot—lbs.
	Per cent surface soil	Surface	Subsoil			
Harper, Sanger	.045	8.2	6.5	15	39	24
Clark, Mexia	.024	8.8	7.1	40	62	22
Average					50	23
Griffin, Thornton	.040	14.0	8.0	116	200	84
Plunkett, Marshall	.030	11.7	7.0	106	141	35
Smith, Stephenville	.012	14.1	6.4	35	51	16
Crawford, Bethel	.012	13.5	6.5	60	88	28
Atwood, Hillsboro	.032	10.0	17.0	150	144	
Rucker, Lingleville	.027	18.2	18.2	206	198	
Bird, Como	.027	18.2	8.8	152	125	
Ely, Avery	.015	12.1	8.2	184	196	12
Stephens, Bagwell	.042	11.2	14.1	104	160	56
Average					139	38
Breeding, Argyle	.023	20.6	19.4	41	68	27
Farmer, Rockdale	.037	27.0	12.4	133	156	23
Klorres, Velasco	.065	25.1	12.4	280	339	59
Wofford, Beeville	.020	27.1	18.2	180	129	21
Average					173	32
Blair, Marquez	.012	34.7	7.6	92	118	26
Trapp, Seabrook	.024	32.4	10.0			
E. Bishop, Gilmer	.022	32.8	8.6	240	270	30

In Bulletin 126 of this Experiment Station we presented a table showing the average and maximum possibility of corn production per acre of a number of soils, based upon the quantity of phosphoric acid removed from the soil by corn in pots, and on the needs of corn for phosphoric acid. The assumption was made that the corn fed to the depth of eight inches. If the roots penetrate deeper the corn possibility is thus greater. Further, the corn in the field has a longer period of growth than that in pots. The corn in the pots received potash and nitrogen. (See Table 13.)

The effect of phosphoric acid in our plot tests was estimated by comparing the "no fertilizer plot" with the phosphate plot. The limiting condition in the plot tests might be nitrogen or potash, and hence the actual effect of phosphate is more pronounced in the pot experiments than in the field tests.

The results of the pot and field experiments are thus not strictly comparable, but nevertheless the comparison yields results of interest. This is made in Table 13.

The corn production in the field was thus greater than the average corn possibility found in the pot experiments, but not so great as the

maximum. So many other factors besides the composition of the soil enter into the field experiments that we cannot expect close agreement, but must consider the other factors. In a more favorable season the production in field experiments would have been much greater and the difference more marked.

TABLE NO. 13—Comparison of Pot and Co-operative Field Experiments.

Parts per million of active phosphoric acid in soil.	Pot experiments, corn equivalent in bushels per acre.		Plot experiments, yield in bushels per acre.	
	Average.	Maximum.	No fertilizer.	Effect of acid phosphate.
			Average.	Average.
0–10	4.5	9	4.5	4
10–20	12.5	31	17.0	6
20–30	20.8	36	24.0	5

We hope to go into the relation between the pot and field experiments, and the chemical composition of the soil, more fully when we have accumulated more data on the subject.

EXPERIMENTS ON COTTON.

The plan of experiment for cotton was the same as for corn (which see).

RESULTS OF 1908 TESTS WITH COTTON.

C. G. Wuthrich, Taylor, Williamson County.—Moderate upland soil, producing 20 bushels corn, or one-quarter bale cotton, in cultivation 19 years. The first picking was made on September 8th, the second on October 6th. The results are given in Table 14. All crops were good this season, whether manure was used or not. Barnyard manure gave very good results. This soil is a black soil.

Cottonseed meal alone had effect.

Mr. Wuthrich also carried out an experiment with cotton in 1909, likewise with unsatisfactory results from the applications.

These soils are high in lime, well supplied with potash and fairly well supplied with nitrogen. Soil No. 2169 is well supplied with phosphoric acid, soil No. 2171 is low. Soil No. 2169 also contains much more active phosphoric acid than soil No. 2171.

We are inclined to believe that the trouble with this soil is due more largely to poor physical character than to lack of plant food. If its physical character were improved perhaps fertilizers would then be effective. The good effect that barnyard manure has is probably due largely to the vegetable matter which it contains, which improves the physical character of the soil. This soil should have a rotation of crops, in which legumes are grown and plowed under or grazed off. Such treatment would improve its physical character decidedly.

Description of Soil.—Probably Houston clay. No. 2169—Depth 0″-12″. Taylor, Williamson county, on C. G. Wuthrich's farm, soil No. 1. One-fourth bale cotton and 20 bushels corn are produced on this soil. It is well drained, rolling land with a southeast slope. The soil

is a black fine sandy loam which remains wet for some time after rains. Cotton dies on this land.

No. 2170.—Depth 12″-21″. No change in color between soil and subsoil. Subsoil to No. 2169. Black fine sandy loam.

No. 2171—Depth 0″-12″ (change of color at 8″). Soil No. 2. Taylor, Williamson county, on farm of C. G. Wuthrich. This is well drained rolling black, very fine sandy loam, which produces one-quarter bale cotton and 20 bushels corn per acre. This soil remains wet after rains.

No. 2172—Depth 12″-21″. Subsoil to No. 2171. A light brown, very fine sandy loam.

Jesse Henry, Bryan, Brazos County.—Stand perfect. Results are in Table 14. This soil evidently needs acid phosphate at present, more than anything else. The experiment does not show whether cottonseed meal would or would not be profitable. The potash had little or no effect.

J. M. Peters, Bryan, Brazos County.—Unable to work cotton properly on account of sickness. Fertilizer was put in when cotton was two weeks old. Red River county long staple cotton. Each plot was two rows 56 feet long. Potash alone was effective.

J. H. Faison, Marquez, Leon County.—Cotton was hurt some by drouth. Two rows, 280 feet long.

TABLE NO. 14—Co-operative Experiments on Cotton, 1903.

Plot No.	Addition.	Taylor, Williamson county.			Bryan, Brazos county.	Bryan, Brazos county.	Marquez, Leon county.
		First picking	Second picking.	Total	Total weight, pounds.		
1	Acid phosphate	28	25	53	118	48	40
2	No addition	29	25	53	92	48	29
3	Acid phosphate and 3 lbs. cottonseed meal	29	28	57	102	48	43
4	Acid phosphate and 10 lbs. cottonseed meal	29	27	56	119	51	46
5	Acid phosphate, 3 lbs. cottonseed meal and 2 lbs. kainit	28	28	56	120	53	41
6	Acid phosphate, 3 lbs. cottonseed meal, and 5 lbs. kainit	29	28	57	124	58	42
7	No addition	29	28	57	.....	.....	.....
	Apparent effect of:						
	Acid phosphate	.....	.....	—1	26	.....	11
	3 lbs. cottonseed meal	.....	.....	4	—16	.....	3
	10 lbs. cottonseed meal	.....	.....	3	1	3	6
	2 lbs. kainit	.....	.....	—1	2	2	—2
	5 lbs. kainit	.....	.....	.....	2	5	—1

H. J. Klorres, Velasco, Brazoria County.—This experiment was somewhat different from the others, and although carried out very carefully by Mr. Klorres, the soil is irregular and contains spots on which the cotton does not do well. The results, therefore, are not conclusive, and the details of the work will not be reported. The cotton made a rank growth, excepting on the so-called alkali spots, some of which were replanted two or three times. No crop on this soil for the last three years. Five pickings were made, August 28th, October 1st, October 15th, November 10th and November 24th.

Experiment of H. J. Kloores, Velasco, Brazoria County.

	First picking.	Second picking.	Third picking.	Fourth picking.	Fifth picking.	Total.
20 lbs. cottonseed meal	20	34	16	10	4	84
No addition	19	54	17	8	3	101
20 lbs. cottonseed meal and 20 lbs. acid phosphate	6	36	15	10	4	71
No addition	9	32	15	10	5	71
20 lbs. acid phosphate and 6 lbs. muriate of potash	12	35	17	9	3	76

Mr. Klorres also made experiments with corn in 1910 and potatoes in 1909. For analyses of soil see under corn 1910.

CONCLUSIONS FOR THE COTTON 1908 EXPERIMENTS.

Six reports were received on the 1908 cotton experiments, but one was practically a report on earliness, and one was so irregular as to be of little value. Of the remaining four, acid phosphate gave increases in two cases, no change in two. Cottonseed meal gave increases in three experiments, the larger applications giving slightly better results. Kainit gave increases in two experiments, the larger application giving the heavier increase.

EXPERIMENTS ON COTTON, 1909.

The plan of the experiments was the same as in 1908.

Bartlett Brothers, Malakoff, Henderson County.—Light sandy soil with clay subsoil. No exact weights given, but they state that one-half bale per acre was secured with the fertilizer and one-fifth bale on adjoining land.

D. A. Willis, Milford, Ellis County.—White upland soil with clay subsoil, known locally as white rock or mountain land, cultivated 15 years. Produces one-third bale cotton. Barnyard manure increases yield 40 per cent. Dry weather reduced the yield considerably.

All applications had some effect.

John Stanfield, Scurry, Kaufman County.—Dark gray sandy upland, with stiff red clay subsoil, 14 years in cultivation. Produces 25 bushels corn and one-third bale cotton. Boll weevils appeared in first forms, but dry weather killed them and the cotton also. The applications had some effect.

This soil is fair in lime, low in potash, nitrogen and phosphoric acid. It contains 38 parts per million of active phosphoric acid, which gives it an average corn possibility for phosphoric acid of 20 bushels per acre, maximum 37 bushels. This soil needs phosphatic fertilizers, but it also needs vegetable matter and nitrogen, and it should have a rotation of crops, with legumes grazed off or plowed under on it.

Description of Soil.—No. 3351—Depth 0″-8″. Three miles southeast, Scurry, Kaufman county, on northeast corner of farm of John Stanfield, R. F. D. No. 2, Box 10. This is nearly level upland, fairly well drained, known as sandy or timber land and considered moderately fertile, 10 bushels corn and one-third bale cotton being produced per acre. Corn, cotton, potatoes and peanuts are grown. The native vegeta-

tion consists of sedge grass and timber. The best crops are grown when the soil is rather wet; when dry, there is almost a failure. The soil packs, crumbles and cracks in the subsoil. The underdrainage is bad. The land washes where it is rolling; dirt does not wash onto it. The land has been cultivated 15 years; it represents 80 per cent of this farm and thousands of acres in county. No fertilizer, green crops or manure have been used on this plot. The soil is similar to other timber land.

No. 3352—Subsoil of No. 3351, 8"-16".

Harry Simms, Ladonia, Fannin County.—Gray sandy poor upland, with clay subsoil 6 inches from surface, 30 years in cultivation and produces one-fifth bale cotton. Conditions for the crop unfavorable, injured by plant lice and drouth.

All applications were effective.

C. M. Loving, Lindale, Smith County.—Light red upland sand with yellow clay subsoil, 18 to 20 years in cultivation and produces 550 pounds seed cotton.

Acid phosphate and cottonseed meal were effective.

W. E. Harvey, Arlington, Tarrant County.—Light red sandy loam upland, with clay subsoil, produces one-third to three-quarters bale cotton. There was never enough rain to wet the ground much after the cotton was planted. Does not consider it a fair test. The land was thoroughly broken. Other land with manure made a better crop.

All applications were effective.

Lola Lewis, Dawson, Navarro County.—Dark tight sand, rolling upland, with chocolate clay subsoil. In cultivation 15 years in oats, corn. Depth 8 inches. Produces one-half bale cotton, 30 bushels oats. Conditions abnormal, no good rain from planting to harvest. Did not make one-quarter crop on any land on account of drouth. One hundred pounds acid phosphate with 50 pounds cottonseed meal has increased yield from one-half bale per acre to three-quarters bale, the increase thus being one-quarter bale.

All applications were effective.

G. S. Smith, Stephenville, Erath County.—Dark sand with red clay subsoil; cultivated five years. Produces 25 bushels of corn. Too dry to plant corn, so planted cotton. He regards the high relative yields of plots 5, 6 and 2 as due to better soil.

Cottonseed meal was alone effective. For analysis of soil, see corn, 1910.

J. H. Powell, Augusta, Houston County.—Red sand, branch bottom, with clay subsoil; eight years in cultivation; produces 20 bushels of corn.

Acid phosphate and cottonseed meal were effective.

John B. Griffin, Thornton, Limestone County.—The pickers mixed the cotton of the second picking, so that only the first picking could be reported as given in the table. Acid phosphate gives the best results so far as the experiment goes.

See also experiments with corn in 1908 and potatoes in 1910.

C. G. Wuthrich, Taylor, Williamson County.—Black moderate upland; 19 years in cultivation; produces 20 bushels of corn or one-fourth bale of cotton. None of the fertilizer had any effect, though the season was bad and he had to replant three or four times. Barnyard manure seems to give better results than any fertilizer. No report of yields.

TABLE NO. 15—Percentage Composition of Soils. Cotton Experiments.

	C. G. Wuthrich, Taylor.		C. G. Wuthrich, Taylor.		J. Stanfield, Scurry,		J. H. Gatlin, Burleson.		A. S. Van Kirk, Bonham.		W. T. Jordan, Hughes Springs.		W. H. Harrison, Como.		A. J. Spencer, Alvord.	
	2169	2170 Sub-soil.	2171	2772 Sub-soil.	3351	3352 Sub-soil.	3209	3210 Sub-soil.	3399	3400 Sub-soil.	3349	3350 Sub-soil.	3428	3429	3416	3417
Phosphoric acid	.090	.060	.030	.03	.025	.031			.095	.08	.015	.007	.015	.027	.02	.02
Nitrogen	.119	.096	.105	.06	.043	.048	.022	.018	.120	.08	.023	.025	.037	.036	.05	.05
Potash	.540	.500	.310	.38	.140	.340			.180	.24	.170	.090	.140	.140	.29	.48
Lime	4.080	5.310	4.400	7.38	.260	.480			.310	.32	.120	.120	.107	.080	.12	.19
Magnesia	1.580	1.080	.750	.81	.140	.470			.210	.29	.070	.090	.060	.070	.15	.43
Alumina and oxide of iron	16.140	17.860	13.680	13.10	2.730	13.170			7.210	9.86	1.410	3.170	1.560	1.750	2.28	8.60
Manganese																
Insoluble and soluble silica	62.360	59.020	67.710	62.57	94.200	75.660			84.650	81.69	97.490	94.830	97.260	97.130	95.80	85.72
Loss on ignition					1.920	5.060			4.830	4.18	.770	1.140	1.000	.820	1.29	2.99
Moisture					.700	4.290			2.180	3.00	.180	.490	.150	.100	.39	1.63
Parts per million:																
Active phosphoric acid	76.00	70.00	46.00	29.00	38.00	11.00	14.00	5.00	18.00	10.00	24.00	7.00	38.00	7.00	2.00	8.00
Active potash	332.00	179.00	198.00	91.00	155.00	98.00	91.00	54.00	80.00	63.00	75.00	154.00	126.00	111.00	164.00	161.00

See experiment in 1908 for analyses of soils.

R. M. Nall, Bryan, Brazos County.—Dark sandy upland prairie soil, with blue clay subsoil. One year in cultivation and produces 30 bushels of corn and one-fourth bale of cotton. Planted March 23d, replanted April 10th. Poor results on account of boll weevil. Stalks grew six feet high where fertilized.

Acid phosphate alone was decidedly effective, though potash had some effect.

A. S. Van Kirk, Bonham, Fannin County.—Black sandy upland, prairie soil, with dark clay subsoil; cultivated 20 years and produces one-fourth bale of cotton. Acid phosphate was effective, and perhaps some results from potash.

This soil is well supplied with potash, phosphoric acid and nitrogen and lime, though low in active phosphoric acid. It evidently needs vegetable matter plowed under on it, with rotation of crops. Legumes should be grown and either plowed under or grazed off, and some acid phosphate should also be applied. The moisture in this soil should be conserved by frequent, shallow cultivation during the growing season.

Description of Soil.—No. 3399—Depth 0″-9″. One mile north of Bonham, Fannin county, on Russell Heights addition to Bonham on Burkhart survey. The land is on Broad and Brenard streets, owned by A. S. Van Kirk. This is slightly rolling, well drained, upland prairie soil, known as sandy land, and is considered poor, one-fourth bale of cotton being produced to the acre.

Corn and cotton are the chief crops. The soil is a black clay, which supports a native vegetation of wire grass and seems to grow an excess of weeds in wet seasons. In dry seasons the balance is better. The soil packs, drys into clods, cracks when very dry and becomes very hard. It washes very little and dirt does not wash onto it. The land has been cultivated 25 years; represents the entire farm and 15 square miles of county. No green crop has been plowed under, but a small amount of manure has been used with little benefit. On similar soil acid phosphate, kainit and cottonseed meal were used. Acid phosphate secured one-third better yields. The soil gets tight after rains. It does not fruit cotton properly.

No. 3400—Depth 9″-21″. Subsoil to No. 3399. Dark brown clay loam.

D. M. Foster, Carthage, Panola County.—Dark upland soil with clay subsoil; three years in cultivation to corn and cotton; produces one-half bale of cotton. A bad rain after planting washed some rows. Cottonseed meal and acid phosphate were effective.

J. H. Gatlin, Burleson, Johnson County.—Sandy upland soil, with clay subsoil; 17 years in cultivation, and producing 20 bushels of corn and 700 pounds of cotton. Land grew fine peanuts in 1908. Cotton planted April 24th, was killed by sandstorm and replanted two weeks later. No rain, except light showers, from October, 1908, to October, 1909. Acid phosphate alone was effective.

This soil is low in nitrogen, in active phosphoric acid and in active potash. It needs rotation of crops with legumes plowed under or grazed off, with applications of acid phosphate.

Description of Soil.—No. 3209—Depth 0″-6″. Burleson, Johnson county, on J. H. Gatlin's farm. This is slightly rolling land and is

considered moderately fertile, 500 pounds of cotton and 20 bushels of corn being produced per acre. The drainage is by means of ditches. The principal crops are corn, cotton, melons and cabbage. The soil gets lumpy when wet and stands drouth well. The soil represents 60 acres on farm.

No. 3210—Depth 6″-15″. Subsoil to No. 3209.

TABLE No. 16—Pounds of Seed Cotton per Plot, 1909.

Plot No.		Milford, Ellis Co.	Scurry, Kaufman Co.	Ladonia, Fannin Co.	Lindale, Smith Co.	Arlington, Tarrant Co.	Dawson, Navarro Co.	Stephenville, Erath Co.	Augusta, Houston Co.	Thornton, Limestone Co.
1	20 lbs. acid phosphate	60	9.00	22	77	15.00	49	22	115.5	39.0
2	Nothing	56	7.50	18	64	12.00	44	32	101.5	12.5
3	20 lbs. acid phosphate, 3 lbs. cottonseed meal	70	9.25	22	81	18.00	51	33	121.0	39.0
4	20 lbs. acid phosphate, 10 lbs. cottonseed meal	72	10.00	27	88	19.50	54	23	123.5	40.0
5	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 2 lbs. kainit	69	9.25	34	84	20.25	53	30	120.5	30.0
6	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 5 lbs. kainit	80	10.00	35	79	20.25	55	34	121.5	27.0
7	Four loads manure								132.0	
	Effect of:									
	Acid phosphate	4	1.50	4	13	3.00	5	−10	14.5	
	3 lbs. cottonseed meal	10	.25		4	3.00	2	11	5.5	
	10 lbs. cottonseed meal	12	1.00	5	11	4.25	5	8		
	2 lbs. kainit	−1		12	3	2.25	2	−3	−.5	
	5 lbs. kainit	10	¾	13	−2	2.25	4	1	.5	

CONCLUSIONS FOR THE COTTON EXPERIMENTS—1909.

Twelve co-operative experiments with cotton were reported in 1909.

Acid phosphate gave increases with eleven of these twelve experiments. In the one experiment which did not give an increase, the co-operator ascribes the high relative yields in plots 5, 6 and 2 to better soil.

Cottonseed meal produces an increase in nine of these twelve tests. The increase, however, is very small in some instances. Ten pounds of meal produces a better increase than three on an average.

Potash (kainit) increases the yield in five instances. There is an apparent increase with one of the applications in potash at Bryan and at Bonham, but as the yield with the complete fertilizer is lower than that with the acid phosphate alone, the increase is not considered as real and is not included with the above.

EXPERIMENTS WITH COTTON—1910.

The plan was the same as for corn in 1910, the additions being as noted in the description of the experiments.

W. T. Jordon, Hughes Springs, Cass County.—Light colored sandy upland soil, with red clay subsoil; 30 years in cultivation, and produces 8 bushels of corn or 300 pounds seed cotton. Cotton planted April 28th and harvested October 1st. Four rows, 4 feet apart, 280 feet long. Chopped out and plowed May 20th; plowed every 12 days up to July 15th. Crop very short owing to very dry season. For the past nine months such a season is unknown by the oldest settlers.

TABLE NO. 17—Cotton Experiments, 1909. Pounds Seed Cotton per Plot.

Plot No.		Bryan, Brazos county.			Bonham, Fannin county			Burleson, Johnson county.			Carthage, Panola county.	
		First picking.	Second picking.	Total.	First picking.	Second picking.	Total.	First picking.	Second picking.	Total.	Total yield.	Total No. stalks.
1	20 lbs. acid phosphate	32.5	8.00	40.50	22	9	31	26	9	35	107	132
2	No addition	21.5	5.00	26.50	12	7	19	16	8	24	109	240
3	20 lbs. acid phosphate, 3 lbs. cottonseed meal	26.5	6.75	33.25	17	7	24	25	8	33	264	160
4	20 lbs. acid phosphate, 10 lbs. cottonseed meal	27.5	5.50	33.00	22	7	29	26	5	31	206	168
5	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 2 lbs. kainit	27.5	6.50	33.00	21	8	29	25	6	31	180	124
6	20 lbs. acid phosphate, 3 lbs. cottonseed meal, 5 lbs. kainit	28.0	7.50	35.50	20	8	28	26	5	31	165	120
	Effect of:											
	Acid phosphate			14.00			12			11	100	
	3 lbs. cottonseed meal			—7.25			—7			—2	60	
	10 lbs. cottonseed meal			—7.00			—2			—4	40	
	2 lbs. kainit			—.25			—5			—2	—40	
	5 lbs. kainit			2.25			—1			—2	—50	

Acid phosphate and cottonseed meal were effective, and perhaps potash also.

This soil is fair in lime and potash, low in nitrogen and phosphoric acid, also low in active phosphoric acid. It needs phosphate as a fertilizer, and a rotation of crops in which legumes are plowed under or grazed off.

Description of Soil—Probably Orangeburg fine sandy loam. No. 3349—Depth 0"-6". Four miles north of Hughes Springs, Cass county, on J. D. Crawford survey, W. T. Jordon's farm. Sample taken just south of barnyard. This is nearly level upland soil with good drainage and a southeast slope. It is known as sandy land; 20 bushels of corn and 50 bushels of potatoes per acre are produced. Corn and potatoes are the principal crops. The soil is a light sandy one and gets soft and boggy when wet and a little crusty when dry. Cottonseed meal and manure have been used; two tons per acre of the manure gave good results. The native vegetation is brown sage and crab grass. The soil does not pack much; it crumbles freely, cracks a little, and dirt does not wash off or onto it. It represents two acres on the farm. No green crops have been plowed under.

No. 3350—Depth 6"-18". Subsoil to No. 3349. A light sandy loam.

H. W. Harrison, Como, Hopkins County.—Sandy loam upland soil, with clay subsoil; 18 years in cultivation, and produces one-half to three-fourths bale of cotton. Cotton planted May 4th, first picking September 15th. Two rows per plot, 5 feet apart, 180 yards long. Broke flat about six inches deep, and harrowed. Fertilizer applied about six days before cotton planted with cotton planter. Cultivated shallow and flat. Crop injured by boll weevils and five months drouth. He believes he would have made twice as much cotton with a single good rain.

Acid phosphate was effective, the others doubtful.

This soil is low in phosphoric acid and nitrogen, fair in potash and lime, low in active phosphoric acid. It needs fertilization with acid phosphate and rotation of crops with legumes plowed under or grazed off.

Description of Soil.—No. 3428—Depth 0"-7". One and one-half miles north of Como, Hopkins county, on Como and Sulphur Bluff road, Broocheen survey, on farm of H. W. Harrison. Sample taken from 110-acre field, nearly in a square on above road. This soil is a well drained, level upland, white sand, known as sandy loam, and considered moderately fertile, one-half bale of cotton and 20 bushels of corn being produced per acre. Corn, cotton, oats and peas are grown. Cottonseed meal was used last year and packing house fertilizer two years ago; 20 bushels of corn was produced in a dry season. Crab grass, burrs and other weeds are the native vegetation. In very wet seasons some parts of this land drown out. In dry seasons it is above the average for this county, 23,500 pounds of cotton being produced on 40 acres in 1909. The soil packs in some spots, does not crack; surface drainage is good, and underdrainage poor in some places. It has been cultivated 20 years; represents three-fourths of farm and one-fifth of county.

No. 3429—Depth 7"-19". Subsoil to No. 3428. White sand.

A. J. Spencer, Alvord, Wise County.—Mr. Spencer also carried out an experiment in 1909 with corn, but the yields were so low, ascribed to lack of stand and dry weather, that the results are not presented in this bulletin. Acid phosphate, however, gave results.

In 1910—Planted early in May and harvested in fall and winter of 1910. Fertilizer applied in the drill. Four rows, 4 feet apart and 284 feet long. Nos. 4 and 5 were affected by an old land furrow. The year was dry, rainfall 13 inches. Some timber died; summer hot; but little dew. Growth of vegetation less than the average by 20 per cent. The indications were exactly the same year before last, as the results this year. Plot 2 showed the best appearance both years and potash the poorest.

This soil is fair in lime and potash, low in nitrogen, in phosphoric acid and in active phosphoric acid. It needs applications of acid phosphate and rotation of crops with legumes plowed under or grazed off to add vegetable matter, and to improve its physical character, especially so that it will hold water better. It also needs frequent shallow cultivation during the growing season.

Description of Soil.—No. 3416—Depth 0″-9″. Four miles west of Alvord, Wise county, on the farm of A. J. Spencer. Sample taken near center of land by a levee; on east side of levee, 100 yards from south end. Abstract 237, Dallas county school land. This is hilly land, well drained, and considered poor. It is known as sandy land and is reddish white in color; 15 bushels of corn and 400 pounds of cotton per acre are produced. Corn and cotton are grown. No fertilizer has been applied. The native vegetation is sage grass, postoak and blackjack. The land is soft in wet seasons and hard in dry. The soil packs, dries into clods and washes. Dirt does not wash onto it and the soil does not crack on drying. The land has been cultivated 16 years. It represents all of farm and one-half of county. No green crops have been plowed under and no manure has been applied.

No. 3417—Depth 9″-21″. Subsoil to No. 3416. A red clay.

TABLE NO. 18—Co-operative Experiment With Cotton, 1910.

Plot Number.		Hughes Springs, Cass county.		Como, Hopkins county.	Alvord, Wise county.
		Weight of cotton per plot.	Stand.	Weight of cotton per plot.	Weight per plot.
1	20 lbs. acid phosphate	27	50	100	66
2	20 lbs. acid phosphate, 6 lbs. cottonseed meal	59	100	110	65
3	Nothing	52	100	95	57
4	20 lbs. acid phosphate, 12 lbs. cottonseed meal	66	100	94	54
5	20 lbs. acid phosphate, 6 lbs. cottonseed meal, ½ lb. muriate of potash	66	100	112	52
6	20 lbs. acid phosphate, 6 lbs. cottonseed meal, 1¼ lbs. muriate of potash	57	100	109	54
	Effect of:				
	Acid phosphate	2		5	9
	6 lbs. cottonseed meal	5		10	8
	12 lbs. cottonseed meal	12		−16	−11
	½ lb. muriate of potash	7		2	−15
	1¼ lbs. muriate of potash	−2		−1	−3

Troup Experiment Farm, by J. L. Welch, Superintendent. Cotton planted April 22d and harvested August 30th, September 15th and October 17th. Fertilizer applied with planter in furrow and listed on. Four rows per plot, 4 feet apart and 280 feet long. Land plowed four

inches deep in November, 1909. Double disced and harrowed in March, 1910, marked off with middle buster, placed fertilizer and listed back. All plots injured by drouth. Plots with cottonseed meal showed stronger plants than phosphate alone, No. 4 showing better than No. 2, No. 7 showing stronger than all the others, Nos. 8 and 9 equal to No. 4 but on a little better soil.

Beeville Experiment Farm, by A. T. Potts, Superintendent. Cotton planted April 4th and harvested August 15th and September 23d. Fertilizer applied by hand in furrows. Four rows, except with 8 and 9, of which there are two only. (Yields are doubled in the table of totals.) Rows 280 feet long, 4 feet apart. Rows opened with middle buster, planted, and land leveled with harrow. Thinned and cultivated every 10 days or sooner if needed. All plots were damaged by wind and rain September 2d.

Just at the time the crop was ready for a picking, early in September, it was damaged by a severe wind and rain. This would have been a very fine yield. Fertilizer did not arrive before planting and was put in May 26th.

TABLE NO. 19—Fertilizer Experiment—Cotton at Troup and Beeville Stations.

Plot No.		Troup, Smith county. Weight per plot. First picking.	Second picking	Third picking	Total	Beeville, Bee county. Weight per plot. First picking.	Second picking.	Total	Stand
1	20 lbs. acid phosphate	30	20	7	57	37.0	24.50	61.5	95
2	20 lbs. acid phosphate, 6 lbs. cottonseed meal	37	16	3	56	36.0	24.75	60.75	90
3	Nothing	20	24	10	54	39.5	19.50	59.00	97
4	20 lbs. acid phosphate, 12 lbs. cottonseed meal	35	26	10	74	66.5	16.50	83.00	88
5	20 lbs. acid phosphate, 6 lbs. cottonseed meal, ½ lb. muriate of potash	35	26	10	71	65.0	15.50	80.50	90
6	20 lbs. acid phosphate, 6 lbs. cottonseed meal, 1¼ lbs. muriate of potash	40	24	9	73	64.50	14.50	79.00	88
7	300 lbs. barn-yard manure	58	23	7	88				
8	20 lbs. Thomas phosphate	24	36	23	83	25.00	8.50	67.00	85
9	20 lbs. acid phosphate, 1¼ lbs muriate of potash	32	38	18	88	23.50	7.00	61.00	90
	Effect of:								
	Acid phosphate				3			2.50	
	6 lbs. cottonseed meal				—1			1.25	
	12 lbs. cottonseed meal				17			21.50	
	½ lb. muriate of potash				15			19.75	
	1¼ lbs. muriate of potash				17			18.25	
	Thomas phosphate				26			6.25	

CONCLUSIONS AS TO COTTON EXPERIMENTS—1910.

Only five successful experiments with cotton were made this season, two being at State substations. On account of the boll weevil we thought it best not to undertake many cotton experiments. The season of 1910 was unfavorable, as a rule, and the yield was short.

Acid phosphate produced increases in each of the five experiments.

Cottonseed meal produced increases in three of the five experiments, the greater increase taking place with the heavier application.

Muriate of potash produced increases in three of the five experiments. A part of this increase at Troup is ascribed to better soil.

Thomas phosphate, in both experiments, produces better gains than acid phosphate, but a part of the difference at Troup is ascribed to better soil.

GENERAL CONCLUSIONS OF COTTON EXPERIMENTS—1908-1910.

Twenty-one co-operative experiments with cotton are here taken into consideration, and the general summary is shown in Table 20.

As with corn, acid phosphate gives the best results. Seventeen of the twenty-one tests gave increases caused by acid phosphate.

Although the cotton seasons were not altogether favorable, the plant can stand more dry weather than corn. We do not find so many instances that the cottonseed meal produced a decrease with cotton, as with corn. The use of nitrogen with cotton appears more likely to be profitable in a poor season than with corn.

Potash shows results in half of the experiments. It is thus more likely to prove of value to cotton than to corn.

CHEMICAL COMPOSITION OF SOILS FOR COTTON EXPERIMENTS.

Chemical analyses of a number of the soils used in the cotton experiments are given in tables preceding. The following analyses are given in connection with the corn experiments: J. B. Griffin, Thornton; H. J. Klorres, Velasco; G. S. Smith, Stephenville.

There are not a sufficient number of analyses from which to draw conclusions. The active phosphoric acid and effect of phosphoric acid are shown in tables preceding. All these soils except two gave results with phosphoric acid. One of these is comparatively low in active phosphoric acid and the other is the black, waxy soil.

TABLE NO. 20—Summary of Cotton Experiments, 1908-10.

	1908	1909	1910	Total.
Number of experiments—total	4	12	5	21
Number showing gains by acid phosphate	2	11	5	18
Number showing gains by cottonseed meal	3	9	3	15
Number showing gains by potash	2	5	3	10
Average gains of seed cotton when a gain occurred, in pounds per plot.				
By acid phosphate (20 lbs.)	18.5	16.0	5.0	
By cottonseed meal (3 lbs.)	2.0	10.5		
By cottonseed meal (6 lbs.)			4.0	
By cottonseed meal (10 lbs.)	4.0	9.7		
By cottonseed meal (12 lbs.)			16.7	
By muriate of potash (½ lb.)	2.0	3.0	14.0	
By muriate of potash (1¼ lbs.)	5.5	6.0	12.0	

EXPERIMENTS WITH THOMAS PHOSPHATE ON RICE.

Thomas phosphate is a by-product in the manufacture of steel from iron containing phosphorus. Like acid phosphate, it is high in available phosphoric acid, containing about 16 per cent. Acid phosphate is an acidic fertilizer, being prepared from phosphate rock and sulphuric acid.

Thomas phosphate, on the other hand, is basic and contains free lime. Its use, therefore, would tend to correct any acidity which might be present. It has given excellent results on Italian rice fields. Our experiments were made with Thomas phosphate furnished us by the Coe-Mortimer Company of New York, free of charge for experimental purposes. Nine lots were sent out to parties who had signified their desire to co-operate with us. The following instructions were sent:

Test of Thomas Phosphate for Rice.—The sack contains 50 pounds of Thomas phosphate, which should be applied to one-half acre of land just before planting. It may be drilled in, or applied broadcast, as is most convenient. The method of application should be noted.

The treatment of the plot should be exactly like all the other rice. If it suffers from insects, lack of water, or any other reason not due to the fertilizer, the fact should be noted.

The rice grown with the Thomas phosphate should be harvested separately. The quantity of rough rice produced by the one-half acre of Thomas phosphate should be compared with the product with other fertilizer or with no fertilizer or both, on the same soil.

If there is any striking difference between the fertilizer plot and the surrounding rice, we would like to be notified, as we may wish to send a representative to visit the field.

RESULTS OF THE TESTS.

Two of the tests were failures, due to dry weather and lack of water. These two were at Orange, Orange county, and near Houston, Harris county. Reports from the other tests are given below.

David Garretson, Friendswood, Galveston County.—Soil was a very deep black waxy.

"We did not get to thresh a measured piece of land bordering that upon which I put the fertilizer, and since quite a little of our rice blew down before time to cut, I can not get a very accurate estimation. Off of the half acre we threshed eight sacks, while our average yield was only nine sacks per acre, but we lost about four sacks per acre, I think, left laying on the ground. That one little piece and a few others were cut while standing."

The Thomas phosphate in this case appeared to produce a gain of about four sacks of rice per acre.

C. E. Fletcher, Katy, Harris County.—It was threshed separately but could tell no difference, neither could there be any difference seen while watering. It was all drilled in the same. It only made 14 sacks of 200 pounds. Some rice on different land in the same field, sowed later and watered differently, also a better stand, made 30 sacks per acre, averaging 201 pounds. The rice was of the Japan variety, known as the Chinerieka. You can hardly tell the difference on new land, no matter what kind of fertilizer is used.

Dr. George W. Dunn, Palacios, Matagorda County.—He could observe no difference between fertilized and unfertilized, but believes the tenant did not water the rice as it should have been watered.

David C. Barr, Raywood, Liberty County.—Heavy gumbo soil; two years in cultivation, and producing 12 to 15 bushels of corn and 10 to 15 sacks of rice. The rice was broadcasted on new land, as was the fer-

tilizer before planting same. The fertilized rice looked some better for a while, but there was no great difference between the two plots in looks. Neither plot made much of a yield on account of lack of water the last four weeks of the growing season. The fertilized rice yielded 496 pounds, the unfertilized yielded 408 pounds.

Oscar Schult, El Campo, Wharton County.—Black hog-wallow soil. "The phosphate or fertilizer was used on about one-fourth acre of rice land. Six tons of other fertilizers were used on land adjoining, and some of the land had no fertilizer, and through the growing season it looked like the fertilized rice was doing some better, but we could hardly see any difference in threshing. We noted the different lots carefully, but there was very little difference, if any. My land was black hog-wallow and had the third crop on it. I think fertilizers are good for light or sandy soils, but it does not help the black, waxy land very much."

John Linderholm, Chesterville, Colorado County.—"The rice without fertilizer stood the weather conditions very well, as did the rice with the other fertilizer mentioned, but most of the stalks of the rice on which your fertilizer was used went down. Only a part could be harvested with the binder, so that no accurate account can be kept as to yield. The rice on which the phosphate was used did not seem to survive the weather. The adjoining cut planted without phosphate stood the weather fairly well, but the phosphate itself seemed to have some peculiar effect on the straw, it going flat. We could not harvest any of it, and are unable to give you any comparisons.

"From examination of the berry of the rice on which the phosphate was used and that planted without fertilizer, I beg to inform you that it was impossible for us to detect any difference. If we could have collected a sufficient quantity, it might have been possible to do so by weight or otherwise, but under the circumstances we could not."

J. C. Chaney, Jefferson County.—The following is a report of the experiment with Thomas phosphate, which was carried on in connection with some other tests by Mr. Chaney:

Plot No.	Weight Per Acre of Fertilizer.	Kind of Fertilizer.	Yield in Sacks of 185 Pounds Per Acre.
1	190	12-2	14.75
2	190	12-2	14.50
3	120	12-2	16.00
4	...	....	14.00
5	175	10-4	14.00
6	125	10-4	13.65
7	125	7-2 5-3	14.60
8	125	14	11.40
9	170	Thomas phosphate	17.00

DISCUSSION OF RESULTS WITH RICE.

The Thomas phosphate was effective in three of the tests, not effective in four, and apparently caused the rice to fall down in one case. In most of these experiments the soil was heavy black soil, probably fairly well supplied with plant food and not over three or four years in cultivation. On such soils fertilizers often have little effect.

The experiments do not show whether Thomas phosphate or acid phosphate would be better for our rice soils. It is believed that Thomas phosphate would give excellent results on rice soils not too rich in nitrogen. On account of the lime which it carries Thomas phosphate would aid in correcting the acidity of the soil, if the soil were acid.

DISCUSSION OF THOMAS PHOSPHATE WITH CORN, COTTON AND RICE.

The number of experiments is too few to draw any definite conclusions as to the comparative value of Thomas phosphate and acid phosphate. The effect of Thomas phosphate was less than that of acid phosphate in the four tests with corn, and was greater in the two tests with cotton. On rice we have no comparative results.

EXPERIMENT ON CAULIFLOWER.

This experiment was made by *Mr. Wm. M. Garrett, Center Point, Kerr county.* The land is postoak valley land, and produces about one-fourth bale of cotton, 20 bushels of corn and 50 bushels of oats. It is a red clay postoak soil with stiff red clay gravel beneath.

The plants were set out August 20 to 25, 1910, and harvested from time to time in December, 1910, the remaining crop being destroyed by a freeze on January 2, 1911. Plots 6 and 9 were not perfect as to stand. Nitrate of soda was used as a top dressing, on alternate rows, 100 pounds per acre. Four rows per plot, 3 feet apart and 80 yards long. The heaviest and most perfect heads were cut from plots 8 and 9. The crop was irrigated. The nitrate of soda produced heads 10 days earlier than where no nitrates were used.

	Fertilizer.	Yield per Plot. Pounds.
1.	30 pounds acid phosphate, 25 pounds cottonseed meal	628
2.	30 pounds acid phosphate, 50 pounds cottonseed meal	600
3.	15 pounds acid phosphate, 25 pounds cottonseed meal	482
4.	50 pounds cottonseed meal	412
5.	45 pounds acid phosphate, 50 pounds cottonseed meal	610
6.	30 pounds acid phosphate, 75 pounds cottonseed meal	622
7.	30 pounds acid phosphate, 50 pounds cottonseed meal, 10 pounds sulphate of potash	724
8.	30 pounds acid phosphate, 50 pounds cottonseed meal, 5 pounds sulphate of potash	832
9.	30 pounds Thomas phosphate, 50 pounds cottonseed meal	812
10.	2 tons manure	490

It is evident that this soil needs phosphoric acid most of all, for cauliflowers, and also potash. Nitrogen does not have a great effect, though the effect of the varying applications of nitrogen may have been masked by the applications of nitrate of soda to alternate rows. The great effect of acid phosphate may be seen by comparing the plots 4 and 10, which received no acid phosphate, with the others. There was no advantage in using over 30 pounds acid phosphate and little advantage in over 25 pounds cottonseed meal on this soil and under these condi-

tions. There was also no advantage in the use of more than five pounds sulphate of potash.

The best results were apparently secured by the use of 300 pounds per acre of acid phosphate, 50 pounds sulphate of potash, 250 pounds cottonseed meal and 100 pounds nitrate of soda. This would involve the use of a fertilizer containing about 8 per cent phosphoric acid, 5 per cent potash and 3 per cent nitrogen, at the rate of 600 pounds per acre, and followed by a top dressing of 100 pounds per acre of nitrate of soda.

EXPERIMENTS ON TOMATOES, 1909-10.

Only one experiment was made on tomatoes in 1909 and one in 1910. The plan was the same as for potatoes.

W. E. Hamilton, Fort Worth, Tarrant County (1909).—Black sandy loam second bottom soil, with red clay subsoil, three years in cultivation to truck, no fertilizer. Plants were set after a shower and no more rain until nearly time for harvest, and then the sun was so hot as to wilt the vines. The largest tomatoes were on No. 4, the smallest on the first plot.

No. 1. 15 pounds acid phosphate	175 pounds
No. 2. 15 pounds acid phosphate and 20 pounds cottonseed meal	191 pounds
No. 3. 15 pounds acid phosphate, 20 pounds cottonseed meal and 1 pound muriate of potash	195 pounds
No. 4. 15 pounds acid phosphate, 20 pounds cottonseed meal and 5 pounds muriate of potash	216 pounds
No. 5. No addition	191 pounds

Conclusions.—The unfavorable weather prevented the action of the fertilizer. The potash was the only application which could be said to give results. One pound muriate of potash increased the yield four pounds, and five pounds muriate of potash increased the yield 25 pounds. The two increases are in nearly the same proportion.

R. O. Ellichman, Denton, Denton County (1910).—Dark sand with yellow clay subsoil, nine years in cultivation and producing 15 bushels corn. Moderate upland soil. Tomatoes planted April 1st and harvested August 12th. Eight rows per plot, 4 feet apart, 100 feet long. Flat broke twice, harrowed twice and cultivated four times with diverse cultivator. Land slopes east and plot No. 1 is highest, and plot No. 5 is lowest. Season was very hot and dry and about one-half of the tomatoes were sun-scorched and lost. These were not included in the report. Vines in plots 3 and 4 were still green at the time of the report, and he believes that they will continue to bear until frost, and that he will get 1,000 pounds more tomatoes off of them. Where acid phosphate only was used the plants seemed to burn up as soon as it got hot. Plot 5 was the lowest, which accounts for it doing so well without fertilizers.

This soil is fair in lime, good in potash, fair in nitrogen and low in phosphoric acid. It contains a fair amount of active phosphoric acid and is low in active potash.

Description of Soil.—No. 3414—Depth 0″-12″. Located three miles southeast of Denton, Denton county, on Joseph White survey, farm of

R. O. Ellichman. Sample taken from north end of field. This is rolling land, known as black sand, and is considered moderately fertile; 20 bushels corn per acre are produced. Corn, cotton and truck are the principal crops. The soil is a dark sand, which behaves fairly well in both wet and dry seasons. It does not pack or crack, but dries into clods. It washes, but dirt does not wash onto it. The surface drainage is good. The land has been cultivated nine years and represents 50 acres on the farm. No fertilizers, green crop or manure has been applied to the soil. The soil has no peculiarities.

No. 3415—Depth 12"-18". Subsoil to No. 3414. A reddish brown sand.

TABLE NO. 21—Co-operative Experiment on Tomatoes, 1910.

Plot Number.		Ellichman, Denton, Denton county.
		Weight per plot
1	15 lbs. acid phosphate	280
2	15 lbs. acid phosphate, 20 lbs. cottonseed meal	500
3	15 lbs. acid phosphate, 20 lbs. cottonseed meal, 1 lb. muriate of potash	650
4	15 lbs. acid phosphate, 20 lbs. cottonseed meal, 5 lbs. muriate of potash	875
5	No fertilizer	400

SUMMARY OF TOMATO EXPERIMENTS.

Only two experiments were made, in one of which only potash gave results, and in the other, both nitrogen and potash. Two experiments are not sufficient to draw any general conclusions.

EXPERIMENTS ON PEANUTS, 1908 AND 1910.

Only two experiments were made with peanuts, one in 1908, the other in 1910.

C. D. Andrews, Rock Island, Colorado County (1908).—The nuts were hulled and planted with a corn planter; rows 30 inches apart. Hills from 8 to 10 inches in the drill, on April 12th. Harvested with a peanut digger August 12th, 110 days from time of planting. They were hoed once, cultivated four times. Lime seemed to give best results. The season has been too dry for peanuts. The yield will be less by one-third than last season. The fertilizer should be in the ground 20 days before planting.

No.	The application to the different plots.	Pounds nuts per plot.
1.	14 pounds acid phosphate, 3 pounds kainit	33
2.	No fertilizer	25
3.	14 pounds acid phosphate, 3 pounds kainit, 40 pounds lime	43
4.	14 pounds acid phosphate, 40 pounds lime	38
5.	14 pounds acid phosphate, 12 pounds lime	32
6.	7 pounds acid phosphate, 3 pounds lime	27

Effect of 14 pounds acid phosphate and 3 pounds kainit, 8 pounds.
Effect of 7 pounds acid phosphate and 3 pounds kainit, 2 pounds.

TABLE NO. 22—Percentage Composition of Soils.

	R. O. Ellichman, Denton.		C. D. Andrews, Rock Island.			W. A. Cone, Laredo.		B. W. Masterson, Laredo.		W. M. Garrett, Center Point.		Beeville Exp. Station.	
	3414	Subsoil 3415	1069	Subsoil 1070	Deep Subsoil 1071	2870	Subsoil 2871	4212	Subsoil 4213	4380	Subsoil 4381	4372	Subsoil 4373
Phosphoric acid	.042	.037	.08	.006	.005	.060	.060	.115	.10	.05	.06	.06	.04
Nitrogen	.063	.051	.06	.020	.040	.066	.038	.070	.05	.07	.09	.09	.08
Potash	.400	.430	.11	.200	.100	.800	.800						
Lime	.160	.190	.09	.090	.130	3.270	6.060	5.920	7.55	.64	1.03	.64	.83
Magnesia	.140	.210	.11	.070	.100	.740	1.020	.610	.97	.65	.85	.30	.42
Sulphur trioxide	.040	.030				.090	.400						
Alumina and oxide of iron	2.690	6.620	1.88	1.780	3.710	9.830	10.070	7.780	7.88	16.70	16.33	5.72	8.32
Manganese			.10	.090	.100								
Insoluble and soluble silica	93.410	98.130	96.01	98.190	94.020	75.440	60.110	73.240	69.79	67.74	59.83	85.47	81.35
Loss on ignition	2.250	2.680	1.55	.770	1.520	5.840	8.400	6.730	5.86				
Moisture	.780	1.580	.42	.280	1.020	3.550	4.180	3.760	3.10				
Parts per million:													
Active phosphoric acid	46		20			24	11	16	85	20			
Active potash	68	572			24	368	85	300	156	634			

Effect of 3 pounds kainit, 5 pounds.
Effect of 40 pounds lime, 10 pounds.
Effect of 7 pounds acid phosphate, 6 pounds.

This soil is low in lime, nitrogen, potash and phosphoric acid, also in active phosphoric acid. Lime has the greatest effect on the peanuts, acid phosphate next, and potash has the least effect, though some. Nitrogen was not applied.

Description of Soils.—No. 1069—Black surface soil.

No. 1070—Subsoil to No. 1069, Rock Island, Colorado county. Farm of C. F. Andrews, sandy subsoil.

No. 1071—Clay subsoil beneath No. 1070 at varying depths.

College Experiment Field, College Station, by H. L. McKnight, Agriculturist (1910).—Five rows per plot, 36 inches apart, 295 feet long. Thorough preparation with disc harrow, followed by section harrow, hoed twice and cultivated three times. Suffered from dry weather.

Analysis of soil under way.

Plot No.	Application.	Weight of crop per plot.
	Plot 70.	
1	200 lbs. acid phosphate	410
2	No fertilizer	330
3	200 lbs. Thomas phosphate	400
4	1200 lbs. hydrated lime	310
5	60 lbs. sulphate of potash	320
	Plot 71.	
6	200 lbs. acid phosphate	370
7	Nothing	330
8	200 lbs. acid phosphate, 20 lbs. sulphate of potash	340
9	200 lbs. acid phosphate, 60 lbs. sulphate of potash	410
10	200 lbs. acid phosphate, 130 lbs. cottonseed meal	381

DISCUSSION OF RESULTS.

The 1908 experiment was a test on production of nuts, the 1910 of hay. Lime was most effective in 1908. The acid phosphate and potash also had some effect.

In 1910 acid phosphate was most effective. Thomas phosphate had nearly the same effect. Lime gave negative results and sulphate of potash gave no average increase. Cotton seed meal gave a slight increase.

EXPERIMENTS ON ONIONS.

We here report one co-operative experiment and two independent experiments made at Laredo.

Co-operative Experiment in 1908.—One test was made. The following instructions were sent:

This fertilizer is to be applied in the row and each lot to be applied to one-twentieth acre of land. The mixture as adapted to your conditions are as follows:

No. 1. Twenty pounds cottonseed meal.
No. 2. Twenty pounds acid phosphate.
No. 3. Twenty pounds cottonseed meal and 20 pounds acid phosphate.

No. 4. Twenty pounds cottonseed meal, 20 pounds acid phosphate and six pounds muriate of potash.

Philip Payne, Clyde, Callahan County (1908).—The season for testing the fertilizer was very unfavorable, not only lateness but heavy rains, followed by long hot dry weather. The soil usually produces about 200 bushels per acre of "prize taker" onions from seed planted early in February and transplanted, with no fertilizer, and ordinary cultivation. Following is a statement of experiment with results:

Variety, Prize taker. Soil, light sandy, thin. Length of rows, 150 yards, plots one-twentieth acre. Distance apart, 2 feet 6 inches. Distance in drill, 6 inches.

The crop was grown from seed planted March 15th in close drill and transplanted in the rows June 1st.

		Yield per acre in lbs.
No. 1.	20 pounds cottonseed meal	4800
No. 2.	20 pounds acid phosphate	7800
No. 3.	20 pounds cottonseed meal, 20 pounds acid phosphate	8000
No. 4.	20 pounds cottonseed meal, 20 pounds acid phosphate and six pounds muriate of potash	8000
No. 5.	No fertilizer	3200
	Effect of acid phosphate (1-5)	4600
	Effect of acid phosphate (3-1)	3200
	Cottonseed meal (2-5)	1600
	Cottonseed meal (3-1)	200
	Muriate of potash	00

Acid phosphate was decidedly the most effective in this experiment. Cottonseed meal had some effect, muriate of potash had no effect.

W. A. Cone, Laredo, Webb County (1909).—*Bermuda Onions.*—This is not a co-operative fertilizer experiment, but was carried out entirely on Mr. Cone's own initiative and he kindly communicated the results to us. The plan of experiment was suggested by Prof. McCandles of the Georgia Station. Plots are one-tenth acre each.

TABLE NO. 23—Fertilizer Experiment on Onions at Laredo by W. A. Cone.

Plot Number.	Application per plot.	Pounds per plot.
1	No fertilizer	3700
2	150 lbs. cottonseed meal	3650
3	200 lbs. acid phosphate	3600
4	100 lbs. kainit	3350
5	No fertilizer	3750
6	200 lbs. acid phosphate, 150 lbs. cottonseed meal	3750
7	150 lbs cottonseed meal, 100 lbs. kainit	3450
8	200 lbs. acid phosphate, 100 lbs. kainit	4100
9	200 lbs. acid phosphate, 100 lbs. kainit, 150 lbs. cottonseed meal	3750
10	100 lbs. slaked lime	4200
	Apparent effect of:	
	Cottonseed meal	−40
	Acid phosphate	+250
	Kainit	+0
	Lime	+450

This experiment was carried on on a very productive piece of land, and the fertilizers had little effect. Acid phosphate had some effect, on the average, kainit no effect, cottonseed meal none, and lime had apparently the greatest effect.

All the applications of fertilizer were excessive. Although lime apparently had effect, the soil contained large quantities of lime. (See analysis, Table 23.)

This soil is high in lime and potash, fair in nitrogen and phosphoric acid. It is low in active phosphoric acid, and acid phosphate should have an effect upon it. The surface soil contains 3.27 per cent lime, which is equivalent to 60,000 pounds of lime per acre to the depth of eight inches, a large part of which is present as carbonate. We are inclined to believe that the apparent effect of lime in the experiment is due to inequalities in the soil, and that it really does not need any lime.

Description of Soil.—No. 2870—Depth 0″-6″ to 8″. Laredo, Webb county, on farm of W. A. Cone. Sample taken on last 10-acre lot on east and third 10-acre lot from east. This is a nearly level, well drained soil, considered moderately fertile. It produces 22,500 pounds onions per acre. Onions are the principal crop. The soil represents 30 acres on farm and a small area in county.

No. 2871—Depth 12″ to 20″. Subsoil to No. 2870.

B. W. Masterson, Laredo, Webb County (1910).—*Bermuda Onions.*—This experiment was not carried out under our directions, but was made independently by Mr. B. W. Masterson, with suggestions from Mr. E. C. Green of the South Texas Garden, Brownsville. Each plot was one-sixth acre.

Seed planted September 20th, transplanted November 20th, 1909, harvested April 20th, 1910. Ten rows per plot, 12 inches apart, 208 feet 9 inches long. Plot No. 9 was damaged by thrip to the extent of about 50 pounds.

Plot No.	Application.	Weight of crop in lbs. per acre.
1.	No fertilizer	19,508
2.	21 pounds nitrate of soda	26,784
3.	27 pounds acid phosphate	19,562
4.	12.5 pounds muriate of potash	19,670
5.	45 pounds cottonseed meal	26,784
6.	27 pounds acid phosphate, 12.5 pounds muriate of potash	19,454
7.	27 pounds acid phosphate, 45 pounds cottonseed meal	26,676
8.	12.5 pounds muriate of potash, 45 pounds cottonseed meal	19,670
9.	27 pounds acid phosphate, 12.5 pounds muriate of potash, 45 pounds cottonseed meal	19,724
10.	No fertilizer	19,562
	Apparent effect of (plots 8 and 9 excluded):	
	Acid phosphate	—60
	Nitrate of Soda	+7,276
	Muriate of potash	+110
	Cottonseed meal	+7,194

The only application which proved profitable was the nitrate of soda or the cottonseed meal.

(Soil analysis under way.)

Experiments at Beeville.—Experiments were carried out at Beeville for four seasons on white Bermuda onions. The results are published in Bulletin 115 of this Experiment Station, by S. A. Waschka. The results indicate that acid phosphate, muriate of potash, nitrate of soda, cottonseed meal or bat guano had little effect upon the yield under the conditions of the experiment, though they apparently had some effect the last year of the test. Stable manure, at the rate of 24,000 or 40,000 pounds per acre, increased the yield during each of the four seasons, and the increase was greatest during the fourth, and much more with the manure than with any other application.

We consider the results of this experiment show that the conditions which limited the yield of onions in this work was not the plant food in the soil, but some other conditions.

The effect of manure, and its cumulative action, indicates that the physical condition or character of the soil is at least one of the limiting conditions.

SUMMARY OF ONION RESULTS REPORTED.

Each of the onion experiments here reported gives different results, but they agree in one particular; potash gives no results with any of them.

In the experiment at Clyde, phosphoric acid was needed most, and nitrogen, represented by cottonseed meal, next. In the experiment of Mr. Cone at Laredo, phosphoric acid apparently had some effect, but lime appears to have had more effect. It is hardly probable, however, that a soil which contains so much lime should respond to liming. The difference is more probably due to difference in the soil, which without any fertilizer was so productive that the productiveness was probably near the maximum. In the experiment of Mr. Masterson cottonseed meal or nitrate of soda have a very decided effect, and we consider nitrogen to be the more important food, in spite of the apparent non-effect of the fertilizer on plots 8 and 9.

It is evident that a larger number of fertilizer experiments with onions should be conducted before decisive statements should be made. We believe that we are justified, however, in stating that nitrogen is the most important plant food for onions, phosphoric acid next and potash least.

A crop of 30,000 pounds onions takes up, in the bulb, approximately the following amounts of plant food:

	Pounds.
Phosphoric acid	37
Nitrogen	72
Potash	72

Composition of soils at Laredo is given in Bulletin 125.

EXPERIMENTS ON POTATOES IN 1909.

No successful experiments with potatoes were carried out in 1908. The instructions sent out in 1909 were as follows:

PLAN FOR FERTILIZER TEST WITH IRISH POTATOES, 1909.

About one-quarter acre of land should be selected, where the soil is uniform. Plant, cultivate and harvest exactly as has been your custom. The only difference in the plots should be the addition of fertilizers.

For each application of fertilizer select two rows 280 feet long, or four rows 140 feet long, or eight rows 70 feet long. We will assume that four rows 140 feet long are used for each plot.

Plot 1. To the first four rows apply 15 pounds acid phosphate.

Plot 2. To the second four rows apply the mixture of 15 pounds acid phosphate and 20 pounds cottonseed meal.

Plot 3. To the third four rows apply the mixture of 15 pounds acid phosphate, 20 pounds cottonseed meal and one pound muriate of potash.

Plot 4. To the fourth four rows apply the mixture of 15 pounds acid phosphate, 20 pounds cottonseed meal and five pounds muriate of potash.

Plot 5. To the fifth four rows make no application.

The fertilizer may be applied in the row and bedded on, if desired. A horn of paper or tin, reaching nearly to the ground, may be used to aid in applying it by hand.

The fertilizer should be mixed well and applied about a week before planting. The entire field should receive the same treatment, and if any of the plots are damaged by storms, insects, or anything else, the fact should be noted and considered. The only difference between the plots should be the quantity of fertilizer. The crop from each plot should be harvested and weighed separately.

The difference between plot 5 and the others shows the effect of the various fertilizers.

The difference between plot 1 and 5 shows the effect of acid phosphate (containing phosphoric acid) alone.

The difference between plot 1 and 2 shows the effect of nitrogen in cottonseed meal.

The difference between plot 2 and 3 shows the effect of adding potash (kainit). The difference between plot 3 and 4 shows the effect of increasing the amount of potash.

COMPOSITION OF FERTILIZER.

The application of fertilizers to potatoes was at the rate of 300 pounds acid phosphate per acre, 400 pounds cottonseed meal and 20 pounds or 100 pounds muriate of potash.

The acid phosphate—cottonseed meal mixture No. 2—would contain approximately 7 per cent available phosphoric acid, and 4 per cent nitrogen, 700 pounds per acre being used. To judge from our experiments, this fertilizer would give results on potatoes on almost any Texas soil.

With the light application of potash, the fertilizer would contain about 7 per cent available phosphoric acid, 4 per cent nitrogen and 1.5 per cent potash. With the heavy application of potash, 800 pounds per acre of fertilizer were used containing approximately 6 per cent available phosphoric acid, 3.5 per cent nitrogen and 6 per cent potash.

POTATOES—1909.

H. J. Kloores, Velasco, Brazoria County.—Black sandy loam hilly soil, with red clay subsoil, 14 years in cultivation and producing one bale cotton before advent of boll weevil. Soil was dry and weather cold, potatoes replanted, and low yield on being late. Experiment not considered satisfactory. For analysis of soil, see corn 1910.

W. W. Ramsay, Winnsboro, Wood County.—Sandy moderate upland soil, produces 14 bushels corn or one-third bale cotton, in cultivation 18 to 20 years. More rotten potatoes were in No. 1 than in all the rest put together. The best and finest potatoes were in the rows having the application of five pounds muriate of potash (No. 4). All the fertilizer applications were successful.

W. E. Peek, Hempstead, Waller County.—Black sandy upland soil, with red and yellow clay subsoil, 60 years in cultivation and producing 15 bushels corn. Plot 6 with cowpea manure made better yields than any of the fertilized plots. All the fertilizer application were successful.

This soil is low in lime, nitrogen and phosphoric acid, fair in potash. It is low in active phosphoric acid and active potash.

Description of Soil.—No. 3266—Depth 0″-12″, one and one-half miles south of H. & T. C. depot, Hempstead, Waller county, farm of S. E. Peek. Sample taken from sandy land half way from center to east line. J. Lindo survey. This is a sandy upland soil with fair drainage, and considered moderately fertile, 15 bushels corn being produced per acre. Corn and cotton are the principal crops. The native vegetation consists of grass, sageweed and postoak. The soil does not get very hard after drying out. The soil does not pack or crack on drying; it dries into soft clods. The land does not wash. It has been cultivated 60 years, represents 60 per cent of farm and 20 per cent of county. No green crops have been plowed under, but four loads of manure to the acre produced good results. The soil has no peculiarities. The land grows crab grass which has been pastured and plowed under, but mostly burned off.

No. 3267—Depth 12″-24″. Subsoil to No. 3266.

W. G. Perkins, Greenville, Hunt County.—Mulatto loam with clay subsoil, 30 years in cultivation. All crops damaged some by frost, especially Nos. 1 and 4. Crops also damaged by drouth, and experiment is considered as unsatisfactory.

Cottonseed meal alone gave results.

F. J. Trapp, Seabrook, Harris County.—Sandy loam prairie soil, with yellow clay subsoil, 28 years in cultivation, produces 32 bushels corn. Early drouth caused the plants to make a slow start and mature early. A test on another plot, planted 14 days earlier on moist ground and dug some time later, fertilized with stable manure, gave 800 pounds.

These soils are good in lime, fair in potash and nitrogen, and low in phosphoric acid. They are also low in active phosphoric acid.

Description of Soils.—No. 2844—Depth 0″-12″. Seabrook, Harris county, farm of F. J. Trapp. Plot bounded on south by line fence, on east by trifoliata hedge, on north by pecan trees and on west by ditch. This is well drained level soil and considered moderately fertile, 20 bushels corn and 45 bushels potatoes being produced per acre. The

principal crops are corn and potatoes. The land suffers in dry seasons and works well when wet. It represents four acres on farm.

No. 2845—Depth 12″-24″. Subsoil to No. 2844.

No. 2846—Depth 0″-12″. F. J. Trapp, Seabrook, Harris county. Soil taken from different place from Nos. 2844 and 2845 q. v.

No. 2847—Depth 12″-24″. Subsoil to No. 2846.

No. 3409—Depth 0″-12″. Located two miles northeast of Seabrook, Harris county, on farm of F. J. Trapp. Sample taken back of residence between orange and pecan groves, west of concrete cottage 60 feet. South of pecan and north of orange grove. On subdivision No. 2, Ritson Morris league.

This land is virgin prairie upland soil known as black sandy and considered moderately fertile. Land is occupied by bermuda sod. No fertilizer has been applied. This is a grayish black clay soil which holds moisture in wet weather and suffers in dry seasons. The soil packs and runs together, crumbles, and the subsoil cracks into cubes on drying. The land washes and dirt washes onto it to some extent.

Owner knows of no other similar land except a three-mile strip on the bay shore 1,000 feet wide. The soil represents 10 acres on this farm. Bermuda grass was plowed under in November 1909. The subsoil contains iron gravel.

No. 3410—Depth 12″-24″. Subsoil to No. 3409.

J. M. Yowell, Ennis, Ellis County.—Black sandy soil with clay subsoil. Second bottom, 15 years in cultivation, produces 50 bushels corn. Crop suffered from frost, long drouth and hot winds, made practically without rain, and therefore cannot be considered a good test.

Acid phosphate gave the best results, but all applications were effective. Mr. Yowell carried out another experiment with potatoes in 1910 (which see). In this test, potash gave no results.

This soil is fair in lime and potash, a little low in nitrogen and low in phosphoric acid and in active phosphoric acid.

TABLE NO. 24—Irish Potatoes, 1909.

	Velasco, Brazoria Co.	Winnsboro, Wood Co.	Hempstead, Waller Co.	Greenville, Hunt Co.	Ennis, Ellis Co.	Seabrook, Harris Co.
15 lbs. acid phosphate	91	172	145	35	82	320.0
15 lbs. acid phosphate, 20 lbs. cotton-seed meal	112	240	280	50	84	417.5
15 lbs. acid phosphate, 20 lbs. cotton-seed meal, 1 lb. muriate of potash	73	260	297	51	87	444.5
15 lbs. acid phosphate, 20 lbs. cotton-seed meal, 5 lbs. muriate of potash	93	292	314	35	92	345.5
No addition	91	80	131	43	71	202.0
Effect of:						
Acid phosphate		92	14	—8	11	118.0
Cottonseed meal	21	68	135	15	2	97.5
1 lb. muriate of potash	—39	20	17	1	3	27.0
5 lbs. muriate of potash	—19	52	34	—15	8	—72.0

Description of Soil.—No. 3418—Depth 0″-12″. Six miles southwest of Ennis, Ellis county, on League 11, Lea Pena survey, farm of J. M. Yowell, R. F. D. No. 2. The sample was taken from 20-acre field with

a gentle slope to the south. This soil is well drained, rolling black soil, known as sandy land and considered moderately fertile, 30 bushels corn and 400 pounds cotton being produced per acre. Corn, cotton, oats and potatoes are grown. No fertilizer, green crops or manure have been applied to this land. Prairie grass is the native vegetation. In wet seasons the soil gets waterlogged, in dry seasons it packs. It dries into clods, does not crack, nor does dirt wash onto it. The soil washes, the underdrainage is good. The soil represents 40 acres of farm and several thousand acres of the county. In dry seasons the soil packs, it is hard to get a stand on same.

No. 3419—Depth 12″-24″. Subsoil to No. 3418. Ennis, Ellis county, farm of J. M. Yowell. Black clay.

RESULTS OF THE 1909 POTATO EXPERIMENTS.

Six experiments are reported. Acid phosphate produces increases in four experiments, cottonseed meal in six, and muriate of potash in three.

EXPERIMENTS ON POTATOES—1910.

The plan of experiment was practically the same as in 1909. The successful results are as follows:

Fred Ohrt, Cuero, De Witt County.—Black and red sandy upland soil with reddish yellow clay subsoil; 12 to 15 years in cultivation and producing 20 to 25 bushels of corn. Located two and one-half miles west of Cuero. Rows three feet apart and not bedded. He believes that the light yield is due to bad mechanical treatment. Each plot consists of eight rows 270 feet long.

Acid phosphate and cottonseed meal were effective.

This soil is a little low in potash, low in nitrogen and phosphoric acid, also in active phosphoric acid.

Description of Soil.—No. 3375—Depth 0″-9″. Two and one-half miles west of Cuero, De Witt county, on H. Taylor league, on the farm of Fred Ohrt. This is black sandy upland, well drained, slightly rolling, known as black sandy or mixed sand and considered moderately fertile, 22 bushels of corn per acre being produced. Corn and cotton are the principal crops. No fertilizer, green crop or manure has been applied. The soil does not pack, crack or wash, and dirt does not wash onto it. The underdrainage is good. The land has been under cultivation from 12 to 15 years, and represents six to eight acres on the farm. Ten loads of manure were put on this soil January 15, 1910.

No. 3376—Depth 9″-20″. Subsoil to No. 3375. Dark brown gravelly clay.

T. E. Martin, Donnie, Freestone County.—Light colored sandy soil, 10 to 15 inches deep with red clay subsoil; in cultivation eight years and produces 700 pounds cotton or 14 bushels of corn. Cotton makes large enough stalk but does not fruit well. Located three and one-half miles west of Donnie. Cottonseed meal and manure gave good results. Planted March 25th and harvested May 28th. Two rows per plot, 280 feet long and 3½ feet apart, bedded. The plants were cut to the ground by a frost on April 25th and the succeeding drouth of four weeks damaged the yield severely. None were larger than a guinea egg and were rotting when gathered.

Cottonseed meal was effective.

This soil is low in lime, potash and nitrogen, fair in phosphoric acid, but low in active phosphoric acid.

Description of Soil.—No. 3401—Depth 0″-7″. Four miles west of Donnie, Freestone county; 12 acres lying south of the 11-league grant and next to southeast corner of Section 32, J. L. Chenert survey, on the farm of T. E. Martin. This is gray sandy upland, known as dark sandy hickory ridge land, and is considered moderately fertile; 20 bushels of corn and 700 pounds of cotton per acre were produced. The drainage is by means of ditches. Corn and cotton are the principal crops. No fertilizer, green crops or manure has been applied. The native vegetation consists of elm, hickory and Spanish mulberry. In wet seasons the soil gets soft if fresh plowed, in dry seasons it gets loose. The soil does not pack, crack, nor does dirt wash onto it. It crumbles on drying and heavy rains wash the land. This soil has been cultivated eight years; it represents one-half of farm and probably one-third of county.

No. 3402—Depth 7″-17″. Subsoil to No. 3401. Reddish sandy clay.

S. L. Horne, Frankston, Anderson County.—Black colored sand with red clay subsoil; three and one-half miles northeast of Frankston; in cultivation eight or nine years with some rotation; produces about 18 bushels of corn. Potatoes planted February 21st and harvested June 14th. Four rows 38 inches apart, 140 feet long. Fertilizer was applied in furrows besides rows after planting. Harrowed across rows with section harrow March 5th and 15th; plowed with diverse culivator March 28th, plowed with heel sweep April 15th. All were equally injured by frost on April 23d and by succeeding dry weather.

All applications were effective.

This soil is low in lime, phosphoric acid and nitrogen, good in potash. It is low in active phosphoric acid.

Description of Soil.—No. 3383—Depth 0″-10″ to 12″. Three and one-half miles southwest of Frankston, Anderson county. Furgeson survey, on east side of farm half way between north and south lines, on the farm of S. L. Horne. This is light colored sandy upland soil, rolling and well drained. It is considered moderately fertile and produces 18 bushels of corn and one-third bale of cotton per acre. It is known as gray sandy land. Corn, cotton and some truck are grown. Pine, hickory and red oak are the native vegetation. The land stands wet and dry seasons equally well. The soil does not pack, crack or wash, nor does dirt wash onto it. The soil crumbles on drying. The soil has been cultivated eight or nine years and represents 18 or 20 acres on farm. No green crop, fertilizer or manure has been applied.

No. 3384. Subsoil to No. 3383. Light sandy subsoil.

Sam W. Harper, Sanger, Denton County.—Poor sandy clay soil, light red in color, with clay subsoil; in cultivation 30 years and produced two bushels per acre of corn in 1909. Located five and one-half miles south of Denton. The yield of potatoes was very light and the potatoes were small; practically no rain from January 15th to April 8, 1910. Potatoes were severely injured by hail and rain on April 8th. All rows 140 feet long and 3 feet 8 inches apart.

Acid phosphate and cottonseed meal were effective.

This soil is well supplied with lime and potash, a little low in nitrogen, fair in phosphoric acid. It is, however, low in active phosphoric acid.

Description of Soil.—No. 3353—Depth 0"-10". Five and one-half miles north of Denton, Denton county, on Wm. Roak survey, on the farm of S. W. Harper. Sample taken 200 yards south and 100 yards east of northwest corner of farm. This is upland soil, well drained and locally known as dark sandy land. It is considered moderately fertile, producing 25 bushels of corn and one-third bale of cotton per acre. Corn, cotton, wheat and garden truck are grown. The yield is fair in wet seasons, not much in dry. The soil packs, dries into clods, cracks on drying (very small cracks) and washes. Dirt does not wash onto it. The underdrainage is fair. The land has been cultivated 30 years and it represents seven or eight acres on this farm. Crab grass has been plowed under and a small amount of barnyard manure applied; the soil was loosened and the yield increased. No fertilizer has been applied. The soil has no peculiarities.

No. 3354—Depth 10"-20". Subsoil to No. 3353.

John B. Griffin, Thornton, Limestone County.—Dark loam upland soil with clay subsoil; 30 years in cultivation, being cropped in cotton exclusively until five years ago, and then commenced to build up. Produces 25 bushels of corn and one-third bale of cotton. Peas and millet were grown on this soil the previous season. Potatoes planted March 7th and harvested June 2d. Fertilizer drilled in furrow a week before planting and a plow run through at planting time. Two rows per plot, 3 feet apart and 280 feet long. Potatoes covered with turning plow. Ridges were harrowed off; two weeks later gave one cultivation with sweep and laid by. No. 5 had an ant bed in it. There was a difference in the quality in favor of the highly fertilized plots.

Acid phosphate and cottonseed meal were effective.

For analyses of soil, see corn experiments.

J. M. Yowell, Ennis, Ellis County.—Light colored sandy soil with clay subsoil; cultivated 20 years and producing 20 bushels of corn or 500 pounds of seed cotton. Six miles north of Ennis, Texas. The land was broken in December. Potatoes planted last week in February and harvested June 17th.

Fertilizer applied in furrow on each side of row. Two rows per plot, 3 feet apart and 280 feet long.

Acid phosphate and cottonseed meal were effective.

A similar experiment was carried out in 1909, in which acid phosphate was most effective, but all applications gave results.

For analysis of soil, see 1909 experiments.

Englehard Brothers, Eagle Lake, Colorado County.—Dull light red sandy loam soil with a similar subsoil. Spotted in character, but they used a uniform piece for the experiment. First and second bottom; six miles southwest of Eagle Lake. The land contains some shells and is known as "Caney Land." It has been in cultivation since the Civil War, mostly with cotton, and produces from 30 to 35 bushels of corn and 60 to 75 bushels of potatoes. The results of the experiment were unsatisfactory, owing to the extreme drouth. A number of other tests were made, but only the results with the mixtures sent out are here reported. All the additions appeared to give results, but the soil is

TABLE NO. 27—Co-operative Fertilizer Experiment With Potatoes, 1910.

Plot No.		Cuero, DeWitt county.		Donnie, Freestone county.		Frankston, Anderson county.		Sanger, Denton county.		Thornton, Limestone county.		Ennis, Ellis county.		Eagle Lake, Colorado county.	
		Weight per plot	Stand	Weight per plot	Stand	Weight per plot	Stand	Weight per plot	Stand	Weight per plot	Stand	Weight per plot	Stand	Weight per plot	Stand
0	No addition	.....	.....	.....	.....	.....	.....	.....	.....	38	90	.....	.....	86	.....
1	15 lbs. acid phosphate	135	Good	22	95	111	100	44	.....	88	90	130	100	98	.....
2	15 lbs. acid phosphate, 20 lbs. cottonseed meal	210	Good	29	100	249	100	56	.....	117	90	140	100	108	.....
3	15 lbs. acid phosphate, 20 lbs. cottonseed meal, 1 lb. muriate of potash	180	Good	27.5	100	277	100	50	.....	122	90	134	100	160	.....
4	15 lbs. acid phosphate, 20 lbs. cottonseed meal, 5 lbs. muriate of potash	200	Good	31	100	328	100	48	.....	113	90	135	100	146	.....
5	No addition	116	Good	23	100	93	100	36	.....	43	90	100	100	136	.....
6	500 lbs. cow-pen manure	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	125	100	.....	.....
	Effect of:														
	Acid phosphate	19	.....	.....	.....	18	.....	8	.....	50	.....	30	.....	12	.....
	Cottonseed meal	75	.....	6	.....	138	.....	12	.....	29	.....	10	.....	10	.....
	1 lb. muriate of potash	−30	.....	1.5	.....	28	.....	−6	.....	5	.....	−6	.....	52	.....
	5 lbs. muriate of potash	−10	.....	+2	.....	79	.....	−8	.....	−4	.....	−5	.....	38	.....

believed to be better where the additions were made, so that there may have really been no effect from the application.

These two soils are both well supplied with lime and potash. No. 1974 contains much more phosphoric acid and nitrogen than No. 1973, and is also a better soil, according to the yields produced. Both of these soils are well supplied with active phosphoric acid, but this phosphoric acid may be distributed through a considerable amount of lime, and, therefore, not be available at once.

Description of Soil.—No. 1972, Surface soil, Eagle Lake, Colorado county, Englehard Brothers. One and one-half to three miles west of Colorado river. This is a red, light sandy land, and is known as Caney soil. It is considered moderately fertile and produces one-third bale of cotton, 25 to 30 bushels of corn and 60 to 75 bushels of potatoes per acre.

No. 1973. Subsoil to No. 1972. Red clay loam.

No. 1974. Surface soil. Eagle Lake, Colorado county, near Colorado river, Englehard Brothers' farm. This is considered good soil. One-fourth bale of cotton and 45 bushels of corn are produced. The soil is a red clay loam.

No. 1975. Subsoil to No. 1974. This subsoil is a clay loam.

TABLE NO. 28. Summary of Potato Experiments, 1909-10.

	1909	1910	Total.
Number of experiments—Total	6	7	13
Number showing gains by acid phosphate	4	6	10
Number showing gains by cottonseed meal	6	7	13
Number showing gains by potash	3	2	5
Average gains of potatoes when a gain occurred, in pounds per plot (1–20 acre)			
By acid phosphate, 15 lbs	59	23	.....
By cottonseed meal, 20 lbs	59	40	.....
By muriate of potash, 1 lb	13	40	.....
By muriate of potash, 5 lbs	31	58	.....

RESULTS OF THE 1910 POTATO TESTS.

The dry weather interfered with a number of these tests. Seven experiments are reported. Acid phosphate showed six gains, cottonseed meal seven gains, muriate of potash, two gains. These results are similar to those for 1909.

SUMMARY OF POTATO EXPERIMENTS.

A summary of the potato experiments is shown in Table 28. Ten of the 13 experiments show gains with acid phosphate, all gain with cottonseed meal, and five gain with potash.

From these results we would conclude that a mixture of acid phosphate and cottonseed meal gives the most profitable results. The experiments do not show the best proportions to mix these. This must depend upon the soil to some extent, and also on the season. The longer the soil has been in cultivation, the more cottonseed meal should be used. A mixture of equal parts cottonseed meal and acid phosphate should give good results. The amount of cottonseed meal may be increased for the poorer soils and decreased for better soils. The larger the quantity of fertilizer used, the richer it may be in cottonseed meal and the lower in acid phosphate.

TABLE NO. 25—Percentage Composition of Soils. Potatoes.

	S. E. Peek, Hempstead.		F. J. Trapp, Seabrook.		F. J. Trapp, Seabrook.		F. J. Trapp, Seabrook.		Fred Ohrt, Cuero.		T. E. Martin, Donie.		S. L. Horne, Frankston.		S. W. Harper Denton.	
	3266	Sub-soil 3267	2844	Sub-soil 2845	2846	Sub-soil 2847	3409	Sub-soil 3410	3375	Sub-soil 3376	3401	Sub-soil 3402	3383	Sub-soil 3384	3353	Sub-soil 3354
Phosphoric acid	.008	.027	.030	.015	.024	.027	.062	.045	.020	.025	.077	.090	.015	.037	.060	.062
Nitrogen	.042	.074	.089	.041	.123	.097	.147	.090	.035	.048	.049	.041	.035	.020	.090	.079
Potash	.370	.370	.167	.380	.260	.150	.380	.440	.140	.470	.090	.220	.220	.090	.580	.450
Lime	.090	.130	.340	.240	.240	.200	.440	.450	.....	.....	.070	.260	.080	.050	.330	.350
Magnesia	.100	.170	.500	.250	.310	.340	.430	.610	.100	.460	.060	.480	.040	.040	.300	.220
Carbon dioxide	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.750	.....	.....	.....
Sulphur trioxide	.....	.120	.017	.022	.020	.060	.100	.005	.070	.060	.040	.010	.040	.060	.020	.060
Alumina and oxide of iron	3.110	7.150	4.250	9.220	8.730	9.380	7.980	12.950	1.720	10.340	1.730	6.630	1.215	1.330	7.270	8.290
Manganese	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Insoluble and soluble silica	94.590	72.990	91.640	84.800	84.220	83.750	82.530	75.870	96.090	77.840	96.340	78.120	97.340	96.71	85.980	84.310
Loss on ignition	1.550	5.410	3.610	4.320	5.700	4.810	5.400	5.490	1.260	4.410	.870	4.520	1.110	.720	3.840	4.380
Moisture	.590	5.320	.920	2.320	1.910	2.060	2.810	3.970	.570	5.090	.370	4.160	.160	.110	1.440	2.090
Parts per million:																
Active phosphoric acid	8	.....	16	.....	11	5	82	10	23	23	18	9	29	11	26	11
Active potash	34	.....	71	94	131	102	213	129	24	108	71	66	93	77	380	278

Potash only gave results in 5 of the 13 experiments, but where it was effective it gave a good increase. Potato growers must make tests of their own and learn by their own experience the best fertilizers to use under their conditions.

Both years where potash was effective (in 5 of the 13 tests), an increase from one pound to five pounds muriate of potash caused an average increase of 18 pounds of potatoes; that is, one pound increase in potash caused an average increase of nine pounds of potatoes.

A mixture of equal parts of acid phosphate and cottonseed meal, or of 1200 pounds of cottonseed meal to 800 pounds of acid phosphate, makes a good potato fertilizer for many Texas soils. On some soils the use of potash would also be of advantage.

TABLE NO. 26—Percentage Composition of Soils. Potatoes.

	J. M. Yowell, Ennis.		Englehard Bros., Eagle Lake.		Englehard Bros., Eagle Lake.	
	3418	Subsoil 3419	1972	Subsoil 1973	1974	Subsoil. 1975
Phosphoric acid	.022	.052	.060	.095	.110	.045
Nitrogen	.070	.054	.060	.040	.130	.030
Potash	.330	.280	.361	.345	.604	.356
Lime	.250	.250	6.650	6.350	4.870	7.460
Magnesia	.250	.260	.570	.980	1.100	.730
Carbon dioxide						
Sulphur trioxide	.040	.050	.032	.015	.130	.063
Alumina and oxide of iron	4.330	6.090	5.380	5.900	8.870	5.550
Manganese						
Insoluble and soluble silica	91.270	89.150	74.140	71.350	65.000	72.300
Loss on ignition	2.600	2.430				
Moisture	1.240	1.630				
Parts per million:						
Active phosphoric acid	18	11	144	22	133	40
Active potash	81	87	160	39	316	61

ANALYSES OF THE SOILS USED IN POTATO EXPERIMENTS.

The chemical composition of the soils used in the potato experiments is presented in tables in the text. Potatoes appear to require fertilizer and to respond to it more frequently than corn or cotton. That is to say, the composition of the soil is not such a great factor as with corn or cotton. Of course, if the soil is rich, the plant food may not have a great effect, but potatoes grow quickly, and benefit by a supply of easily available food, such as is furnished by fertilizers.

Active Phosphoric Acid.—The relation of this to the field yields is shown in tables preceding. All the soils are low in active phosphoric acid excepting the one from Eagle Lake. All but one respond to applications of phosphates. The Eagle Lake soil apparently responds, but the results here were unsatisfactory on account of drouth and differences in the soil, and it is not certain that the gain is really due to the acid phosphate.

GENERAL STATEMENTS CONCERNING CORN, COTTON AND POTATO EXPERIMENTS.

In previous bulletins dealing with the composition and properties of Texas soils (Nos. 99 and 125) we have pointed out that Texas soils are most likely to be deficient in phosphoric acid, next in nitrogen, and last

nd least in potash. The field experiments presented in this bulletin onfirm this conclusion. A summary of the corn, cotton and potato xperiments is given in Table 29. Acid phosphate was effective in over 0 per cent of the tests, cottonseed meal in about 64 per cent, and potash n about 40 per cent.

NOTE.—We expect to discuss in full in later bulletins the relation etween the composition of the soil, pot experiments and field experiments, and we expect to include analyses of soils on which experiments re reported in this bulletin, but which the analyses are not yet ready.

TABLE NO. 29.—Summary of Corn, Cotton and Potato Experiments.

	Corn.	Cotton.	Potatoes.	Total.
Total number of experiments.....	37	21	13	71
Number of gains by acid phosphate....	31	18	10	59
Number of gains by cottonseed meal...	17	15	13	45
Number of gains by potash.....	12	10	5	27

SUMMARY AND CONCLUSIONS.

1. This bulletin contains the results of 37 co-operative fertilizer experiments on corn, 21 on cotton, 7 on rice, 1 on cauliflower, 2 on peanuts, and 1 on onions, 2 on tomatoes, and 13 on potatoes, carried out in 1908, 1909 and 1910.

2. The objects of these experiments are to ascertain the fertilizers adapted to various crops on Texas soils, under Texas conditions, and also to ascertain the relation between chemical composition, pot experiments and needs of soil as shown by fertilizer experiments.

3. Fertilizer supply plant food to the soil. Other conditions which control plant growths are moisture, temperature, depth and physical character of soil, condition of soil, insect pests, etc. The size of the crop depends upon the least favorable controlling condition.

4. Nitrogen for ordinary farm crops should be secured from the air by growing legumes and plowing them under or grazing them off. Phosphoric acid can be purchased as acid phosphate or bone meal, and potash as potash salts.

5. Field experiments with fertilizers are likely to vary on account of inequalities in soil on subsoil, or on account of other conditions than the one to be studied, and the fact must be considered in interpreting the results of such experiments.

6. Dry weather interfered to some extent with the experiments on corn. Acid phosphate at the rate of 200 pounds per acre increased the yield in 31 of the 37 experiments. The increase averaged from 390 to 440 pounds per acre of ear corn in the three years.

7. Seventeen of the 37 experiments gave increases with cottonseed meal, which supplies nitrogen mostly. The average increase was greater with 120 pounds per acre than with 60 pounds per acre. Corn fertilized with cottonseed meal appears to suffer more quickly from drouth than that fertilized with acid phosphate.

8. Potash increased the yield in 12 of the 37 experiments. Where it was needed, it had a considerable effect on the yield.

9. The soils which gave increased yields with cottonseed meal con-

tain, on an average, less nitrogen than those which did not give increases.

10. When less than 10 parts per million active phosphoric acid was present two soils gave increases with acid phosphate and one did not, but it is believed the sample did not represent this soil. The average yield without fertilizer on these two plots is 4.5 bushels per acre. The average corn possibility in pot experiments, based on phosphoric acid removed, is 4.5 bushels per acre. (See Bulletin 126.)

11. Six of nine soils containing 10 to 20 parts per million of active phosphoric acid gave increases with phosphate, and the average yield without fertilizer is about 17 bushels per acre. The average corn possibility based on pot experiments is 12.5 bushels per acre, maximum 31 bushels.

12. Four soils containing 20 to 30 parts per million of active phosphoric acid all responded to phosphate and the average yield without fertilizer was about 24 bushels per acre. The average corn possibility from pot experiments was 20.8 bushels per acre, maximum 36 bushels.

13. There was a relation between the average production of corn by the soils, and the quantity of active phosphoric acid in them.

14. In 17 of 21 co-operative experiments on cotton, acid phosphate increased the yield.

15. In 15 of the 21 experiments cottonseed meal increased the yield. Cotton fertilized with cottonseed meal does not suffer so much from drouth as does corn fertilized with it.

16. In 10 of the 21 experiments potash increased the yield. It would appear from these experiments that potash is more likely to be of benefit to cotton on Texas soils than corn.

17. The effect of Thomas phosphate on corn was less than that of acid phosphate in the four tests, and greater on cotton in the two tests.

18. In the experiment on cauliflower the best results were secured with an application of 300 pounds acid phosphate per acre, 50 pounds sulphate of potash, 250 pounds cottonseed meal, with a top dressing of nitrate of soda, equivalent to 600 pounds per acre of a fertilizer containing 8 per cent phosphoric acid, 5 per cent potash and 3 per cent nitrogen, followed by the top dressing with nitrate of soda.

19. Potash was effective in two experiments on tomatoes. Nitrogen also was effective in one experiment.

20. Lime was most effective in the production of peanuts at Rock Island, acid phosphate and potash being also effective. Acid phosphate and Thomas phosphate were most effective in the production of hay at College Station.

21. One co-operative onion experiment and three other experiments on onions are reported. Potash gave no results in any of them. Phosphoric acid was most effective at Clyde, cottonseed meal was also effective. Lime was apparently most effective in one experiment at Laredo, but this soil is very rich in lime. Nitrate of soda or cottonseed meal was most effective in another experiment at Laredo. Barnyard manure was the only addition which had much effect at Beeville.

22. In 10 of 13 experiments in Irish potatoes acid phosphate produced results.

23. In 13 of 13 experiments on potatoes cottonseed meal produced results.

24. In 5 of 13 experiments on potatoes potash produced results.

25. A mixture of equal parts acid phosphate and cottonseed meal, or of 800 pounds acid phosphate to 1,200 pounds cottonseed meal, makes a good potato fertilizer for many Texas soils. On some soils the use of potash also would be of advantage.

26. In the 71 tests with corn, cotton and potatoes, 59 tests respond to acid phosphate, 45 to cottonseed meal and 27 to potash. This confirms our conclusions from soil analyses in previous bulletins, that Texas soils are likely to be deficient in phosphoric acid first of all, next in nitrogen, and last and least often in potash.