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COMMERCIAL FERTILIZERS AND COMMERCIAL POISONOUS INSECTICIDES.

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COMMERCIAL FERTILIZERS AND COMMERCIAL POISONOUS INSECTICIDES.

BY H. H. HARRINGTON.

This bulletin contains a discussion of some of the fundamental principles underlying the use of fertilizers and insecticides, together with their chemical composition, and a list of dealers and agents who handle commercial fertilizers in this State. Most of the analyses have been made by Dr. Fraenkel and Mr. Hargis, aided as his time would allow by Professor Tilson. The increase of fertilizers in this State, for this season over last, has been about 100 per cent.; some 10,000 tons being sold. This rapid increase is mainly due to the impetus given truck crops in the eastern part of the State, although the "coast country" uses a considerable quantity of fertilizers. It is expected that this increase will continue in almost the same ratio for several years, because it has been proven, over and over again, that fertilizers justify their use on thin, or even medium land, with the ordinary farm crop, while for successful truck crops they are absolutely essential. In the older Southern Atlantic and Gulf States, the fertilizer industry has grown to immense proportions. The following table will show the enormous quantity of fertilizers used in some of these States in 1891 and 1902, as well as the rate of increase.

	Number of tons consumed— 1891.	1902.	Percentage of increase.
Mississippi	20,000	65,000	225 per cent.
Louisiana	8,000	48,000	500 per cent.
Alabama	115,000	175,000	52 per cent.
Tennessee	14,000	40,000	185 per cent.
Kentucky	9,500	40,000	321 per cent.
Georgia	306,000	478,000	56 per cent.

North Carolina uses about the same quantity as Georgia. The soil of East Texas is such as to respond most beneficially to the use of commercial fertilizers; a clay loam or sand on top, with a porous red clay beneath. At present the use of fertilizers is restricted almost entirely to truck crops, but the time is near by when field crops will rarely be grown without fertilizers.

State Control.

Under the law of the State all fertilizer dealers or manufacturers must have every sack or lot of fertilizer to be sold properly tagged. This tag shows, over my name, the composition and approximate valuation of the fertilizer. But farmers as a rule do not give sufficient attention to the analysis as printed on the tag. This is mainly the result of not understanding clearly just what the analysis means; that is, just what significance is attached to the terms used in expressing the analysis. To illustrate the meaning of these terms we copy a tag of this season, as follows:

"Tag not good after September 1, 1903.

Agricultural and Mechanical College of Texas.
Chemical Department.
Certificate of Analysis.

Standard Guano and Chemical Manufacturing Co. of New Orleans, La., having complied with the law in this State regulating the sale of commercial fertilizers, the particular brand herein named, *Stern's Ammoniated Raw Bone Superfosfate,* has the following composition:

Total phosphoric acid	9.61 per cent.
Water soluble phosphoric acid	6.38 per cent.
Reverted phosphoric acid	2.19 per cent.
Available phosphoric acid	8.57 per cent.
Nitrogen	2.27 per cent.
Equivalent in ammonia to	2.76 per cent.
Potash	2.36 per cent.

Valuation per ton $20.25."

Particular attention is directed to the statement at the top of the tag, "Not good after September 1, 1903." This means simply that the fertilizer season of the year closes at this time, and the manufacturer must furnish new tags. It does not mean that the goods have deteriorated, since a fertilizer, if kept dry, should remain of about the same value for at least one year. The fertilizer season runs from September 1st to September 1st of the following year. Attention is next called to the "*water soluble phosphoric acid.*" This means that this amount of phosphoric acid is immediately soluble in water, and is the most valuable form of phosphoric acid. While the valuation is based on the amount of "available phosphoric acid"—which is the sum of "water soluble" and the "reverted"— the water soluble should be as large as possible, and the reverted as small as possible. Since this water soluble phosphoric acid is immediately soluble in water, it might appear that there would be great danger of its being washed out of the soil by drainage, and thus lost to the crop. But as a matter of fact, there is very little danger of this kind, unless the fertilizer should be applied some time in advance of planting the crop; because the phosphoric acid is held chemically and mechanically in the soil in such a way as to retard its loss by drainage. It becomes diffused through the soil by the percolating water, but is not likely to be leached before the plant roots assimilate it. Let us notice the label next for the "reverted phosphoric acid." This really means phosohoric acid that was once soluble in water, but which has changed back or "reverted" into a less soluble form. In this form it is not soluble in pure water, but the soil water is never pure, and the roots of the plant exude acid juices in a small quantity which help to dissolve this reverted phosphoric acid. Hence, while it is less valuable than soluble phosphoric acid, it is frequently assigned an equal commercial value, as we do in this State, because it does become soluble and available during an ordinary crop season. Again referring to the tag, we notice the "total

phosphoric acid." In this case, it is 9.6 per cent. The difference between it and the "available" should be kept by the manufacturer as low as possible. In the case of this tag it is quite low, only about 1 per cent. This difference represents *insoluble* phosphoric acid, and is not bought or paid for by the farmer, since it is supposed to be of no value to crops. Still, it is stored in the soil, and ultimately—no one can say at what time—some part of it, at least, becomes useful. We next refer to the tag for the percentage of nitrogen. Its "equivalent in ammonia" is stated merely for comparison by the farmer. It is the *nitrogen* and not the ammonia which is given a valuation. We know much less about the solubility or availability of nitrogen in its various forms, than we do of the phosphoric acid and potash. There are certain forms of nitrogen, such as that in nitrate of soda, dried blood, finely-ground steamed bone, bat guano, and cotton seed meal, that we know are immediately available to the plant, or early become so after being applied to the soil. But there are many other forms that we know are not immediately soluble, and we cannot tell just how soon they become so. Sometimes the name on the tag, as in this case—"*Ammoniated Raw Bone Superfosfate,*" will, if true to name, give us some indication of the source of the nitrogen. But in many other cases the name affords us no evidence as to the source from which the materials are obtained. At other times the name of the manufacturer appearing on the tag will be an indication of the source of nitrogen. We may be reasonably sure, for example, that the Swift and Armour brands of fertilizers derive their nitrogen from refuse animal products; so with the Union Meat Company of San Antonio, and the Houston Packing Company. In the South, cotton seed meal is one of the most common sources of nitrogen. But the *form* of nitrogen, whether derived as a waste product from animals, or plants, or existing as *nitrate* nitrogen, is of some importance, and should be considered by the farmer. All potash salts are soluble in water; but here again, the form may have considerable influence and should be carefully considered. After a study of the percentage composition of the fertilizer as shown by the tag, notice the valuation per ton.

This is not intended to be anything more than relative, and to serve as a general guide for the buyer. In most cases, it is somewhat under rather than above the real value of the fertilizer, and in a general way is based upon

The Commercial Value of Cotton Seed Meal.

Texas cotton seed meal is particularly rich in nitrogen, rarely ever falling below 7½ per cent., sometimes reaching more than 8 per cent. This is fortunate both for the cattle feeder and the fertilizer consumer, but does not always carry the American average in potash and phosphoric acid. The average for meal is about as follows:

Phosphoric acid	3.00 per cent.
Potash	1 50 per cent.
Nitrogen	7.00 per cent.

Assigning a valuation of 13 cents a pound for the nitrogen, 5 cents for the potash, and 7 cents for the phosphoric acid, the fertilizer value of a ton of meal becomes, practically, $25.00. During the fall, meal

can always be purchased at this price, and sometimes much cheaper. Cotton seed meal, therefore, becomes a guide in a general way for the Texas farmer in the purchase of a fertilizer. It is, of course, not a well-balanced fertilizer; and its use by itself would be poor economy. It contains an excess of nitrogen, and, if used by the farmer, should be mixed with an acid phosphate or "superfosfate" as it is frequently called, together with potash in some form. It is true that it may sometimes give seemingly good results when used alone. This may be explained by the statement that in some special cases of soil and crop, an excess of nitrogen is an advantage. But it is more generally the result of most soils and all crops being in need of all three ingredients—nitrogen, phosphoric acid and potash, which are supplied by cotton seed meal, but as stated above, not in the right proportion. But the application of an improperly balanced fertilizer is better than not to use any. Then again, cotton seed meal adds very considerably to the humus of the soil, the presence of which is always desirable. Acid phosphate of good quality can usually be bought at from fourteen to seventeen dollars per ton, while kainit, an impure sulphate of potash carrying 12 per cent. of actual potash, and an excess of chloride of sodium and magnesium, may be bought for fourteen to sixteen dollars per ton. So that, while the Texas farmer is considerably removed from the fertilizer market, he is in a measure independent.

"What is the Best Fertilizer?"

This is a very natural question and I receive quite a number of letters making the inquiry. Yet it is a question which would be asked only by the inexperienced in the use of fertilizers. There is, of course, no fertilizer made which would respond to all requirements as being the *best fertilizer;* and a specific answer by a State Chemist would simply be an advertisement of the goods of some particular manufacturer. All manufacturers make a constant study of the needs of the various crops grown within their trade territory, and of the fertilizer requirements of the different soils. At the same time, the manufacturer must keep in view his net profits. So that each manufacturer is trying the same thing—to make as much money as a legitimate business will allow, and still hold his trade with the farmers. Of course, one of the best means of holding trade in the long run is honest, legitimate business. But as it takes at least one season, and sometimes several, by actual field experience, for the discovery of fraud in fertilizers, the fertilizer laws providing for analysis and inspection are enacted in the several states. In this way, both the honest dealer and the farmer are protected against fraud by the unscrupulous manufacturer or dealer. But while the manufacturers are constantly at work to furnish goods suitable to their trade, they must be largely dependent upon the results obtained in actual field tests, either by the farmers themselves or by the experiment stations. Even then, with this knowledge, they find it difficult to compound a fertilizer precisely suitable in each case. It will be seen, therefore, that each farmer must decide this question for himself by actual field tests on his own farm, if he wants a specific answer. At the same time, as

the result of experiments in different localities on various soils and under changing climatic conditions, together with the facts learned by analysing the crops or plants themselves, certain general principles have been found out, which every farmer should know for his guidance in the absence of that information which comes from long experience. For example, a certain class of crops, if grown in pure sand, would need nitrogen, phosphoric acid and potash in one proportion, while another class grown in a similar way, would need the above three elements of plant food in a different proportion. So that crops, supplying them with the same type of soil—pure sand—feed differently. The table below gives the percentage ingredients of fertilizers recommended for some of the common crops. Of course such a table must be made suggestive only; but it will serve as the basis of a guide to the farmer, in the absence of definite or specific information from field trials.

Relative Percentage Amount of Plant Food Snggested for Some Common Crops

	Relative amounts of—		
(Kind of Crop.)	Nitrogen	Potash	Available Phosphoric Acid.
Tomatoes	4	6	8 per cent.
Irish potatoes	3	5	8 per cent.
Onions	4	6	7 per cent.
Melons	4	6	8 per cent.
Cabbages	4	6	8 per cent.
Beets	4	6	8 per cent.
Strawberries	4	6	8 per cent.
Sweet potatoes	1	6	7 per cent.
Beans	1	7	7 per cent.
Corn	3	3	8 per cent.
Cotton	2	3	9 per cent.
Oats	3	3	9 per cent.
Cucumbers	4	6	8 per cent.

It must be understood that the above table is not exact; but still, no great mistake will be made, or loss incurred, if it is adopted in the absence of actual experimental trials. It is presumed that the "truck crops," or "market crops" will be grown on a sandy upland soil, with clay subsoil; while the soil upon which the field crops, cotton, corn and oats, are grown may be any kind that the farmer selects. Therefore the fertilizer for these crops may vary quite widely in its proportion of plant food from that given above, according as to whether it is a sandy soil, a clay loam or an alluvial soil rich in nitrogen, upon which the crop is grown. The proportions given in the table are suitable for a sandy soil. Then it must be remembered that when fertilizers are used successively year after year, a part of the potash especially remains over in the soil, and the quantity required the first year may be somewhat diminished the next season; this is true to a less extent of the phosphosic acid and nitrogen.

The Form of the Plant Food as indicated by its Origin.

It is well known that there are certain crops, like the melons, turnips, cucumbers, cabbages, and onions, that do best with a large amount of humus. Hence, decaying vegetable or animal matter should be applied to them. All the barn-yard manure available may be applied with profit. Cotton seed meal, tankage, or bat guano, balanced with acid phosphate or steamed bones, may be used to advantage. There are other crops, like tomatoes, strawberries, and Irish potatoes, that stand in need of somewhat quickly available plant food. Whenever the time of productive growth is short, then the fertilizer must be one that is easily available.

Time of Application.

This will depend upon the kind of crop—particularly the time required for maturity—and the kind of fertilizer. Barnyard manure may usually be applied in the fall with best results, although if it has been well rotted, it may be applied in late winter or early spring; most commercial fertilizers some two weeks previous to planting; but with some crops, and quickly available fertilizers, it is best to make two applications, especially so if the rainfall will admit of it. In our climate care should be taken not to apply a fertilizer so late in the season as to create danger of "firing" or "burning" the crop. This danger easily arises if the second application is made when there is not sufficient moisture in the ground to insure the decomposition or solution of the fertilizer without depriving the plant of some of the moisture necessary for its growth and development. However, a crop which has been "fired" in the above way is frequently relieved by a timely rain and greatly increased in yield as a result of the fertilizer. Oats are usually sown here in the fall, and a part of the fertilizer should be applied at that time. In late winter or early spring, after the heavy rains, another application should be made. With Irish potatoes, one application may be made in the drill one or two weeks before planting, and a light dressing when the plants are eight to twelve inches high. Tomatoes may have their first dressing a week or ten days before setting out the plants, and if the fertilizer is an easily available one, a second dressing some four weeks after the plants have been set out.

As to method of application, it is best to apply in the drill the first time, and if a second application is made it should be on the side of the plant, or around it, near to it; but the fertilizer should not be allowed to strike the foliage, as it will burn it and injure the plant. In all cases it is desirable that the fertilizer should be commingled with the soil. This promotes decomposition and solution, and at the same time prevents the escape into the air of the ammonia formed in the process of decay.

Commercial Materials Used in the Manufacture of Fertilizers.

In the South, cotton seed meal is the basis of many fertilizers. The meal is of course mixed with acid phosphate, and some potash salt, usually *kainit*, to balance the relative quantities of nitrogen, phos-

phoric acid, and potash, making what is called a *complete* fertilizer. The term "complete fertilizer" being applied to one that contains, in amount according to the needs of the crop, the three ingredients, nitrogen, phosphoric acid, and potash. A *special* fertilizer is one that contains either one or two of the above ingredients, to suit the requirements of some particular crop or soil under special conditions. Cotton seed meal is essentially a nitrogenous fertilizer. It contains nitrogen in what is known as the *organic* form, and specifically, *vegetable* organic nitrogen, to distinguish it from *animal* organic nitrogen, like that in bone meal, dried blood, bat guano, tankage, etc. Besides organic nitrogen, we have nitrate of soda, in which condition the nitrogen is spoken of as *nitrate* nitrogen. We have *ammonia* nitrogen in sulphate of ammonia. The source of phosphoric acid is acid phosphate, or as it is sometimes called, superphosphate, or bone meal and steamed bones. Acid phosphate or superphosphate means an insoluble phosphate—whether a rock phosphate, a bone phosphate, or a bone-ash phosphate—which has been treated with sulphuric acid, or oil of vitriol, in order to make the phosphate soluble. The potash, with the single exception of that in wood ashes, used in fertilizers, is derived entirely from the *Stassfurt mines* in Germany. The owners of these Staasfurt mines control the world's market value of potash. They keep three general agencies in this country to encourage the use of their various commercial products. Three of their crude salts are imported and used as such, viz: *Kainit, Carnallit, Sylvinit.* Kainit is the only one sold in this State, and the chief one sold in this country. It is an impure sulphate of potash, containing, however, much chlorine. From these crude salts named, the sulphate and muriate of potash are made. In buying either the sulphate or muriate, the buyer should require a statement and guarantee from the seller of the actual amount of potash. While kainit is more frequently used, because it is somewhat cheaper in proportion to the actual amount of potash contained than the sulphate or muriate, it is doubtful if such a practice is the best. In most cases I should prefer to use either the sulphate or muriate, even at a slightly increased expense.

Home Mixtures.

Very frequently the farmer would like to prepare a mixture containing plant food in some special proportion for specific use, or he may have available some one ingredient, cotton seed meal, for example, and want to know how much of a potash salt and phosphate he shall add in order to balance the nitrogen. He must of course decide first in what proportion he wants the nitrogen, phosphoric acid, and potash. Then he must know the average composition of the meal, or in case of other fertilizer commodity, its guaranteed composition. We may say cotton seed meal contains 7 per cent. of nitrogen, 3 per cent. of phosphoric acid, and 1½ per cent. of potash. Assume that he wants a fertilizer carrying 3 per cent. of nitrogen, 8 per cent. of available phosphoric acid, and 5 per cent. of potash. If this is calculated on the basis of a ton, or 2000 pounds, we would want in our home mixture, 60 pounds of nitrogen, 160 pounds of available phosphoric acid, and 100 pounds of potash. Then the mixer asks himself,

"What amount of meal will give the 60 pounds of nitrogen?" Divide the per cent. of nitrogen in the meal, which is 7, into the number of pounds of nitrogen required for the 2000 pounds of mixture, which is 60, and multiply the result by 100, and you will have the number of pounds of meal required, practically, 850 pounds.

$(60 \div 7 = 8\frac{1}{2};\ 8\frac{1}{2} \times 100 = 850.)$

To prove this multiply the 850 pounds of meal by its percentage of nitrogen, 7, the result is 59½ pounds of nitrogen. But the meal contains 3 per cent. of phosphoric acid; and 3 per cent. of 850 would be 25½ pounds of phosphoric acid. Meal contains 1½ per cent. of potash, and the 850 pounds of meal would therefore furnish 12¾ pounds of potash. Our statement would therefore become:

850 pounds of meal, carrying
Nitrogen ..... 60 pounds.
Phosphoric acid ..... 25½ pounds.
Potash ..... 12¾ pounds.
But we want the mixture on the basis of a ton which contains
Nitrogen ..... 60 pounds.
Phosphoric acid ..... 160 pounds.
Potash ..... 100 pounds.

The difference between 850 and 2000 is 1150; so that we must use some substance or substances, not more than 1150 pounds in total amount, that will supply the remainder of our phosphoric acid and potash. The full amount of nitrogen is supplied by the meal. The amount of phosphoric acid required, 160 pounds, less that in the meal, 25½ pounds, is 134½ pounds needed. The amount of potash required, 100 pounds, less 12¾ pounds supplied by the meal, leaves 87¼ pounds needed. We can secure acid phosphate carrying 14 per cent. of available phosphoric acid; we require 134½ pounds of phosphoric acid, additional to that in the meal. Divide 134.5 by 14 and multiply the result by 100. We have $134.5 \div 14 = 9.6$; $9.6 \times 100 = 960$ pounds of acid phosphate. This added to 850 pounds of meal makes us 1810 pounds of our mixture, leaving 190 pounds of some potash salt to supply the 84¼ pounds of potash required. A high-grade muriate will contain about 50 per cent. of actual potash. This would give us 95 pounds of potash in 190 pounds of the muriate, which would complete our formula as follows:

2000 pounds mixture containing
850 pounds cotton seed meal.
960 pounds of acid phosphate, carrying 14 per cent. available phosphoric acid.
190 pounds of high grade muriate of potash.

The mixture contains plant food in the following proportion:
Nitrogen ..... 3 per cent.
Available phosphoric acid ..... 8 per cent.
Potash ..... 5 per cent.

This mixture will do for oats, and corn; and fairly well for many vegetables.

Other Home Mixtures.

Tankage ..... 1,200 pounds.
Acid phosphate ..... 300 pounds.
Kainit ..... 500 pounds.

Assuming that the tankage carries 6 per cent. of nitrogen and 8½ per cent. of available phosphoric acid; that acid phosphate has 14 per cent of available phosphoric acid; and the kainit 12 per cent. of actual potash, the above mixture would show about

3.6 per cent. nitrogen.
7.2 per cent available phosphoric acid.
3.0 per cent. potash.

It should be noted, however, that the composition of tankage varies quite widely, according to the relative amounts of dried blood or dried meat to that of crushed bones, the nitrogen of course being derived mainly from the former, and the phosphoric acid from the latter.

Using *Bat Guano Compost,* with a guaranteed composition of 4 per cent. of nitrogen, 6 per cent. available phosphoric acid, and ¾ of 1 per cent. of potash, we may supplement its acid phosphate and potash as follows:

1,400 pounds bat guano compost.
400 pounds acid phosphate.
200 pounds high grade muriate of potash.

This would give us a mixture containing about the following proportion of plant food:

2.8 per cent. nitrogen.
9.0 per cent. available phosphoric acid.
5.5 per cent. potash.

This makes a highly concentrated and quick-acting fertilizer. Bat guano compost is nothing but a mixture of bat guano, and bat guano ash. The bat guano itself varies quite widely in composition, owing to the varying amount of dirt and foreign material mixed with it. The following analysis shows the results of a recent sample:

Moisture ..... 12.18 per cent.
Ash ..... 17.93 per cent.
Organic matter ..... 69.89 per cent.
Total nitrogen ..... 9.94 per cent.
Total phosphoric acid ..... 5.00 per cent.
No nitrate present.

If we desire the quick effects of nitrate of soda, we may use this mixture:

300 pounds nitrate of soda.
1,200 pounds acid phosphate.
500 pounds kainit.

This mixture would carry:

3.00 per cent. nitrogen.
8.40 per cent. available phosphoric acid.
3.00 per cent. potash.

If it is desired to increase the amount of potash, replace a part of the kainit with muriate or sulphate of potash. For example:

150 pounds of the muriate,
350 pounds of the kainit,

carrying the potash to nearly 6 per cent. This mixture makes a very highly concentrated fertilizer, and a very expensive one in this State.

In making up home mixtures, care should be exercised to select, as far as possible, materials that are evenly balanced as to solubility. That is, a fertilizer carrying any one ingredient, phosphoric acid, for example, which will only slowly dissolve, along with quickly available nitrogen, like that in nitrate of soda or dried blood, should be avoided. This care in selection of material for the compost applies particularly to the forms of phosphoric acid and nitrogen, since all the potash salts are soluble. But of these salts the sulphate is more desirable, and a little higher priced than the muriate, while kainit is practically the crude sulfate, but carrying a large excess of chlorine in proportion to the real amount of potash. So that, when excess of chlorine is to be avoided, it is better to use even the muriate, rather than kainit.

When the farmer has just so many pounds of any particular ingredient necessary for a home mixture, and wants to incorporate it with other materials, and have the whole mixture carry a certain ratio of plant food, he can make his calculation after the following manner:

Suppose it is 500 pounds of kainit. This carries 12 per cent. of potash, or 12 pounds of potash to the 100 pounds of kainit; 500 pounds of kainit would therefore carry 60 pounds of potash. Divide this by 20, and we have the per cent. of potash in our 2000 pounds, or ton, of mixture, which is 3. If we want a mixture containing just 3 per cent. of potash, we can supplement this amount of kainit, with other things, for our nitrogen and phosphoric acid, selecting such materials in whatever amounts that will carry the necessary percentages of nitrogen and available phosphoric acid in our whole mixture of 2000 pounds when it is made up.

Home mixtures are sometimes objected to because it is said their mechanical condition is not good; that is, they may become lumpy. It is claimed that the *mixing* cannot be well made. Consequently a uniform product is not obtained, resulting in loss of fertilizer or plant food after it is applied to the soil. The advantages are that the farmer knows precisely the *form* of food that he is giving his soil and crop. Then, again, it is cheaper. The general *hindrance* to the practice in this State, *is the difficulty of getting the separate ingredients, and having them mixed in time for the crop.* Because of the size of our State, and the further fact that there are no fertilizer factories in this State, with the exception of two small ones just starting up, it is difficult and expensive for the farmer to get small lots of acid phosphate and potash salts. He delays his purchases until a fertilizer factory offers to deliver a car lot of commercial fertilizer and distribute among his neighbors, which usually settles the matter. If this delay and expense incident to the purchase of small lots could be overcome, I should advise that the practice of home mixing be much more generally adopted.

What Quantity of Fertilizer Shall Be Applied.

This depends largely upon the kind of crop, and upon its money value. Any crop which is expected to bring a high price should be fertilized with a high-grade fertilizer in such quantity as may be necessary for bringing the best net returns. Of course this applies to

early truck crops. In pounds the amount may vary anywhere from 200 to 1250 per acre. The time of application and what may be expected of rainfall or water supply must be considered. There is no question but that fertilizers hasten maturity of the crop; but a proper amount of water in the soil is necessary for the fertilizer to be best appropriated.

Tobacco Waste.

This substance is very often used as an insecticide, and because of the quantity necessary to use for this purpose, it has, at the same time, a practical fertilizer value. The following is the analysis of a sample furnished by the Department of Entomology:

Moisture	11.76 per cent.
Ash	19.59 per cent.
Organic matter	68.65 per cent.
Potash	3.57 per cent.
Phosphoric acid	1.17 per cent.
Nitrogen	12.70 per cent.

Goat and Sheep Manure.

Mr. W. H. Dodd of Langtry, Texas, writes as follows: "The sample was taken from bedding grounds of the sheep and goats. It has accumulated to the depth of one or two feet, and has lain on the ground for so many years that it is thoroughly rotted."

Analysis:

Moisture	27.38 per cent.
Organic matter	36.40 per cent.
Ash	36.22 per cent.
Total phosphoric acid	.48 per cent.
Potash	.15 per cent.
Nitrogen	1.30 per cent.

This would give a chemical valuation of about $4.75 per ton; but its agricultural value, because of the large amount of humus present, would increase it considerably above that price. Three samples of goat manure show the following results:

	Number 1.	Number 2.	Number 3.
Moisture	39.78 per cent.	42.27 per cent.	42 42 per cent.
Nitrogen	.77 per cent.	.97 per cent.	1.35 per cent.
Organic matter	22.75 per cent.	21.21 per cent.	33 91 per cent.
Ash	36.49 per cent.	35.75 per cent.	22.32 per cent.

The moisture determinations were made on samples just as received, in wet condition, and not on air-dried samples. Air-dried, these show the following:

	Number 1.	Number 2.	Number 3.
Nitrogen	1.32 per cent.	1.60 per cent.	2.00 per cent.
Phosphoric acid	.50 per cent.	.40 per cent.	.50 per cent.
Potash	7.50 per cent.	4.00 per cent.	4.50 per cent.

This manure comes from El Paso county, and is of special interest because it shows the slow rate of deterioration in that dry climate. Mr. J. T. Porcher, who sends on this, thus writes of it:

"Number one is a manure taken from where there was a pen some fifteen years ago. Number two from a pen used some seven or eight years ago, and number three is taken from a pen where the goats sleep every night." Samples one and two were thoroughly rotted and disorganized. They are all most excellent fertilizers. The amount of potash is quite exceptional. This can probably be explained by the nature of the vegetation on which they graze.

Barnyard Manure.

The sample below was taken from a car-lot shipped in by Professor Kyle, and its inferiority to the goat or sheep manure is very apparent.

Moisture	59.25 per cent.
Organic matter	17.77 per cent.
Ash	22.98 per cent.
Nitrogen	.63 per cent.
Total phosphoric acid	.32 per cent.
Potash	.31 per cent.

This is manure from open cattle pens, and was of course saturated with moisture, showing a very small amount of plant food. But when the water is eliminated, it makes a very good showing:

Nitrogen	1.6 per cent.
Phosphoric acid	.8 per cent.
Potash	.8 per cent.

Of course this still leaves it a very low valuation in dollars and cents; but the organic matter is worth something, particularly on a stiff clay soil such as we have here. But aside from the organic matter present, and the above chemical elements of commercial fertilizers, barnyard manure still has an agricultural value difficult to explain, possibly due to the number of microscopic organisms which it contains, and to particular combinations which it sets up in the soil, favorable to plant development. Of course the great benefit of the mechanical effect on the soil is understood.

Spent Bone Black from Sugar Refinery.

Total phosphoric acid	30.00 per cent.
Nitrogen	.10 per cent.

This is not used directly as a fertilizer, on account of its very low solubility, but is first treated, as rock phosphate is, with sulphuric acid to make its phosphoric acid soluble.

Below is a table giving list of manufacturers who have complied with the law in this State for season of 1903–4, showing at the same time the composition of the different brands of fertilizers which they offer for sale.

Manufacturer and Brand.	Total Phosphoric Acid—per cent.	Available Phosphoric Acid—per ct.	Nitrogen—per cent.	Potash—per cent.	Valuation—dollars per ton.
Huntsville Cotton Oil Co., Huntsville, Texas.					
Texas Vegetable Compound	8.68	8.23	4.00	5.89	$ 28.99
Pure Ground Raw Bone	23.25	.....	3.87	.....	26.34
Huntsville High Grade	10.75	10.27	2.15	2.74	23.26
Standard Guano and Chem. Mfg. Co., New Orleans, La.					
Sulfate of Potash	.....	.....	.....	48.00	$ 62.40
High Grade Sugar Fertilizer	11.42	10.00	2.50	2.00	23.00
Blood, Bone and Meat Guano	12.27	8.00	1.65	2.00	17.89
Dissolved Bone and Potash	12.68	8.00	.....	3.00	14.20
Muriate of Potash	.....	.....	.....	49.00	49.00
Acid Phosfate	17.27	12.00	.....	.....	16.80
Stern's Ammoniated Raw Bone Superfosfate	10.32	9.00	1.65	1.50	18.75
Kainit	.....	.....	.....	12.50	12.50
Standard Ammoniated Soluble Guano	8.85	8.00	1.65	1.50	17.35
Vegetable Fertilizer	8.35	6.00	3.00	5.00	21.80
Pure Ground Bone	18.50	.....	2.50	.....	23.65
Champion Farmer's Choice	10.00	9.00	1.65	1.00	18.25
Meridian Fertilizer Factory, Meridian Miss.					
Meridian Vegetable Grower	6.00	6.00	2.00	6.00	$ 20.80
Meridian Acid Phosphate	14.00	14.00	.....	.....	19.60
Meridian Home Mixture	9.00	9.00	1.65	1.50	18.70
Meridian Blood and Bone	9.00	9.00	1.62	1.24	18.30
Jackson Fertilizer Co., Jackson, Miss.					
Fruit and Vegetable Fertilizer	7.05	6.25	3.07	4.72	$ 22.40
J. A. Kelley, Las Esperanzes, Coahuila, Mexico.					
Mexican Vampire Bat Guano	2.00	1.76	9.77	0.86	$ 28.89
Armour Fertilizer Works, Chicago, Ill.					
Texas Vegetable Grower	11.63	10.48	2.05	2.79	$ 23.35
Phosfate and Potash	11.58	10.71	.....	1.96	17.35
Blood, Bone and Potash	11.78	9.38	4.16	7.85	33.37
Corn and Cotton Grower	10.28	9.40	1.21	1.03	17.54
Raw Bone Meal	25.35	.....	3.72	.....	27.72
All Soluble	10.35	9.03	2.83	4.34	25.34
King Cotton	10.35	9.48	1.66	1.70	18.93
Armour's Truck Special	9.95	8.65	4.49	5.91	30.88
Star Phosphate	16.05	15.62	.....	.....	21.87
Houston Packing Co., Houston, Texas.					
Tankage	.....	8.10	4.85	.....	$ 18.00
Ennis Cotton Oil and Ginning Co., Ennis, Texas.					
Hurry Plant Complete Fertilizer	7.65	6.64	1.82	2.85	$ 17.45
Crescent City Stock Yard and Slaughter House Co., New Orleans, La.					
Crescent Ground Bone	23.10	.....	3.87	.....	$ 26.22
Henderson Cotton Oil and Gin Co., Henderson, Texas.					
Royal Acid Phosfate	15.25	13.13	.....	.....	$ 15.76
East Texas Fertilizer Co., Tyler, Texas.					
Cotton and Corn Grower	8.58	8.05	2.79	2.50	$ 21.52
Texas Vegetable Grower	9.68	8.00	2.69	7.91	27.68

Manufacturer and Brand.	Total Phosphoric Acid—per cent.	Available Phosphoric Acid—per ct.	Nitrogen—per cent.	Potash—per cent.	Valuation—dollars per ton.
Arkansas Phosphate Co., Phosphate, Ark.					
Acid Phosphate	18.15	12.60			$ 17.64
Twentieth Century Fertilizer	15.55	10.21	1.66	0 82	19.60
Nitrated Superphosphate with Potash	14.00	7 66	1.55	4.36	20.17
John Marbach, New Braunfels, Texas.					
Bat Guano Compost	9.50	6.64	5.43	0.55	$ 25.00
New Orleans Acid and Fertilizer Co., New Orleans, La.					
Dissolved Bone and Potash	12.84	11.28		2.62	$ 20.65
Blood, Bone and Potash	9.75	8.53	1.88	2.08	19.30
Crescent City Acid Phosphate	15.25	13.44			18.80
Vegetable Grower	10.22	9.12	2.80	1.89	21.37
Goldsmith's Improved Mixture	10.85	9.47	1.92	1.52	20.00
Shreveport Fertilizer Co., Shreveport, La.					
Caddo Cotton	7.93	7.48	2.43	1.33	$ 18.39
Caddo Vegetable	8 90	8.32	3.18	4.70	25.56
Corn and Vegetable	5.40	5.13	2.99	1 85	17.18
Caddo Special	5 78	5.52	2.76	7.31	23.68
Star	10.28	9.96	2.00	1.96	21.50
Swift & Co., Kansas City, Kan.					
East Texas Truck	10 48	8.00	2.47	3.00	$ 21.22
Garden City Phosfate	15.00	14.00			19.60
High Grade Sulphate of Potash				50.00	55.00
Champion Vegetable Grower	10.40	8.00	3.30	3.00	23.38
Superphosphate	10.80	8 00	1.65	2.00	17.89
Union Meat Co., San Antonio, Texas.					
U. M. C. Fertilizer	13.00	12.68	6.61		$ 30.66
Geo. A. Wright, Palestine, Texas.					
Wright's Vegetable	11.43	9.20	2.01	6.03	$ 25.34
Jno. Marbach, New Braunfels, Texas.					
Bat Guano	3.89	3.60	8.88	1.00	$ 29.53
Virginia-Carolina Chemical Co., Memphis, Tenn.					
V-3-C. Fruit and Truck Special	10.68	9.22	3.53	9.21	$ 33.14
German Kainit				12.00	14 40
Capital Bone and Potash Comp.	11.85	10.00		2.00	16.40
Royal Fruit Grower	10.18	8.00	2.47	5.00	23.62
Royal Animal Bone Guano	13.43	9.00	1.65	1.00	18.09
Royal Potash Comp.	12.03	11.55		4.49	21.55
Royal Vegetable Fertilizer	12.03	8.00	2.47	4.00	22.42
Scott's State Standard Guano	9.88	8.00	1.65	2.00	17.89
Royal Cotton Boll Guano	13.15	10.40	2.20	2.86	23.71
Scott's Gossypium Phospho (Special)	10.57	9.57	1.65	2.00	20.09
Scott's Gossypium Phospho	11.25	10.00	1.65	1.50	20.09
Royal Acid Phosfate	16.00	14.00			19.60
Royal High Grade Guano	13.85	10.00	1.65	1.50	20.09
V-C. Co.'s Truck Grower	11.93	8 00	2.00	6.00	22.76

The following companies have registered fertilizers for sale in this State for the season 1904–5:

Armour Fertilizer Works, Chicago, Ill.
Jno. Marbach, New Braunfels, Texas.
Houston Packing Co., Houston, Texas.
Union Meat Co., San Antonio, Texas.
Huntsville Cotton Oil Co., Huntsville, Texas.
Standard Guano and Chem. Mfg. Co., New Orleans, La.
Caddo Fertilizer and Cotton Oil Co., Shreveport, La.
Meridian Fertilizer Factory, Meridian, Miss.
Virginia-Carolina Chem. Co., Memphis, Tenn.
East Texas Fertilizer Co., Tyler, Texas.
Armour Fertilizer Co., Fort Worth, Texas.
New Orleans Acid and Fertilizer Co. New Orleans, La.
Tuscarora Fertilizer Works, Chicago, Ill.
The Gulf Port Cotton Oil and Manfuacturing Co., Gulf Port, Miss.
Jackson Cotton Oil Co., Jacksonville, Texas.
Swift & Co., Chicago, Ill.
Pittsburg Cotton Oil Co., Pittsburg, Texas.
Houston County Oil Mill and Mfg. Co., Crockett, Texas.

Insecticides.

Before the enactment of the State Insecticide Law, it was becoming quite common for Paris green especially to be adulterated, usually with white arsenic, which is so much cheaper; but not uncommonly with other cheap substances less efficient. Paris green, London purple, and white arsenic were, until three or four years ago, almost the only arsenical insecticides sold in the State; and they were consumed in large quantities. Arsenate of lead was proposed as a remedy for the boll weevil, and considerable quantities of the poison were used for one or two seasons in an effort to check, if not destroy, the progress of the little pest. But he declined to eat it in any appreciable quantity. But still, the introduction of the arsenate was a valuable addition to the list of insecticides mentioned above for the poison of other insects, poisons long used for the destruction of the cotton leaf worm particularly. Arsenate of lead is a white powder, more insoluble even than Paris green. It is usually put up in the form of a semi-paste, sometimes mixed with a little glucose to make it sweet and give it adhesive qualities. It is not used in the dry state to dust upon the plant, but entirely with the spray. Being insoluble and very poisonous, it has the advantage over the other arsenical insecticides in not "burning" the plant. At the same time it adheres with great tenacity to the foliage.

Paris Green.

This is a compound of acetic acid, copper, and arsenic. It is so difficultly soluble in water, that it appears to be entirely insoluble. But this is not the case, and it is sufficiently soluble to sometimes burn a plant. It is, however, a very valuable insecticide to the cotton farmer, since, when properly used, it affords the cotton plant almost certain protection against the cotton leaf worm, with very little danger to the plant. It can be conveniently dusted upon the plant without an ex-

pensive spray of any kind, and has this advantage over the arsenate of lead, although if the latter were put up in the form of a dry powder, it could probably be used in the same form as the Paris green is used.

London Purple.

London purple is a by-product obtained in the manufacture of analine dyes. It contains only about three-fifths as much arsenic as Paris green carries, but the arsenic is much more soluble, and therefore much more dangerous to the foliage of plants. The arsenic is in combination mainly with lime. During the last few years London purple comes in a somewhat different color from that in which it was formerly obtained, and this leads to the suspicion on the part of many farmers that it is adulterated; but I do not think it has been at any time, since all that is consumed in this country comes from one London manufacturer. But it has sometimes such a pale pink color that it looks as if the original material had been mixed with wood ashes.

White Arsenic.

White arsenic is too well known to need description; it is frequently sopken of merely as "arsenic." It is cheap and never adulterated so far as I know. The price of arsenate of lead by retail is about 25 cents; of Paris green, about 20 cents; London purple, 10 to 12 cents, and white arsenic, 5 to 7 cents.

Other Insecticides.

Most insecticides depend for their value upon arsenic in some form, usually one of the forms above given, or upon the presence of one or more of the following materials: sulphate of copper, commonly known as "bluestone;" tobacco dust, or its extract; sulphur, or sulphide of lime; petroleum, either as the crude or as kerosene and formalin, or formaldehyde. Of course hydrocyanic gas and carbon bisulphide are in common use for certain purposes. Many commercial insecticides containing chiefly a mixture of two or more of the above, with or without a very little arsenic, are still valuable. They are usually sold at a high price when their composition and efficiency is compared to the price and work of the arsenical insecticides. That is to say, the farmer could usually buy the crude materials and mix them separately at a considerable saving; but in this case, as in that of commercial fertilizers, the question is, Will he do it? Unless they are brought to him ready-made with specific directions in each case, many farmers are likely not to use an insecticide at all.

Below will be found a table giving the names of manufacturers authorized to sell poisonous insecticides in this State last season, together with the brand and analysis of their goods offered for sale. Of the manufacturers Messrs. James Bute, Benjamin Hammond, and the Bollene Manufacturing Co., have complied with the law this season.

Name and Place of Manufacture.	Total Arsenic—per cent.	Soluble Arsenic—per cent	Copper Oxide—per cent	Lime—per cent
Adler Color and Chemical Works, New York.				
Paris Green	55.90	.95	29 77	
James Bute, Houston.				
Paris Green	55 15	76	29.74	
London Purple	31.90			25 78
Fred L. Lavenburg, New York.				
Paris Green	55.45	1.00	29.65	
Arsenate of Lead	White Arsenic 21 2	Lead Oxide 40 6	Organic Matter 2.7	Moisture 29 00

	White Arsenic (free.)	Lead Oxide (combined)	Organic Matter (fixed).
McLean & Graham, Caldwell, Texas.			
Insecticide	8.00	15 9	Organic Matter (fixed). 66.6 (volatile). 9 5

	Total Arsenic.	Soluble Arsenic	Lime.
Meyer Bros. Drug Co., St. Louis, Mo.			
Purple Poison	30.9	9.5	8.5

	White Arsenic (combined).	Lead Oxide	Moisture and Organic Matter.
Merrimac Chemical Co., Boston, Mass.			
Arsenate of Lead	14.70	44.98	37.4

	Carbon Bisulphide	Mineral and Essential Oils.	Water and Residue.
Bollene Manufacturing Co., Galveston, Texas.			
Bollene	47 8	12.2	40 00

Benj. Hammond, Fishkill-on-Hudson, New York. *Slug shot.* } Less than 1 per cent. Arsenic. About 70 per cent. Sulphate of Lime. Mixed with smaller amounts of sulphur, bluestone, oxide of iron, carbolic acid, and tobacco.