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FARM FERTILIZERS.

BARNYARD MANURE.

Farming without the use of manures is a waste of energy and results in the exhaustion of soils. The saving of farm manures is one of the most important problems of husbandry. The convenience of commercial fertilizers has caused farmers to neglect the home supply. The lack of intelligent care of this supply has frequently reduced its value to an almost negligible quantity. Commercial fertilizers have proved of great value and are destined to play even a greater part in farm economy, but their effect is greatly increased by the use of green crops or farm manures.

Commercial fertilizers are costly; their exclusive use tends to hasten the depletion of the soil and they should never be considered a substitute for green crops or barnyard manure.

The small value frequently realized from the use of barnyard manure arises from the fact that it is not properly saved and handled and the manure has lost the greater part of its plant food. Barnyard manure may be regarded as just so much vegetable matter. It differs, however, from the food from which it is derived in that, having been once digested, its fertilizing elements are more available for plants.

Available plant food means plant food that is easily decomposed and soluble in water. If the manure is left exposed to the elements the water from rains easily and rapidly leaches out the soluble plant food. On the other hand, if the manure is allowed to heat, a large amount of the nitrogen is driven off into the atmosphere; so in order to get the most valuable manure both of these sources of loss must be avoided. There are several ways of accomplishing this. Probably the best plan, where it is practicable, is to haul the manure direct upon the land and plow it in—shallow on clay soils, deeper on sandy loams. Again, especially with horse manure, etc., it is good to allow the manure to remain in the stable, using plenty of litter. The animals tramp the manure down, thus excluding air, and as it is kept dry

it will keep with practically no loss. The litter used in bedding not only is itself of value as a fertilizer, but serves also to absorb all liquids and prevent their loss. If not practicable to pursue either of these methods, then a cheap shed can be provided and the manure stored in it until ready for use.

There is one precaution that must be observed when a shed is used, and especially if the droppings from horses predominate. Under these conditions the manure is apt to heat. This should be prevented by dampening it. For this reason it is a good plan to have a leaky shed—one that will not permit the entrance of enough water to leach through, but will leak enough to keep the manure moist. In case of protracted drought there should be artificial means of watering the compost. The question may arise with the farmer whether it is more economical to go to this trouble and expense with his manure than to depend upon commercial fertilizers. This question is soon answered in the affirmative.

Bear in mind that while the farmer may buy an equal number of pounds of plant food he can not get it in as good a form, nor do the commercial fertilizers have as great an effect. They do not add vegetable matter, do not start soil fermentation, and do not correct mechanical defects of the soil. A ton of well-preserved manure from a well-fed horse contains about 9.8 pounds of nitrogen, 5.2 pounds of phosphoric acid, and 9.6 pounds of potash—plant food that would cost $2.18 bought as commercial fertilizer. This is on a basis of 15 cents a pound for nitrogen, 4½ cents for phosphoric acid, and 5 cents for potash.[1]

A horse weighing 1,000 pounds will produce about 12 tons of manure in a year, and this manure is consequently worth 7⅗ cents a day, or about $27 a year. The manure from the average cow is worth about 6½ cents a day, or $23.20 per year. These values are based on the presumption that the animals are well fed. Where the common manure heap is used for all animals and for all farm refuse, while its composition is necessarily variable, it can safely be assumed that a ton of it will contain 12 pounds of nitrogen, 5 pounds of phosphoric acid, and 6 pounds of potash. The plant fertilizers in a ton of manure are worth commercially from $2 to $2.25. These values do not take into consideration the indirect benefits to the soil. While the actual plant food contained in a ton of barnyard manure is worth at least $2, it is safe to say that the farmer will derive nearer $3 worth of good from it.

When left in loose heaps under cover it has been found that manure loses 1.4 per cent of its nitrogen. When these heaps are not covered this loss amounts to 30 per cent, and when exposed in thin layers, as is the case when it is left on the barn lot, this loss increases to 64 per cent. Putting it differently, the same manure that when properly cared for is worth $2.18 a ton, if allowed to remain in loose heaps for twelve months is worth only $2. When those heaps are uncovered the value falls to $1.70, and the unprotected thin layer

[1] The values of fertilizers and manure here given are based on the prices of cottonseed meal at $25 a ton, acid phosphate (15 per cent purity) at $15, and kainit at $12. Of course when these articles cost more, nitrogen, phosphoric acid, and potash should be rated higher and stable manure would be worth more.

at the end of that time is worth only $1.10. This is not the extent of the loss, for that portion of the fertilizer ingredients that is left is the least valuable, and what we have is really only the refuse of the formerly valuable manure. This tremendous loss from improper handling easily explains why our farmers find it necessary to use such large quantities of manure to derive much benefit from it. It will be observed that even when the manure is stored in a shed there is a loss. By covering the manure heap with certain substances it is found that not only can this loss be prevented, but that the stock of manure can be very greatly increased. A ton of ordinary loam will absorb 13 pounds of nitrogen, and if placed over the manure heap will prevent all loss of that substance. Sawdust will absorb 8 pounds per ton. Wheat straw will absorb nearly 4 pounds of the nitrogen.

The necessity for absorbents brings us to the consideration of the compost heap.

THE COMPOST HEAP.

By the compost heap the farmer is able to multiply his available manure many fold. We should remember that anything of vegetable or animal origin is a valuable fertilizer if put in proper condition. The compost heap is the means of doing this. One ton of leaves contains 16 pounds of nitrogen, 6 pounds of phosphoric acid, and 6 pounds of potash, and at ordinary values for these substances is worth nearly $3. A ton of straw similarly is worth $2.25, and sawdust $2.20. These values, of course, are based on their total composition. In actual practice it is safe to assume that half of their values are available. But it is only after undergoing fermentation in the compost heap that these values are available.

That it will pay the farmer to give more attention to the compost heap has been repeatedly proved by practical trials. At the North Louisiana Experiment Station, Calhoun, La., the following results were obtained: The land normally would produce one-fourth of a bale of cotton and 7 to 10 bushels of corn to the acre. By the annual application of 30 bushels per acre of a compost composed of stable manure, cottonseed, acid phosphate, and loam this yield has been increased to from 1¼ to 1½ bales of cotton and 50 to 60 bushels of corn. The annual expense of applying this compost amounted to a little over $1 per acre.

HOW THE COMPOST HEAP IS MADE.

Locate the compost heap in an old shed or build a shed with any kind of old material for a roof. If the shed leaks some, all the better. Spread on the ground in a layer 10 inches thick 10 bushels of stable manure, wetting thoroughly. Over this scatter 100 pounds of acid phosphate or 100 pounds of high-grade ground phosphate rock. Then follow with another layer of manure and phosphate, etc. Continue these alternate layers until all the manure is used up or until the pile has become inconveniently high; then cover the pile, both top and sides, with 4 inches of forest mold or good loam taken from the fence corners. If stable manure or mold is not available, use straw, leaves, or any waste material, even weeds. Be sure and wet all thoroughly. After the heap has stood from four to six weeks it should be worked over and well mixed. This is best done by begin-

ning at one end and cutting it down vertically, throwing the manure in a pile behind. Wet again and cover again with loam. It will be ready for use in three or four weeks.

The above proportions are for use with cotton. When the compost is desired for corn the quantity of phosphate can be reduced—use only 50 pounds instead of 100 to each layer. Thirty bushels, or one two-horse wagonload, per acre of this compost will produce very marked results. When this quantity is used, it is best applied in the drill just prior to planting. If preferred, the rows can be marked off and the compost distributed in this furrow and then bedded on. Be careful, however, not to bury it too deep, especially on clay soils. It is safe to estimate that this quantity of such a compost will more than double the crop on poor land the first year. Thus the composted land can be rotated, and in the course of a very few years all the land will be permanently improved.

Bearing in mind the supplemental value of the cowpea, it is safe to say that at least 50 per cent can be added to the productiveness of the average 100-acre farm, and that simply at the cost of a few tons of acid phosphate and a little labor. With the compost and with the cowpea at his service to save and gather nitrogen for him, the average farmer is simply throwing his money away when he buys that substance in commercial fertilizer, for he could produce all that his land needs upon his farm. Economy should be his watchword, and there is no better place for him to start than by stopping the waste of nitrogen that is so flagrant throughout the whole South.

VALUE OF FARM LITTER.

Every ton of hay sold from the farm the manure from which is not returned to the soil takes off $5 worth of fertilizer, cottonseed about $11, corn $6.75. This has been going on till the farm responds reluctantly to many of our drafts. The richer the material in the compost the greater the effect on the crop. There is no better way of increasing the value of the materials than to have all the stable manure it is possible to get. To do this all the stock on the farm must be kept under sheds and in stables when feasible, and an abundance of bedding furnished to absorb the liquids as well as add to the bulk of the manure heap.

The materials named in the following table are more or less available on every farm, and it can be seen from the composition of each which are the most desirable.

TABLE I.—*Composition of farm litter and straw and its value as fertilizer.*

Kind of straw or litter.	Nitrogen.	Phosphoric acid.	Potash.	Value of each ton.
	Per cent.	*Per cent.*	*Per cent.*	
Wheat straw	9.6	4.4	16.4	$3.18
Rye straw	11.2	5.1	18.1	3.54
Oat straw	14.4	3.6	23.0	4.35
Barley straw	11.4	5.0	23.5	3.87
Pea straw	20.8	7.0	19.8	5.61
Soy-bean straw	14.0	5.0	22.0	4.31
Buckwheat straw	13.0	7.1	24.2	4.35
Millet straw	14.0	3.6	34.0	4.88
Marsh hay	17.2	10.6	54.0	7.06
Leaves	15.0	3.2	6.0	4.12
Rice straw	15.1	5.2	8.4	3.79

We trust that we have made the value of farm manures sufficiently evident and that more farmers will give attention to their saving.

COMMERCIAL FERTILIZERS: THEIR USES AND VALUE.

Since the prime object in the use of all commercial fertilizers is to increase production, they must be used either to supply plant food directly or to act upon the soil so that a larger quantity of its nutritive elements will be at the disposal of the plant. In actual practice most commercial fertilizers combine both effects. All the substances required by plants except three—nitrogen, phosphoric acid, and potash—are abundant in most soils.

The chief function of nitrogen in plants is to promote growth, but it is also of very great importance in the perfection of fruit. Nitrogen enters largely into the composition of plants, and it follows that everything of vegetable origin is a valuable source of this substance. When vegetable matter is burned, the nitrogen is released from its combination and escapes into the atmosphere and is lost.[1] The forms most important to the farmer of the South in which nitrogen is available are vegetable matter, the droppings of animals, cottonseed meal, bone meal, nitrate of soda, sulphate of ammonia, and the products of the slaughter pen in what is known as tankage.

Next in importance as a plant food is phosphoric acid. It is largely required by the plant for growth, but is absolutely essential in the perfection of seed and is a great factor in hastening the maturity of crops. The form of phosphoric acid most accessible to the farmer is known as acid phosphate.

Potash is more directly effective in promoting fruitage, but it is rarely very deficient in soils, and especially in soils of the Gulf States. It is found in abundance in ashes. Commercially it is most cheaply obtained in the form of kainit.

WHAT FERTILIZER TO BUY.

Since the elements of plant food already mentioned are required in different quantities by different plants and since the soils vary in their supply, it is well for the farmer to know what his soil and plants need before investing his money in fertilizers. The practical way for the farmer to determine these facts is to observe the growth of the plants on his land. If the plants grow rapidly and make an abundance of leaf and stalk, it is evidence of a good supply of nitrogen. If there is not a proportionate amount of fruit, it is a sure indication that the soil needs phosphoric acid. On the other hand, if the plant has not a good color and tends to drop its fruit before it reaches a fair size, it indicates that the soil requires potash.

Most of the soils of the South are deficient in both nitrogen and phosphoric acid, and some in potash. So, when we buy commercial fertilizers we buy them for their content of these substances. If the farmer has saved all his manures and has grown cowpeas abundantly, as he should, he will rarely have to buy nitrogen.

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[1] It is a bad practice to burn off fields and destroy vegetable matter; it is better to turn it under. The humus in vegetable matter has a value in soil renovation frequently greater than its value as a plant food.

HOW TO BUY FERTILIZER.

Commercial plant food, called "fertilizer," is never sold pure, but in combination with other substances. The substances with which it is combined are of no value to the farmer, but simply add to the weight. The laws of nearly all of the States now require that on each sack of commercial fertilizer shall be stamped just what plant food it contains. This composition is given in percentages, which means that in a hundred pounds of the fertilizer there are so many pounds of the particular substances. For example, a certain fertilizer is offered for sale on the sack of which is branded the following:

Nitrogen	3 per cent.
Soluble phosphoric acid	6 per cent.
Reverted phosphoric acid	4 per cent.
Available phosphoric acid	10 per cent.
Potash	2 per cent.

Translated into terms of pounds, this means that in a sack weighing 100 pounds there are—

Three pounds of nitrogen.
Six pounds of soluble phosphoric acid.
Four pounds of reverted phosphoric acid.
Ten pounds of available phosphoric acid.
Two pounds of potash.

This gives a total of 15 pounds of plant food in a 100-pound sack. When a ton of such fertilizer is bought, the purchaser secures nitrogen, 60 pounds; soluble phosphoric acid, 120 pounds; reverted phosphoric acid, 80 pounds; and potash, 40 pounds. Notice that what is called "available" is the sum of the soluble and the reverted acid. In this fertilizer we obtain three things that are of use—3 pounds of nitrogen, 10 pounds of phosphoric acid, and 2 pounds of potash to the hundred pounds.

If cottonseed meal, acid phosphate, and kainit are used to make this fertilizer, it will require the following quantities for 1 ton of the mixture:

Fertilizing material.	Pounds.	Price per ton.	Cost.[1]
Cottonseed meal	690	$25	$8.65
Acid phosphate (15 per cent available)	1,108	15	8.31
Kainit	202	12	1.21
Total	2,000	.....	18.17

[1] These prices are based on cottonseed meal at $25 per ton, acid phosphate at $15, and kainit at $21; if the price of these articles varies up or down, of course that of the ton of fertilizer will vary accordingly.

Ammonia is nothing but nitrogen in combination with another substance of no value. Inserting the ammonia in the formula is apt to deceive one who does not know the distinction. Remember that it is the pounds of plant food that are wanted, and not just a sack of stuff the majority of which is of no value.

Taking acid phosphates as an example, we find that there is a great variation in their composition. Some run as low as 10 pounds of available phosphoric acid to 100 pounds, while others contain as much as 14 or 15 pounds. As phosphoric acid generally sells at

about 5 cents a pound, the former would be worth 50 cents a hundred, whereas the latter would cost 75 cents. In buying, then, it is economy to take the high-grade goods, even though they cost a little more.

An average sample of cottonseed meal contains the following percentages of plant food:

Nitrogen	7.5 per cent.
Phosphoric acid	2.5 per cent.
Potash	1.5 per cent.

A 100-pound sack will therefore contain the following quantities of plant food:

Nitrogen	7.5 pounds.
Phosphoric acid	2.5 pounds.
Potash	1.5 pounds.

The phosphoric acid may be considered as available, as the fermentation renders it so.

HOW TO USE COMMERCIAL FERTILIZERS.

If fertilizers are used, the following general rule should govern: On rich lands use mainly fertilizers that will stimulate the fruit and not the stalk growth. On lighter lands use more of the elements to force growth, combined with others which will mature the fruit.

High-grade 14 per cent acid phosphate may be considered a basis for increasing fruit and hastening maturity of crops. Even on the richest land it has been demonstrated that a small percentage of nitrogen added to the acid phosphate gives better results. Use three parts of acid phosphate and one part of cottonseed meal for cotton.

A mixture of one part of cottonseed meal to two parts of high-grade acid phosphate will greatly increase the growing condition and will be better for medium soils.

Air-slaked lime is of value for use on stiff or gummy soils to loosen them up, permit the air to enter, and prevent a sour condition of such soils when too wet.

On thin or impoverished soils equal quantities of cottonseed meal and acid phosphate can be used to advantage.

In case the foregoing can not be obtained, standard-grade commercial fertilizers may be used. These should contain in the mixture 8 to 10 per cent of available phosphoric acid, 2 to 3 per cent of nitrogen, and 1½ to 2 per cent of potash, or on some lands a high-grade acid phosphate, 14 per cent, may be used.

On black waxy land the best practice is to have the cotton follow a crop of cowpeas.

Where lands are greatly worn by years of cropping, more fertilizer should be used to the acre, and it should contain about equal parts of cottonseed meal and high-grade acid phosphate. The beneficial effect of commercial fertilizers depends largely upon the presence of humus in the soil; hence the importance of using stable manure and plowing under green crops.

In applying the foregoing instructions the farmer must use considerable judgment and modify his practice where necessary to fit local conditions.

HOW TO APPLY COMMERCIAL FERTILIZERS AFTER THE SOIL HAS BEEN THOROUGHLY PULVERIZED.

In the absence of a good machine, apply the fertilizer as follows:

Mark out the rows or bed-up, spacing as specified in the circular of this series containing general instructions (Circular No. "A"—69), and distribute the fertilizer in rows. Follow after with a bull tongue or scooter shallowly to mix the fertilizer thoroughly with the soil.

Bedding-up land is a precaution against a heavy rainfall after planting. In sections where there is no danger from excessive moisture, flat planting is preferred, and in some cases it may be necessary to plant a few inches below the surface. Seeds must have moisture, but they must be kept out of standing water in the soil.

The fertilizer should be distributed several days before planting, as there is danger of injuring the seed if brought in immediate contact with strong fertilizer. A very careful mixing of the fertilizer with the soil is necessary for the same reason. On all except very rich waxy lands it will pay to use commercial fertilizers somewhat liberally.

Where as much as 400 pounds of fertilizer is used for corn we recommend two applications, one in the furrow before planting and an application of from 150 to 200 pounds of cottonseed meal in the furrow when the corn is about 1 foot high.

Where lime is used scatter it broadcast when the land is plowed, using about 4 barrels of air-slaked lime per acre, or apply in the row about 2 barrels per acre a short time before planting, mixing it thoroughly with the soil.

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Approved:
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