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UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
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Use of Commercial Plant Foods on Missouri Farms

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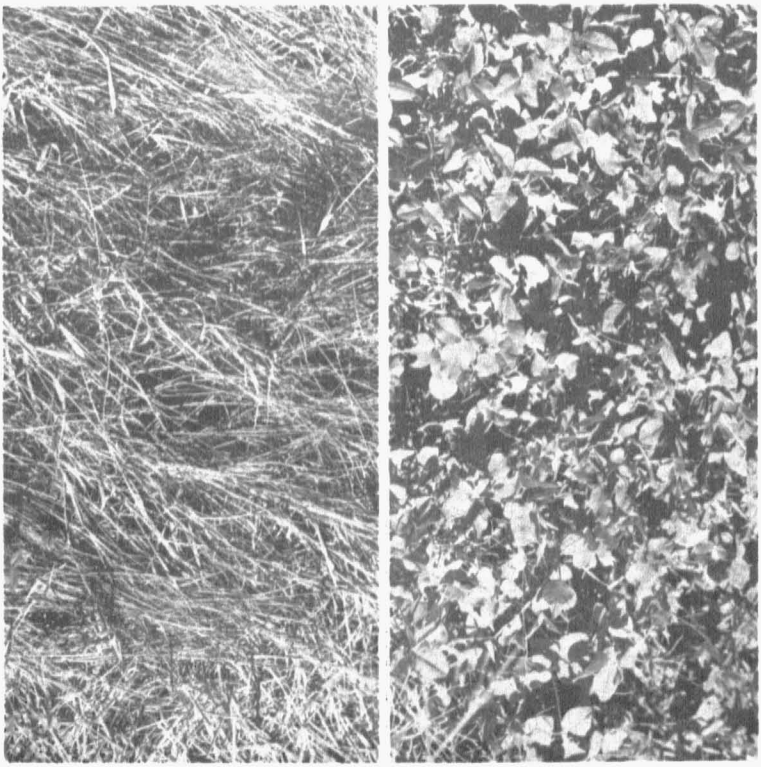

Commercial Plant Food Makes the Difference

COLUMBIA, MISSOURI

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COMMERCIAL PLANT FOODS ARE NEEDED ON MISSOURI FARMS

On most Missouri farms that have been in cultivation more than a hundred years, the soil no longer contains the fertility needed to produce high yields of crops rich in proteins and minerals. To get such crops we must apply commercial plant foods carrying the essential elements that are lacking in the soil.

Depletion of the soil's plant food supply is shown by low average acre yields. Even with the use of hybrid corn, the yields of this crop in the favorable growing season of 1948 were only slightly above 40 bushels per acre. In 1947, a less favorable growing season, the average yield was down to 25 bushels. Long-time average yields of hay are slightly over a ton per acre. It is estimated that the large acreage used for permanent pastures in Missouri produced only 70 to 100 pounds of beef, or its equivalent in milk, per acre.

Moreover, nearly 80 per cent of Missouri's farm income is realized from the sale of livestock and livestock products--meat, milk and eggs. These are mineral and protein rich foods. To produce them, animals must depend entirely on their food for the basic material they require for building protein and mineral tissue. Without plenty of high-quality feeds rich in these elements, livestock production cannot be successful.

Where cash crops are the chief source of income, high acre yields of quality crops are essential for the most profit. Labor, seed and other cost factors in crop production are approximately the same for low yields of poor crops as they are for high yields of quality crops. The margin of profit is in the better quality and extra production per acre.

Commercial plant foods, wisely used along with farm manures and legume crops protected by erosion control, rebuild the soil's fertility supply. Thus renewed and carefully managed, the land again provides the larger income needed by the farm family for better living. It produces crops that carry the nutrients essential for thrifty, efficient livestock and a normal, healthy family.

Plant Foods Usually Needed

Only about 5 per cent of the plant's substance comes from the soil. The rest comes from air and water. The plant must have the soil-borne nutrients in order to use the air elements--carbon, hydrogen, oxygen and nitrogen.

Numerous long-time experiments and demonstrations show that the food needed by the plant can be profitably applied to the soil. The lime or calcium lacking in most Missouri soils is essential for the best growth of the mineral and protein rich legumes and also for other crops. Phosphorus, also deficient in most Missouri soils, is required along with calcium as the chief bone-building constituent for men and animals. Both calcium and phosphorus function in growth and the synthesis of proteins in plants. Nitrogen is needed on all soils. Fortunately, much of the nitrogen can be supplied by the frequent growth of legumes in crop rotations and in pastures. Chemical nitrogen can be used to supplement the nitrogen furnished by legumes, manure and crop residues. Several soil types also need potash. Some soils need other elements such as magnesium and the so-called trace minerals.

Commercial Plant Food is Economical

Commercial plant food wisely selected and applied to correct soil deficiencies pays good returns on pastures, meadows and cropland.

Pastures.--One of the many examples showing such improvement is a poor upland pasture in Boone County. Soil treatments used were 3 tons of limestone and 836 pounds of 0-12-12 fertilizer per acre. These treatments made it possible for legumes to grow in the grass mixture and crowd out weeds and other low quality vegetation. The legumes in turn provided nitrogen for the grass. In a single year, these treatments increased the protein harvest 343.5 pounds and the yield of forage 3,444 pounds per acre. One treated acre, so far as protein yield was concerned, was equal to 2.7 untreated acres. In total forage production, one treated acre was equal to 2.3 untreated acres. One ton of the forage from the treated land was equivalent in phosphorus to 1.6 tons of the forage from untreated land, and in calcium one ton of the forage from the treated land was worth 1.7 tons from land that was not treated.

The annual cost of this soil treatment at present prices of limestone and fertilizer is about $3.00 per acre. A similar response to soil treatment could be obtained on several million acres of Missouri pasture land.

Cash and Feed Crops.--Use of the right plant foods will also increase yields and pay big dividends on small grains and hay crops.

This has been shown by Missouri Experiment Station trials on the various soil types of the state.

On Texas County upland during the period 1939-1944, in a wheat-lespedeza rotation, one treated acre produced as much wheat as 2.4 untreated acres. And one treated acre in lespedeza hay was almost equal to 2 acres of untreated land. The cost of the extra wheat and lespedeza hay resulting from the soil treatments was $0.30 per bushel and $2.80 per ton respectively. Use of soil treatments was equivalent so far as production was concerned to more than doubling the size of the farm without the extra labor and other expense involved in farming the larger acreage.

In a corn-wheat-red clover rotation on the gray prairie soils on the University South Farms near Columbia, similar results were obtained. By the use of commercial plant food, extra corn was produced at a fertilizer cost of 34 1/2¢ per bushel, wheat at 52¢ per bushel, and clover hay at $3.58 per ton.

Commercial Plant Foods Pay Also on the Better Soils.--It is generally recognized that proper soil treatments pay on soils of medium or less fertility. Tests have shown also that plant foods selected to fit the soil needs materially increase yields of the phosphorus rich grain crops even on the better soils. In 1946 in 20 trials where plant food was applied in accord with soil tests on the dark soils of North Missouri, corn yields were increased an average of 16.1 bushels per acre at a fertilizer cost of 39¢ per bushel. The yields of the untreated plots were 73.9 bushels and the treated 90 bushels. Twenty acres of corn properly fertilized yielded as much as 25 acres untreated.

Chemical Nitrogen Gives Big Boost in Small Grain Yields at Low Cost.--Where mineral plant foods have been supplied or are naturally present in sufficient amounts, chemical nitrogen can be used advantageously to supplement the nitrogen furnished by legumes, manure and crop residues, to increase acre yields of small grain, grass pastures and hay crops. In 1946 and 1947 in 20 tests with wheat and 25 tests with oats, extra nitrogen made it possible to produce wheat at a fertilizer cost of 37¢ per bushel and oats at 15 1/2¢ per bushel.

Chemical Plant Food Reduces Variation in Crop Yields

In favorable seasons even a poor soil may release sufficient fertility to produce fair crops. In unfavorable seasons the crop on such soils usually is near failure because under such conditions in addition to other unfavorable factors there is not enough fertility released for the growth and performance of crops.

Replacement of the plant food reserves of the soil with commercial plant food and then maintaining them at a high level will

overcome the shortage of soil fertility as a limiting factor in plant growth. Even in unfavorable seasons, fair crops will be obtained. Ample soil fertility does prevent big drops in crop yields in unfavorable seasons, as indicated in long-time experiments on Sanborn Field at Columbia.

In the past 32 years where lime and fertilizer were used on this field in a 4-year rotation of corn, oats, wheat and red clover, the clover failed but once in eight trials. Seven good crops were obtained. Where no soil treatments were used only four partial crops were obtained. The other 4 crops on the untreated land were chiefly weeds and other unpalatable vegetation of low feeding value. In the 60-year period in a three year rotation of corn, wheat and clover where soil treatments were used, only one of the nineteen wheat crops was less than fifteen bushels per acre and nine of the nineteen exceeded thirty bushels per acre. Where no soil treatments were used, twelve of the nineteen wheat crops were less than fifteen bushels to the acre; seven of the nineteen were less than ten bushels per acre and none exceeded 30 bushels per acre.

And it pays to bolster up crop yields in unfavorable seasons, for it is then that prices usually are highest.

Commercial Plant Food Helps Check Soil Erosion

Recent experiments show that if an adequate supply of plant food is placed deeply into fertility-depleted, eroded soils, deep rooted legume crops can be grown successfully. These in turn help to aerate the soil and as these roots decay, they put organic matter into the lower soil layers. Other crops which follow are able to use the plant food left by legume roots in this zone thus starting the cycle of soil rebuilding. With an increased supply of soil fertility all crops make more rapid growth providing more top and root growth thus breaking the force of the rainfall and its ability to move the soil from the field. The extra top and root growth increases the supply of organic matter in the soil which in turn also helps to aerate the soil, improve soil tilth and increase the intake of the rainfall into the soil thus reducing water runoff and its accompanying soil erosion.

Commercial Plant Food Prices Are Favorable to the Farmer

A good time to build back the mineral plant food reserve of the soil is when the price of farm products are high as compared to the price of commercial plant food. Such a favorable ratio has existed the past several years. By taking advantage of this favorable price ratio, farmers can build back the soil fertility reserves more economically than when this ratio is less favorable to the farmer.

Fertilize the Soil, Then the Crop

Where plant food is applied liberally to build up the plant food reserves, it should be placed well into the soil where the moisture supply is more or less constant. When placed in the lower soil layers it reacts with the minute soil particles and becomes available to the plants as it is needed. This method prevents salt injury which may occur when heavy applications of soluble salts are placed close to the seed or germinating plant. Fertilizer can be put into the lower soil layers by drilling it, or broadcasting it on the surface and plowing it under.

In addition to the heavier applications, starter applications are usually needed to give the plant a quick start and to maintain the soil fertility level. These starter applications can be applied with a drill or fertilizer distributor, or in the case of row crops with a fertilizer attachment on the planter.

Where nitrogen materials are used separately such as on small grains, they can be applied as a top dressing with a drill or fertilizer distributor. All equipment should be thoroughly cleaned immediately after use to prevent corrosion and damage to the equipment.

Summary of Factors To Consider

In using commercial plant foods, or fertilizers, especially for maintenance of soil fertility, there are numerous factors to keep in mind. Some of these are:

1. The soil type and soil characteristics. A soil that is well aerated and drained will usually give better response to soil treatments than one which is poorly aerated and drained.

2. Degree of leaching the soil has undergone. Young soils, such as the wind-blown soils in Northwest Missouri and along the Missouri and Mississippi Rivers, are able to release more fertility than the older soils of the Ozarks. These soils differ in kind and amount of plant food needed.

3. The soil structure must be considered. A silt loam of good granular structure is usually more productive than either the clay or sandy loams - the clay soil is more compact and the sandy soil more open. The best response from fertilizer usually is obtained on a well aerated soil.

4. Dark soils are usually more productive than light colored soils if equally well drained and aerated, on account of the greater reserve in organic matter. Having more organic matter, they are able to release more nitrogen and other plant food to crops.

5. The preceding crop on the land, as well as the cropping system, should be considered. Some crops draw much more heavily on the soil for nutrients than others. A full crop of corn requires nearly twice as much fertility as a full crop of small grain.

Consequently, where a heavy crop of corn was harvested the preceding year, the soil will likely have less reserve fertility than where a crop like small grain was grown which has drawn less heavily on the soil, and has given the soil a "rest" period the preceding autumn. Where little or no manure has been applied and where crop residues such as straw, stalks, etc. for hay have been removed, the need for potash fertilizers is likely to be more pronounced than where crops are pastured out and crop residues are returned to the land.

6. The crops to be grown and the length of time they are to remain on the land should be considered in making recommendations for soil treatment. Crops like corn, which use a large amount of fertility in a short growing season, will require more and different soil treatments than crops like fall seeded small grains which have a longer growing season and draw less heavily on the soil for fertility. Alfalfa and grasses occupying the land for several years will usually need heavier initial applications of fertilizer than crops which occupy the land for a single season and obtain tillage during their growth.

7. Previous soil treatments should be considered. For instance, soils well supplied with lime and containing considerable exchangeable calcium will likely release more phosphorus than when extremely acid or deficient in calcium. The need for potassium on soils that have had considerable calcium will likely be greater than on soils more deficient in calcium.

8. Method and time of seedbed preparation should be known. For instance, where the land is plowed early for fall seeded small grain, a large accumulation of nutrients, especially nitrogen, will be available for the newly seeded small grain. In contrast there is little accumulation of plant food where the seedbed is prepared immediately ahead of seeding and where weeds, trash and strawy material were turned under recently. Commercial plant food containing more nitrogen should be used where the latter condition exists than where a good seedbed is prepared.

9. Soil tests should be made once every rotation to give an inventory of the fertility released by the soil. These soil tests are very helpful if considered along with the factors mentioned above in selecting the plant food required by the soil.

Experiments and Soil Tests Aid in Selecting Plant Foods

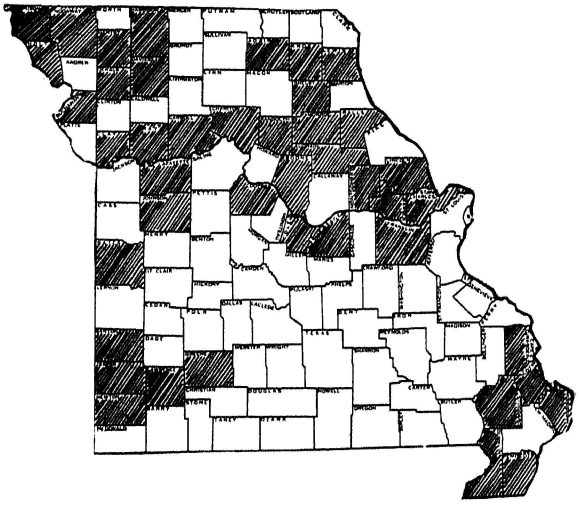
The University of Missouri College of Agriculture, through experiments and observations through the years, has accumulated a great deal of information on effects of fertilizers on the different soils of the state. This information is available at the College of Agriculture and through county agents.

Based on these experiments, soil testing laboratories have been established throughout the state in or near the county agent offices. (See outline map for location of these laboratories.) These laboratories are under the supervision of the University's department of soils. Soil tests can be obtained at a low cost. Before starting to build back the reserves in soil fertility, farmers are urged to have a chemical inventory made of all the fields on their farms.

The Soil Testing Laboratories.--Local farm organizations and business groups have set up modern soil testing laboratories under the supervision of the county agent in the counties shown on this map. Others are being established.

Farmers can have a chemical test made of their fields for a reasonable charge. This can be made in the laboratory nearest them - even if it is outside their own county.

To get this work done you should first see your county agent and then get the soil samples as described on pages 7 and 8. The samples should be sent or taken to the county agent. He will make the tests or have them made, showing the present level of organic matter, phosphorus, exchangeable potassium, magnesium, calcium and lime in your soil.



Indicates counties where soil testing laboratories are located.

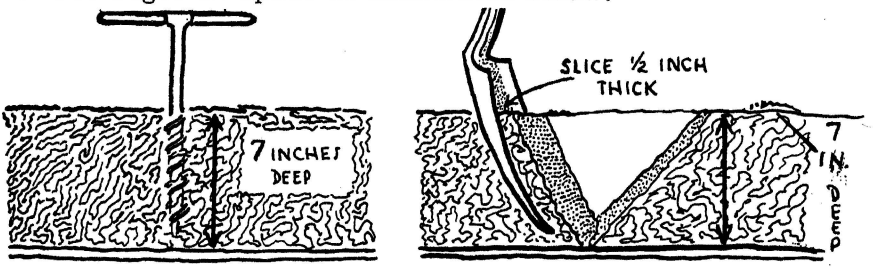
The county agent will also help you interpret the tests and select the plant food needed. If there is no soil testing laboratory near, the University of Missouri will test a limited number of samples in the soils department laboratory at Columbia.

INSTRUCTIONS FOR TAKING SOIL SAMPLES FOR SOIL TESTS

The reliability of the soil test depends upon the soil sample tested. Good samples are essential and can be obtained by following the instructions below.

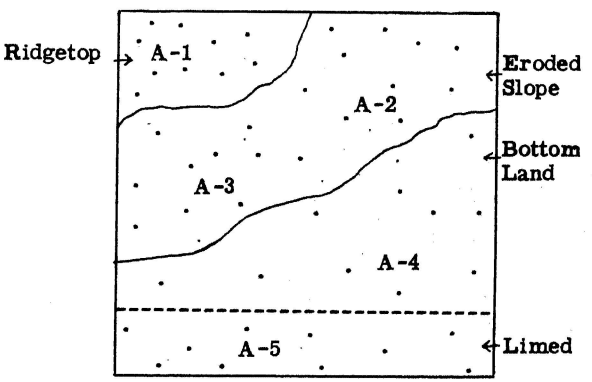
1. Get clean bucket for mixing samples and pint size ice cream containers or paper bags (heavy paper, 1/2 pound size preferred) for sending soil samples to laboratory.
2. Take samples.

a. Use auger or spade as illustrated below.



With an auger make a boring about 7 inches deep. Remove auger with soil. Or, with a spade dig a V-shaped hole about seven inches deep and cut a thin slice from the side of the hole and put in a clean bucket.

b. Number of samples required from a field. The diagram below indicates method of properly locating samples. Each composite should represent not more than ten acres.



=Samples to be taken with an auger or a spade. For each composite sample, make at least 10 borings, or samplings with a spade, and mix together in a clean bucket. Put a teacup full of the mixture in a 1/2 pound sack, as the composite sample to be tested. Give each field a letter (A, B, or C, etc.) and number the composite samples in each field as A-1, A-2, B-1, B-2, etc.

A-1, A-2, A-3, etc. - Composite samples representing a mixture of 10 or more auger or spade samplings (.) from each area in the field which is definitely of a different soil type, color, elevation, slope, known difference in productivity, or where the cropping or soil treatment has been different.

3. Label samples as indicated above and take to county agent's office.

Before limestone and fertilizer recommendations can be properly made, following the soil test, all information on the past history of cropping and soil treatments, as well as future rotation plans, must be known.

WHAT THE TESTS INDICATE

The tests can show many things. First they show the degree of acidity, which ranges from very strong to neutral. Next they indicate the pounds of exchangeable calcium, ranging from low to very high. The tests also rate as very low, low, medium, high or very high such things as pounds of exchangeable magnesium, percentage of stable organic matter, pounds of soluble phosphate per acre, and pounds of exchangeable potash.

Plant Food Materials Used.--Materials which are used to furnish plant food to soils directly or in mixed fertilizers are given below.

AVAILABLE FERTILIZER MATERIALS; PER CENT PLANT FOOD AND POUNDS OF PLANT FOOD PER TON

Nitrogen Materials	Per Cent Nitrogen	Lbs. Nitrogen Per Ton
Ammonium Nitrate	32.5	650
Ammonium Sulfate	20.5	410
Cyanamid	21.0	420
Nitrate of Soda	16.5	330
Urea Compounds	42 to 46	840 to 920
Phosphate Materials	**Per Cent Phosphate (P_2O_5)**	**Lbs. Phosphate Per Ton (P_2O_5)**
Super phosphate	18 to 20	360 to 400
Super phosphate	32	640
Double or treble superphosphate	40 to 50	800 to 1000
Rock Phosphate Total	30 to 32	600 to 640
Citrate Soluble	3 to 4	60 to 80
Potash Materials	**Per Cent Potash (K_2O)**	**Lbs. Potash Per Ton (K_2O)**
Muriate of Potash (potassium chloride)	50 to 60	1000 to 12000
Potassium Sulfate	48	960
Manure Salts	20 to 30	400 to 600
Hard wood ashes (unleached)	2 to 8	40 to 160

Fertilizer Grades and Ratios.--Mixed fertilizers contain the basic plant foods, nitrogen, phosphate and potash, in varying amounts. They are made with different ratios of nitrogen to phosphate and of phosphate to potash. The first figure in a fertilizer grade designates the per cent or pounds of nitrogen (N), the second

TABLE 1. SUGGESTED FERTILIZER RATIOS AND GRADES FOR MISSOURI FROM WHICH SELECTIONS BASED ON SOIL TESTS AND OTHER FACTORS CAN BE MADE

Ratio of $N:P_2O_5$	RATIO OF $P_2O_5 : K_2O$								
	1:0	4:1	3:1	2:1	3:2	1:1	1:2	1:3	0:1
0:1	0-45-0 0-32-0 0-20-0 Phosphate materials			0-30-15 0-20-10 0-16-8 0-14-7			0-15-30 0-12-24 0-10-20	0-12-36 0-9-27 0-6-18	0-0-60 0-0-50 0-0-48 Potash materials
1:8									
1:6	(6-30-0)			4-24-12 3-18-9 2-12-6					
1:4	(11-48-0) 4-16-0	8-32-8 4-16-4		4-16-8	4-12-8	4-16-16 3-12-12			
1:3	10-30-0		8-24-8 4-12-4				3-9-18		
1:2	(20-50-0)			8-16-8 6-12-6 5-10-5	(8-16-12) (4-10-6)	6-12-12 5-10-10	6-12-24		
1:1	(16-20-0)					10-10-10 8-8-8	8-8-16	6-6-18	
2:1					(10-6-4)				
Nitrogen Materials 1:0	46-0-0 33-0-0 20.5-0-0 16-0-0								

( ) Grades in parentheses do not quite fit specified ratios.

The grades are listed in order of the percentage of plant food they contain. The highly concentrated mixtures are listed first and the mixtures of lower concentration are listed last.

figure designates the per cent or pounds of phosphate (P_2O_5), and the third figure the per cent or pounds of potash (K_2O) in 100 pounds of fertilizer. For example, a 3-12-12 fertilizer contains 3 per cent or pounds of nitrogen (N), 12 per cent or pounds of phosphate (P_2O_5), and 12 per cent or pounds of potash (K_2O) per 100 pounds.

Low and High Grade Fertilizers.--Fertilizers or commercial plant food is purchased for the plant food it contains. Fertilizers containing 24 per cent or less of plant food are usually classed now as low grade fertilizers. Fertilizers containing more than 24 per cent plant food are usually spoken of as high grade fertilizers. Fertilizers with a high content of plant food require less labor to handle a given amount of plant food than do low grade fertilizers on the part of the farmer, dealer and manufacturer. For example, a ton of 45 per cent phosphate will supply the same amount of phosphate (P_2O_5) as 2 1/4 tons of 20 per cent phosphate. Likewise, one ton of 4-24-12 will supply as much plant food as 2 tons of 2-12-6. Because of the saving in manufacturing costs, bags, freight, etc., the plant food in the higher grade fertilizer can usually be purchased at a lower cost per pound than the plant food in low grade goods.

Experiments conducted by the University of Missouri Department of Soils show conclusively that the response from the plant food in the concentrated fertilizer is equal pound for pound to that in lower grades. It is sometimes pointed out that the low grade fertilizers contain more of the trace or minor plant foods than high grade fertilizers that may be beneficial to crops. The fact is that the high grade fertilizers usually have some of the same additional plant foods in smaller amounts. Should these additional plant foods be needed, neither the high or low grade fertilizer will likely contain a sufficient amount. The trace or minor plant foods can more easily be added to the high grade goods than the low grade goods.

Soil Fertility Should Be Considered in Cost of Production.--Applied plant food, such as limestone, phosphate and potash which do not leach out of the soil and which are not used by the immediate crop, builds up the soil reserve in these minerals. Their entire costs, therefore, should not be all charged to the immediate crop but regarded as a gain in inventory. Likewise, where no plant food is used the plant food removed in the crop should be charged as a loss in the soil fertility inventory. For instance, during 1944 to 1947 inclusive, where 50 pounds of phosphate were applied per acre to a low phosphate soil ahead of corn, an average increased yield of 8.9 bushels was obtained in 16 tests on eleven

different soils. The average yield of corn from the soils which received no phosphate was 43.0 bushels per acre while the phosphated areas gave a yield of 51.9 bushels per acre. The untreated crop removed 17.9 pounds of phosphate per acre. The higher yield removed 19.2 pounds. The present replacement cost of this phosphate in commercial plant food was $1.61 and $1.74 per acre, respectively. The cost of the applied phosphate on the treated area was $4.50 per acre. The crop used 19.2 pounds which cost $1.74. In this case there was an actual gain of $2.77 per acre in the inventory so far as phosphate was concerned. On the untreated land the phosphate inventory was reduced $1.61 per acre. The actual fertilizer cost of the increased corn yield was $0.194 per bushel. Other mineral plant foods should be evaluated in the same manner.

FERTILIZER USAGE IN MISSOURI; 1947

An approximate total of 293,704 tons of fertilizer was shipped for use in Missouri in 1947. This total was computed by compiling the data in reports received from fertilizer manufacturers who do business in this state. The 1947 shipments total 71,894 tons more than the amount shipped in 1946. This represents an increase of 32% in tons shipped over 1946.

The fertilizer shipped in 1947 contained plant food as follows:

Nitrogen	10,292 tons
Phosphoric Acid (P_2O_5)	39,748 "
Potash	13,447 "

In addition to the above, there were substantial amounts of calcium, magnesium, sulfur and the rarer plant food elements carried in this fertilizer.

Federal Agencies shipped 9,020 tons of superphosphate into Missouri. This tonnage is not included in any of the tables in this bulletin.

TABLE 2. FERTILIZER TONNAGES SHIPPED IN 1947 CLASSIFIED BY GRADE

	Spring	Fall	Total
	Tons	Tons	Tons
Superphosphate	22,613.1	17,738.4	40,351.5
Low Grade Mixed	2,336.5	69.0	2,405.5
Medium Grade Mixed	118,739.6	98,510.1	217,249.7
High Grade Mixed	5,210.2	2,822.2	8,032.4
Nitrogenous Materials	5,572.9	5,412.7	10,985.6
Potash Materials	242.0	247.0	489.0
Miscellaneous	5,866.5	8,324.0	14,190.5
Totals (Tons)	160,580.8	133,123.4	293,704.2

Definition of terms used in Tables 2 and 3:

Low Grade Mixed - All mixed fertilizers carrying less than 20 units of plant food.

Medium Grade Mixed - All mixed fertilizers carrying from 20 through 29 units of plant food.

High Grade Mixed - All mixed fertilizers carrying 30 or more units of plant food.

Nitrogenous Materials - Includes ammonium nitrate, ammonium sulphate, sodium nitrate, and cyanamid.

Potash materials - Includes muriate of potash, kainit, manure salts, and potassium sulphate.

Miscellaneous - Includes sewerage residue, bone meal, raw rock phosphate, and animal manures.

TABLE 3. FERTILIZER AND PLANT FOOD TONNAGES BY GRADE; 1947

	Fertilizer Tonnage		Plant Food Tonnages									
			Nitrogen		Available Phosphoric Acid		Insoluble Phosphoric Acid		Phosphoric Acid From Bone		Potash	
Kind of Fertilizer	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall
Superphosphate	22,613.1	17,738.4			5,167.7	3,620.5						
Bone Meal Fertilizer	39.0	37.8	0.8	0.8					10.5	10.2		
Low Grade Mixed	2,336.5	69.0	73.8	5.5	276.7	4.8					92.7	2.1
Medium Grade Mixed	118,739.6	98,510.1	3,479.1	2,835.8	14,318.6	11,881.8					6,645.5	5,285.0
High Grade Mixed	5,210.2	2,822.2	231.4	78.8	551.3	315.6					819.1	460.1
Nitrogenous Materials	5,572.9	5,412.7	1,783.0	1,693.8								
Potash Materials	242.0	247.0									93.5	67.5
Rock Phosphate	4,379.6	7,461.0			131.4	223.8	1,182.5	2,014.5				
Sewerage Residue	945.0	647.0	56.7	38.8	18.9	12.9						
Animal Manures	502.9	178.2	10.1	3.6	5.0	1.7					8.9	3.1
Season Totals	160,580.8	133,123.4	5,634.9	4,657.1	20,469.6	16,061.1	1,182.5	2,014.5	10.5	10.2	7,659.7	5,817.8
Grand Totals	293,704.2		10,292.0		36,530.7		3,197.0		20.7		13,477.5	

TABLE 4. SUMMARY REPORT OF FERTILIZER TONNAGES SHIPPED FOR USE IN MISSOURI, CALENDAR YEAR 1947

Grade	Spring Tonnage	Fall Tonnage	Total Tonnage
0-9-27	2.0	29.4	31.4
0-10-20	180.0	165.0	345.0
0-12-12	779.4	117.0	896.4
0-14-7	6,992.1	4,251.6	11,243.7
0-18-0	3,499.0	711.9	4,210.9
0-19-0	1,636.0	170.0	1,806.0
0-20-0	14,664.6	16,514.9	31,179.5
0-20-10	91.8	443.7	535.5
0-45-0)			
0-46-0)	2,813.5	341.6	3,155.1
0-47-0)			
2-12-6	52,342.8	46,647.5	98,990.3
3-9-18	4,293.4	2,082.2	6,375.6
3-12-4	2,263.0	-----	2,263.0
3-12-8	2,537.0	878.0	3,415.0
3-12-12	4,755.3	2,511.2	7,266.5
4-12-4	43,273.1	42,201.9	85,475.0
4-12-8	1,380.6	477.1	1,857.7
4-16-0	2,488.6	394.1	2,882.7
5-5-10	0.7	-----	0.7
5-10-5	167.3	138.2	305.5
5-10-10	627.6	-----	627.6
6-8-6	96.0	50.0	146.0
6-8-8	-----	5.0	5.0
6-8-12	200.0	136.0	336.0
6-10-4	23.0	14.0	37.0
7-6-19	2.0	-----	2.0
7-8-5	3.3	-----	3.3
8-7-3	73.5	69.0	142.5
8-8-8	1,926.3	496.9	2,423.2
9-9-9	16.9	-----	16.9
10-6-4	918.6	87.6	1,006.2
10-8-6	211.0	104.0	315.0
11-15-20	1.0	-----	1.0
16-20-0	640.0	101.9	741.9
Ammonium Nitrate	5,355.4	4,903.7	10,259.1
Ammonium Sulphate	131.0	36.0	167.0
Cyanamid	40.0	380.0	420.0
Sodium Nitrate	46.5	93.0	139.5
Bone Meal	39.0	37.8	76.8
Rock Phosphate	4,379.6	7,461.0	11,840.6
Sewerage Residue	945.0	647.0	1,592.0
Cattle Manure	119.5	43.8	163.3
Poultry Manure	0.3	-----	0.3
Sheep Manure	383.1	134.4	517.5
Muriate of Potash	122.0	40.0	162.0
Manure Salts	120.0	207.0	327.0
Total	160,580.8	133,123.4	293,704.2

TABLE 5. APPROXIMATE TONNAGE OF FERTILIZER SHIPPED INTO MISSOURI BY COUNTIES, 1947
(Calendar Year)

County	Spring Tonnage	Fall Tonnage	Total	County	Spring Tonnage	Fall Tonnage	Total
Adair	1866	1227	3093	Linn	2289	1259	3548
Andrew	286	182	468	Livingston	991	596	1587
Atchison	1138	1288	2426	McDonald	669	679	1348
Audrain	2963	2167	5130	Macon	1485	870	2355
Barry	3126	1483	4609	Madison	632	484	1116
Barton	1864	3446	5310	Maries	60	351	411
Bates	2597	2782	5379	Marion	1184	1590	2774
Benton	1033	1192	2225	Mercer	1752	711	2463
Bollinger	1302	1326	2628	Miller	425	604	1029
Boone	1947	2051	3998	Mississippi	1036	399	1435
Buchanan	3415	1924	5339	Moniteau	812	1482	2294
Butler	803	279	1082	Monroe	1745	2019	3764
Caldwell	1177	1203	2380	Montgomery	1680	1845	3525
Callaway	893	1382	2275	Morgan	1082	781	1863
Camden	75	64	139	New Madrid	1763	1009	2772
Cape Girardeau	1740	2493	4233	Newton	2167	2502	4669
Carroll	1080	821	1901	Nodaway	823	577	1400
Carter	152	45	197	Oregon	600	582	1182
Cass	2037	1940	3977	Osage	616	1236	1852
Cedar	962	808	1770	Ozark	182	236	418
Chariton	1402	1172	2574	Pemiscot	887	355	1242
Christian	1306	928	2234	Perry	975	1686	2661
Clark	2114	1244	3358	Pettis	1077	1578	2655
Clay	649	1167	1816	Phelps	517	849	1366
Clinton	1362	874	2236	Pike	1926	1481	3407
Cole	1058	1299	2357	Platte	1291	610	1901
Cooper	1149	833	1982	Polk	2073	1940	4013
Crawford	365	440	805	Pulaski	249	313	562
Dade	1425	1856	3281	Putnam	1214	247	1461
Dallas	656	480	1136	Ralls	381	277	658
Daviess	1781	633	2414	Randolph	874	1033	1907
DeKalb	1493	908	2401	Ray	1622	1508	3130
Dent	520	494	1014	Reynolds	161	185	346
Douglas	790	862	1652	Ripley	544	236	780
Dunklin	7170	2822	9992	St. Charles	850	1386	2236
Franklin	1112	1975	3087	St. Clair	745	1138	1883
Gasconade	566	1735	2301	St. Francois	1059	1056	2115
Gentry	1447	815	2262	Ste. Genevieve	525	984	1509
Greene	5248	3326	8575	St. Louis	3133	1752	4885
Grundy	1219	441	1660	Saline	1328	789	2117
Harrison	2256	1049	3305	Schuyler	1311	752	2063
Henry	1353	1646	2999	Scotland	1462	563	2025
Hickory	674	565	1239	Scott	2252	1424	3676
Holt	575	202	777	Shannon	333	313	646
Howard	611	412	1023	Shelby	1769	1620	3389
Howell	2205	1036	3241	Stoddard	1914	1303	3217
Iron	213	166	379	Stone	1006	212	1218
Jackson	6696	3839	10535	Sullivan	978	380	1358
Jasper	4826	5747	10573	Taney	333	338	671
Jefferson	635	463	1098	Texas	1413	1482	2895
Johnson	1265	1539	2804	Vernon	2171	2861	5032
Knox	877	620	1497	Warren	661	1469	2130
Laclede	1435	891	2326	Washington	340	307	647
Lafayette	2142	1666	3808	Wayne	334	292	626
Lawrence	2726	2639	5365	Webster	1947	1271	3218
Lewis	1799	1397	3196	Worth	375	225	600
Lincoln	1530	1837	3367	Wright	1881	1211	3092