Fertilizer Recommendations

For 1948 Oklahoma Crops

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By H. J. HARPER, H. F. MURPHY, F. B. CROSS and H. B. CORDNER*

This bulletin contains information on the kind and quantity of fertilizer materials or mixtures which should be applied to nutrient deficient soils to increase crop production. Following the table of recommendations is a brief general discussion on the use of fertilizer in Oklahoma, and appendices list grades and manufacturers registered in Oklahoma.

Additional information on the use of fertilizer and related problems of crop production can be obtained from county agents or by writing the Experiment Station.

The information presented in this bulletin is based on thirty thousand chemical analyses of soil samples from all 77 counties in Oklahoma, and on nearly five hundred cropping tests made by the Experiment Station in upward of sixty counties.

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Selection of a fertilizer depends upon which of the elements needed by plants (see footnote page 13) are lacking from the soil. Chemical soil tests are a valuable guide in determining whether fertilizer is needed on cultivated land not seriously damaged by erosion. Field tests covering a period of several years are also helpful. These points are further discussed on page 10.

The quantity of fertilizer to apply depends upon the crop to be planted and the value of the increase in yield over unfertilized land. Probable financial return from fertilization was taken into consideration in arriving at the quantities recommended for various crops in the table on page 5.

The benefit from applying a commercial fertilizer depends in part on availability of soil moisture. In eastern and central Oklahoma, drought may limit the production of crops in some years, and in those years the effect of fertilizer will be less than when rainfall is sufficient. In dry seasons, fertilizer will be more beneficial on deep sandy land than on shallow or fine-textured soils.

* Respectively, Soils Scientist, Head of Agronomy Department, Head of Horticulture Department, and Horticulturist (Vegetables).

In western Oklahoma, the amount of water available is usually the chief factor determining crop yields. Consequently, the natural fertility of western Oklahoma soils must decline to a relatively low level before fertilization will give a profitable increase in yields.

Genral Recommendations

Field Crops

Crop	Fertilizer and Method of Application	Rate of Application in Pounds per Acre
Alfalfa	Rock phosphate to last for several years applied broadcast when seedbed is prepared for new plantings. Acid soil should be limed one or two years before alfalfa is planted, for best results.	400-500
	Superphosphate broadcast or drilled annually on established fields in early spring or when seedbed is prepared for new plantings. 0-12-12, 2-12-6, or 3-9-18 to replace superphosphate on potash-deficient soils when manure is not available for top-dressing. Acid soils must be limed.	200-300
Corn	Superphosphate, 4-16-0 or 2-12-6 in row. Apply 75 to 150 pounds of ammonium nitrate as a side dressing on deep soils at the second cultivation, May 15 to June 1, when a soil building legume is not planted in the cropping system.	100-200
Cotton	5-10-5 on sandy soils; 4-16-0 or 4-12-4 on fine-textured soils; superphosphate on dark-colored soils. Drill in row at time of planting. Where cotton rust is severe use 200-300 pounds of 3-9-18 or 8-8-8 with 0-12-12 on legume crop.	100-200

Crop	Fertilizer and Method of Application	Rate of Appfication in Pounds per Acre
Pasture	*Permanent pastures containing legumes:* Apply superphosphate on phosphorus deficient soils, and 0-14-7 or 0-12-12 on soils deficient in phosphorus and potassium. Drilled in 14-inch rows, 150 pounds per acre.	150-300
	Rye grass or small grain for temporary pasture: Apply 4-16-0, 4-12-4, 5-10-5 or 16-20-0 at time of planting. Top dress as spring growth begins with 50 to 100 pounds of ammonium nitrate.	
	Bermuda grass with low vegetative vigor: Apply a mixture containing equal quantities of ammonium nitrate and superphosphate immediately after mixing, at the rate of 200 pounds per acre about April 15. Or use a 10-6-4 fertilizer.	
Small Grains	2-12-6, 4-12-4, 4-16-0 or superphosphate, preferably drilled in row at seeding time. These fertilizers will supply the phosphorus requirements for lespedeza on slightly acid to moderately acid soils in eastern Oklahoma.	150
Peanuts*	2-12-6, 0-14-7 or 0-12-12 on light-colored soils. Superphosphate on dark-colored soils.	200
Sorghum	No fertilizer recommended.	

* Mixed fertilizers should not be in direct contact with seed, as they may severely injure germination and early seedling devlopment.

Crop	Fertilizer and Method of Application	Rate of Application in Pounds per Acre
Soybeans*	Superphosphate, 0-14-7, 0-12-12, 2-12-6 or 4-12-4 in row.	200
Summer Legumes**	The residual effect of phosphate fertilizer on previous crops will meet the requirements for these crops.	
Sweet Clover	Rock phosphate or superphosphate drilled in row between small grain in rows 14 or 16 inches apart. If rock phosphate is broadcast, apply at the rate of 400 pounds per acre. Lime should be applied if the soil is acid. (See Oklahoma Agricultural Experiment Station Bulletin B-298.)	200
Winter Legumes		
Group A: Hairy vetch and Austrian winter peas	Rock phosphate or superphosphate in row. If rock phosphate is broadcast, use 400 lbs. per acre.	150-300
Group B: Hop, bur, white dutch and ladino clover, black medic, and other fall-planted pasture legumes	Superphosphate on phosphorus deficient soils; 0-14-7 or 0-12-12 on soils deficient in phosphorus and potassium, preferably drilled in rows 14 inches apart with seed dropped above fertilized zone in new plantings.	150-300***

* Mixed fertilizers should not come in direct contact with seed, as they may severely injure germination and early seedling devlopment.
** Includes cowpeas, mung beans and crotalaria. These crops do not respond to fertilizers except on soils very low in available phosphorus.
*** For broadcast application use the higher rate. If drilled in 14-inch rows use the lower rate.

Vegetable Crops for Commercial Production*

If the fertilizer recommended in the following table cannot be obtained, a 4-16-0 or 16-20-0 may be substituted **on an equivalent nitrogen basis,** especially in central Oklahoma.

Crop	Fertilizer and Method of Application	Rate of Application in Pounds per Acre
Cabbage	5-10-5 in row	400-600
Irish Potatoes	5-10-5 in row	300-600
Onions	5-10-5 in row	400-600
Snap Beans	5-10-5 in row	300-500
Spinach or Other Greens	5-10-5 and a top-dressing of ammonium nitrate or nitrate of soda. (16 to 32 pounds of nitrogen per acre.)	200-300
Sweet Corn	4-12-4 in row	200-400
Sweet Potatoes	2-12-6 or 4-12-4 in row	300-400
Tomatoes	4-12-4 mixed in row with soil before plants are set	400-600
Watermelons, Cantaloupes, and Cucumbers	5-10-5 in row or ¼ pound per hill mixed into soil	100-300
All Other Vegetable Crops	5-10-5; drill in row if rows are far apart. Mix fertilizer with soil if rows are closely spaced.	300-600

Fertilizers applied in a row should be thoroughly mixed with the soil to a depth of three or four inches or placed in a band at the side and below seed level to prevent injury to seed germination, or young plants.

If soil is moderately or strongly acid, lime should be applied to neutralize acidity (expect for Irish potatoes.)

Plant cowpeas as a summer catch crop, or use hairy vetch or other legumes in a rotation to replace nitrogen and organic matter which disappears as a result of cultivation.

For small gardens, it may be more convenient to broadcast two pounds of fertilizer per hundred square feet before the land is plowed or spaded.

Calcium cyanamid may be applied one to four weeks before a crop is planted to supply a readily available form of nitrogen on soils where nitrogen is needed for maximum yields.

* Recommendations for fertilizing home gardens are given in Oklahoma Extension Circular E-196, "Home Vegetable Garden."

Small Fruits

Crop	Fertilizer and Method of Application	Rate of Application in Pounds per Acre
Blackberries	Plant hairy vetch between rows as recommended for orchards; or use 5-10-5, drilled or broadcast and disked into soil in spring before growth starts.	300-500
Strawberries	4-12-4 for new plantings, drilled or broadcast and worked into soil before planting in February or March, with a side-dressing of 50-100 pounds of ammonium nitrate (16 to 32 pounds of nitrogen) or equivalent amounts of sodium nitrate or ammonium sulfate in late September or early October. (150-200 pounds of a 10-6-4 may be used if ammonia or nitrate nitrogen is not available).	200-300

Orchards

Plant hairy vetch in September at the rate of 10 or 15 pounds of seed per acre in central and eastern Oklahoma to supply nitrogen. Superphosphate should be applied at the rate of 200 pounds per acre on phosphorus deficient soils, preferably drilled in the row at time of seeding, to increase the yield of vetch. Disk or plow vetch residues into soil in July after seeds are mature, or in late May if grass or weed growth is abundant.

Fruit trees, except pears, should receive 2 to 5 pounds of sodium nitrate or ammonium sulfate per tree. If ammonium nitrate is available, apply one to two pounds per tree. If nitrogen fertilizer is not available apply 4 to 10 pounds of 10-6-4. If cyanamid is used it must be applied in the fall after the leaves have dropped. (Never apply at any time except during the dormant season).

Lawns, Shrubs, and Flower Beds

Cottonseed meal or soybean meal applied at the rate of 3 or 4 pounds per 100 square feet about March 1 is an excellent fertilizer for lawns, shrubs, or flower beds. Mix fertilizer thoroughly into soil on cultivated areas. A 10-6-4 fertilizer can be used at the rate of ½ to 1 pound per 100 square feet, or a 5-10-5 at the rate of 1 or 2 pounds per 100 square feet.

Suggestions on Using Fertilizer

Whether it will be profitable to use commercial fertilizer depends on:

1. The physical and chemical composition of the soil.
2. Climatic conditions, especially rainfall. (Any statement in this bulletin implying that fertilization will increase yields always carries the implied qualification: "Provided sufficient soil moisture is available.")
3. The probable income per acre from the crop to be planted.
4. Proper methods of applying the fertilizer.

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Chemical soil tests are a valuable guide in determining whether fertilizer is needed on cultivated land not seriously damaged by erosion. Simple soil tests can be made locally by county agents, vocational agriculture teachers, or Soil Conservation Service employees. Other tests will be made upon request by the State Soils Laboratory at the Experiment Station.

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Useful information about the probable need for fertilizer is provided by results of the Station's field tests. These tests have been made at nearly five hundred locations in upward of sixty counties, and new tests are made each year. Several crops are usually grown at each location. Information on the results of local tests can be obtained from county agents or by writing to the Station.

A single year's test or experience with fertilizer is seldom dependable in Oklahoma, because of annual differences in rainfall. Before too much reliance is placed on a particular field test, it should be known that the test was conducted over a period of several years.

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Dark colored soils usually do not need fertilization except for a few special crops, unless they are moderately to strongly acid. Dark colored soils which are acid, however, often lack phosphorus

in a form available to plants. On such soils, yields can be increased temporarily by phosphate fertilizer.

Strongly acid sandy soils with acid sandy subsoils usually are low in both phosphorus and potassium.

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The quantity of nitrogen and potassium in mixed fertilizers such as 4-12-4 and 5-10-5 is enough to give long-season crops a start, but not enough to carry them through to maturity and produce a good yield. The phosphorus content, on the other hand, is usually adequate. For example, 200 pounds of a 4-12-4 mixture contains enough phosphorus to produce about fifty bushels of corn, but only enough nitrogen and potash to produce about four bushels. Therefore if the soil is low in either nitrogen or potash in available form, yields will be low despite use of 4-12-4 or similar mixtures at usual rates.

One way to supply more nitrogen or potash is to increase the rate of application. In that case, a mixture with a lower proportion of phosphorus (such as an 8-8-8) should be used for economy.

Another way of supplying additional nitrogen is by a side-dressing of ammonium nitrate or other nitrogen fertilizer at the proper stage of crop growth, or by growing a soil-building legume in the cropping system.

To provide more potassium, muriate of potash could be applied broadcast, or a high potash fertilizer such as a 3-9-18 could be used.

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In eastern and central Oklahoma, a soil-building legume such as alfalfa, sweet clover, hairy vetch, Austrian winter peas or lespedeza should be grown in the cropping system to assist in maintaining yields as soil fertility declines. On fertile soils, the practice of regularly growing a soil-building legume in a crop rotation is usually sufficient to make maximum yields of field crops. On acid, low-phosphate soils, lime and phosphate will be needed to produce maximum growth of the legumes.

Soil-building legumes supply both nitrogen and organic matter. The nitrogen provided by legumes is needed because the average fertilizer mixture at usual rates of application provides only a small percentage of the nitrogen required to produce a

crop. (Soil depleting crops contain about five times as much nitrogen as phosphorus.)

Organic matter improves the physical condition of medium and fine textured soils, reduces the hazard from wind erosion on sandy land, and increases the moisture absorbing capacity of all soils.

Soil organic matter contains nearly all of the nitrogen and sulfur and about one third of the phosphorus in the surface soil, but these plant nutrients cannot be used by plants until the organic matter decays. Soil conditions favoring decay are more common in summer than in spring or fall. Consequently, crops which make most of their growth during the summer are more likely to benefit from decaying organic matter than are crops which do most of their growing in spring and fall. As a result, spring- and fall-growing crops are more likely to benefit from fertilizer than are summer-growing crops.

Soil conditions are more favorable for nodule development on the roots of soil building legumes during the spring and fall. Legumes which grow during cool weather obtain more nitrogen from the air than legumes which grow when the weather is hot and the moisture content of the soil is low. An application of a phosphate fertilizer or a mixed fertilizer containing phosphorus and potassium will increase the yield of a legume crop which grows during cool weather on nutrient deficient soils. This method of soil improvement will increase the supply of available nitrogen for succeeding crops and will also produce additional quantities of protein feed for livestock.

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When soil-building legumes are grown regularly in the cropping system, the nee dfor top- or side-dressings o fnitrogen fertilizer will be greatly reduced if not completely eliminated. However, for most vegetable crops a combination of legumes and row fertilization is recommended.

In years when excessive rainfall carries plant nutrients into the subsoil beyond the zone of root development, a top dressing of nitrate fertilizer will increase the yield of small grain.

On soils low in organic matter, a side-dressing of nitrate or ammonia nitrogen will stimulate early growth of cotton and corn

and thereby increase yields, provided supplies of other plant nutrients are adequate and drought does not interfere. About one-third or one-fourth of the nitrogen should be applied at planting time on soils low in organic matter.

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The so-called "trace elements"* are rarely deficient in Oklahoma soils. All field experiments and chemical tests of soils and plants made to date by the Experiment Station indicate that a satisfactory supply of trace elements is normally present as chemical impurities in phosphate and potash fertilizers.

Calcium, which is needed in rather large quantities by legume crops, is supplied in the lime used to correct soil acidity.

Magnesium as well as calcium is found in dolomitic limestone. Therefore this type of limestone should be used on acid soils low in available magnesium. Dolomitic limestone is used instead of sand as a filler in some fertilizers.

Sulfur is supplied by ordinary superphosphate, or by mixed fertilizers in which ammonium sulfate is used to provide all or a part of the nitrogen. From 6 to 12 pounds of sulfur occurs in the rain falling on each acre of land, annually.

The manganese supply in the average Oklahoma soil is high, chemical analyses indicate.

Applications of copper, boron, zinc, manganese and magnesium have not increased crop yields on plots fertilized with superphosphate, muriate of potash and lime, with legumes supplying nitrogen.

* The 11 elements which plants must obtain from the soil are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, boron, manganese, zinc, and copper. Iodine, cobalt and chlorine are not needed for plant growth but are essential for the growth of animals. Some fertilizer companies manufacture special fertilizer grades containing all elements needed for plant growth which plants obtain from the soil. Others offer mixtures of trace elements for supplementing standard grades of fertilizer.

APPENDIX I:

Fertilizer Materials and Grades

Fertilizer materials and grades registered for sale in Oklahoma are:

FERTILIZER MATERIALS		FERTILIZER GRADES
Nitrogen carriers		
Ammonium nitrate	32% N or higher	0-12-12
Ammonium sulfate	20% N or higher	0-14-7
Calcium nitrate	16% N or higher	2-12-6
Cal-Nitro	16% N or higher	3-9-18
Cyanamid	20% N or higher	4-12-4
Sodium nitrate	16% N or higher	4-16-0
Uramon	42% N	5-10-5
		6-8-8
		8-8-8
		10-6-4
Phosphate carriers		
Bone meal		
Superphosphate	18% P_2O_5 or higher	
Rock phosphate	80% thru 200 mesh	
Potash carriers		
Kainit	20% K_2O or higher	
Muriate of potash	50% K_2O or higher	
Sulfate of potash	48% K_2O or higher	
Sulfate of potash-magnesia	30%K_2O or higher	

Miscellaneous fertilizers

Ammonium phosphate 11-48-0 and 16-20-0
Ammoniated superphosphate (as guaranteed)

APPENDIX II:

Sources of Fertilizer

In areas where fertilizer cannot be obtained from local dealers, information concerning the nearest source of different fertilizer materials or grades may be obtained by writing to companies which manufacture or distribute these products. Usually any company distributing mixed fertilizers will also be able to supply superphosphate, nitrogen, and potash.

The following list was prepared from a list provided by the State Board of Agriculture, Oklahoma City, showing companies registered with the Board for sale of fertilizers in Oklahoma. Companies registering liquid and specialty fertilizers are omitted, since these fertilizers are normally distributed in small packages and sold by many local seed, drug, and other types of stores.

MIXED FERTILIZERS

NAME OF COMPANY	ADDRESS
American Agricultural Chemical Co.	National Stock Yards, Ill.
Arkansas Fertilizer Co.	North Little Rock, Ark.
Armour Fertilizer Works, Inc.	Houston, Texas
Fidelity Chemical Corp.	Houston, Texas
Fort Smith Cotton Oil Co.	Fort Smith, Ark.
Gate City Fertilizer Co.	North Little Rock, Ark.
International Agricultural Corp.	Texarkana, Ark.
International Minerals and Chemical Corp.	Texarkana, Ark.
Missouri Chemical Co.	Joplin, Mo.
Newhouse Chemical & Supply Co.	North Little Rock, Ark.
Oklahoma Chemical Co.**	Tulsa, Okla.
Ralston Purina Co.*	St. Louis, Mo.
Red Star Fertilizer Co.	Sulphur Springs, Texas
Shannon Fertilizer Manufacturing Co.	Tulsa, Okla.
Shreveport Fertilizer Works	Shreveport, La.
Swift and Co.	Shreveport, La., and National Stock Yards, Ill.
United Chemical Co.	Dallas, Texas
Virginia-Carolina Chemical Corp.	Shreveport, La., and Little Rock, Ark.
Waldo Fertilizer Works*	Waldo, Ark.
Wilson & Company	Oklahoma City, Okla.

* Only mixed fertilizer registered.

** Not registered at time this listing was prepared, but expected to be in operation early in 1948.

NITROGEN, PHOSPHORUS AND POTASH MATERIALS

Nitrogen

American Cyanamid Co.	30 Rockefeller Plaza, N. Y., N. Y.
Associated Cooperatives, Inc.†	Sheffield, Alabama
Chilean Nitrate Sales Corp.	120 Broadway, New York, N. Y.
Colorado Fuel and Iron Corp.**	Pueblo, Colo.
Ford Motor Co.**	Dearborn, Mich.
Lion Oil Co., Chemical Division	El Dorado, Ark.
Southern Acid & Sulphur Co., Inc.	Pasadena, Texas
Spencer Chemical Works†	Kansas City, Mo.

Potash

French Potash Co., Inc.	New York, N. Y.

Rock Phosphate

American Cyanamid Co.	30 Rockefeller Plaza, N. Y., N. Y.
Kellogg Company	Ocala and Hernando, Fla.
Loncala Phosphate Co.	High Springs, Fla.
Robin Jones Phosphate Co.	Nashville, Tenn.
Ruhm Phosphate and Chemical Co.	Mt. Pleasant, Tenn.
Schrock Fertilizer Service	Congerville, Ill.
Soil Builders, Inc.	Dunnellon, Fla.
Thompson Phosphate Co.	407 So. Dearborn St. Chicago, Ill.

Superphosphate††

Anaconda Copper Mining Co.	Anaconda, Mont.
Southern Acid & Sulphur Co., Inc.	Pasadena, Texas
Simplot Fertilizer Company	Pocatello, Idaho

Raw Bone Meal

Consolidated Chemical Industries, Inc.	Houston, Texas

† Produce ammonium nitrate.

** Produce ammonium sulphate.

†† Superphosphate is also available from most of the companies listed under "Mixed Fertilizers."

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