Lime for Oklahoma Soils

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OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE
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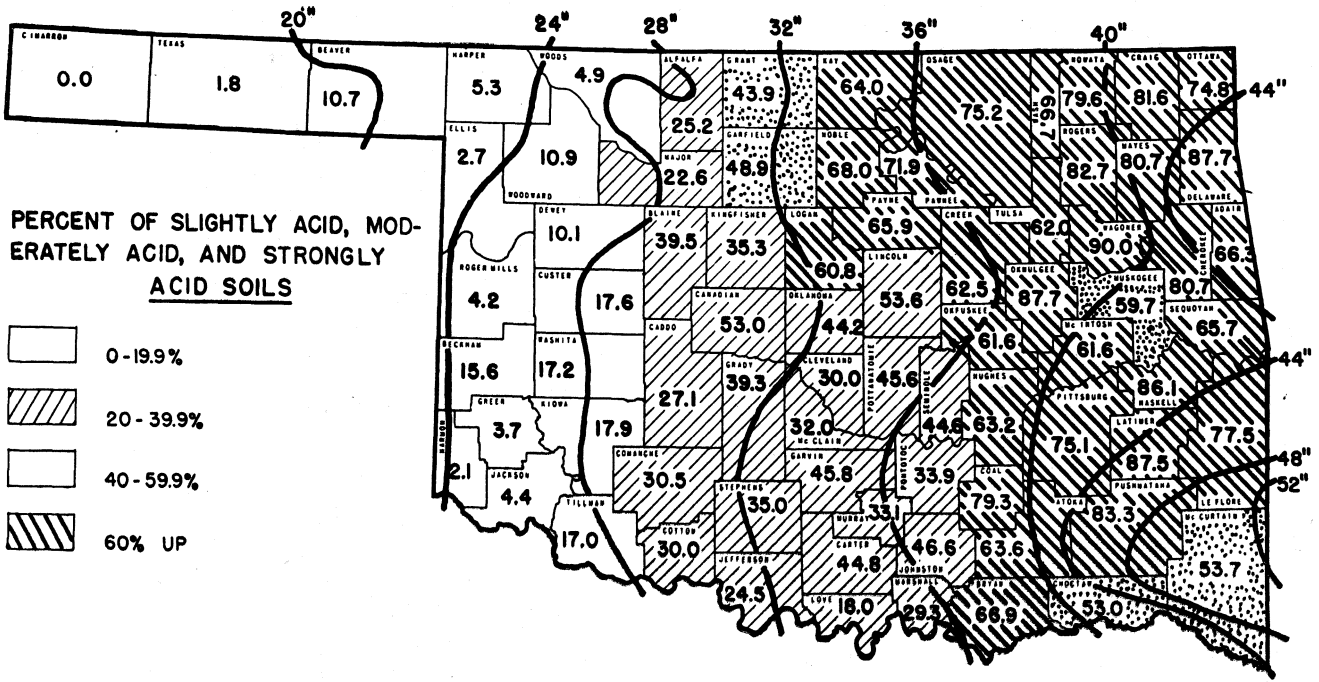
20"
24"
28"
32"
36"
40"
44"
48"
52"
PERCENT OF SLIGHTLY ACID, MODERATELY ACID, AND STRONGLY ACID SOILS
0-19.9%
20-39.9%
40-59.9%
60% UP
CIMARRON
TEXAS
BEAVER
HARPER
WOODS
ALFALFA
GRANT
KAY
OSAGE
NOWATA
CRAIG
OTTAWA
ELLIS
WOODWARD
MAJOR
GARFIELD
NOBLE
PAWNEE
ROGERS
MAYES
DELAWARE
DEWEY
BLAINE
KINGFISHER
LOGAN
PAYNE
CREEK
TULSA
WAGONER
CHEROKEE
ADAIR
ROGER MILLS
CUSTER
CANADIAN
OKLAHOMA
LINCOLN
OKMULGEE
MUSKOGEE
SEQUOYAH
BECKHAM
WASHITA
CADDO
GRADY
CLEVELAND
POTTAWATOMIE
SEMINOLE
OKFUSKEE
MC INTOSH
GREEN
KIOWA
HARMON
JACKSON
COMANCHE
GARVIN
MC CLAIN
HUGHES
PITTSBURG
LATIMER
LE FLORE
TILLMAN
COTTON
STEPHENS
JEFFERSON
CARTER
LOVE
MURRAY
JOHNSTON
MARSHALL
COAL
ATOKA
BRYAN
PUSHMATAHA
MC CURTAIN
0.0
1.8
10.7
5.3
4.9
2.7
10.9
25.2
43.9
64.0
75.2
79.6
81.6
74.8
22.6
48.9
68.0
71.9
82.7
80.7
87.7
10.1
39.5
35.3
65.9
62.0
90.0
66.3
4.2
17.6
60.8
53.6
62.5
87.7
59.7
80.7
53.0
44.2
61.6
65.7
15.6
17.2
30.0
45.6
61.6
27.1
39.3
86.1
3.7
17.9
32.0
44.6
63.2
75.1
77.5
2.1
4.4
30.5
45.8
33.9
87.5
17.0
35.0
33.1
79.3
83.3
30.0
44.8
46.6
63.6
53.7
24.5
16.0
29.3
66.9
53.0

LIME FOR OKLAHOMA SOILS

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Acting Extension Agronomist

Agricultural limestone supplies calcium—one of the important elements necessary for proper growth and development of crops and livestock. Limestone neutralizes harmful acidity and creates a more favorable condition for the growth of many legumes, which, in turn, add organic matter and nitrogen to the soil. In the soil, it stimulates the growth and activity of soil bacteria and hastens the decay of organic matter, thereby increasing the amount of nitrogen, phosphorus, potassium, and other plant nutrients available for crop use. Lime also increases the value of farm manure and fertilizers on acid soils.

AREAS WHERE NEEDED

Many soils in central and eastern Oklahoma have been severely leached of their calcium. Consequently, soil acidity has become a serious problem in those areas. The degree of acidity varies from very strongly acid in some soils to slightly acid, and the percentage of cropland which is acid bears a very close relation to rainfall intensity. In the eastern section of the State, where the average annual rainfall is 36 inches or higher, 72.6 percent of the soils are acid. In the central area, the average annual rainfall varies from 28 to 36 inches, and 44.8 percent of the soils are acid. In the western section, where the rainfall average is less than 28 inches, only 14.3 percent of the soils are acid. As the degree of acidity increases, environmental conditions in the soil become less favorable for plant development. Furthermore, the rate of decay of organic matter is decreased, and the availability of nitrogen, phosphorus, calcium, and other essential plant nutrients is reduced.

TEST SOILS FOR LIME REQUIREMENT

Since soils vary widely in origin, texture, and the amount of leaching and erosion which have taken place, specific lime needs can be determined only by a soil test. It is advisable, therefore, to have the soil tested before the expense of applying lime is incurred.

Certain definite steps should be carefully observed in collecting soil samples for testing. Samples should be taken from both the surface and the sub-surface soil. If the soil in the field is fairly uniform, collect 5 to 10 small samples of surface soil and mix together to form a composite sample. If the field contains more than one distinct type of soil, a composite sample should be collected for each separate type. In obtaining soil samples from cultivated land, loosen the surface soil and pick up a handful of soil from several locations. In sampling pasture land, use a soil auger or spade and obtain the soil from the surface downward to a depth of 3 to 4 inches.

Three or four samples should be taken at a depth of 12 to 18 inches and mixed thoroughly to make up the sub-surface composite. One pint of soil is sufficient for testing purposes. The samples should be numbered in such a manner that they can be readily identified and their location in the field determined. The samples should be taken to the office of the county agent; or, after air drying and wrapping securely, they may be sent to the Soils Laboratory, Oklahoma A. and M. College, Stillwater, Oklahoma.

KIND OF LIME TO USE

There are several forms of lime that may be used, but finely ground limestone is the form most commonly used in Oklahoma. The effectiveness of agricultural limestone in correcting soil acidity and supplying calcium depends upon the degree of fineness to which it has been ground and the percentage of calcium carbonate which it contains. A high grade of agricultural limestone should contain not less than 85 percent of calcium carbonate; 90 percent of the ground material should pass through a 10-mesh sieve; and 40 percent should pass through a 60-mesh sieve. The fine portion of the limestone, if properly mixed with the soil, is available the first season for neutralizing soil acidity. Since any immediate effect must be obtained from the "flour" lime present, it is evident that larger quantities of coarse material must be applied to produce the same result.

WHEN AND HOW TO APPLY

Limestone may be applied at any time during the year when spreading machinery can be moved over the land and crops do not interfere. It is often spread during the winter months when other work is light.

Thorough mixing of the lime with the surface soil is necessary for immediate benefits. Lime may be applied on plowed land and harrowed or double disced into the soil. When applied on stubble or unplowed land, a disc or field cultivator should be used to mix, with the surface soil before the land is plowed.

Grassland should be disced to loosen the surface soil before spreading lime. The discs should be set so as to cut deeply and with as little turning of the soil as possible, in order to leave deep open furrows to facilitate penetration of the lime into the soil. On sloping land, the disc should be run on the contour. If grass sod is very thick, a second discing may be necessary. This operation should be done in late fall or early spring when there is plenty of moisture in the soil. If lime is applied on the surface of a pasture, it will move downward into the soil very slowly, and, on steep slopes, a considerable portion of the fine material may be carried away by runoff water.

HOW TO SPREAD

The best method of applying limestone is by the use of a lime spreader. There are several types of manufactured spreaders on the market. These range from the small trailer type to large machines. A manure spreader can be used if a layer of straw is placed in the bottom before the limestone is added. A spreader may be purchased by several farmers cooperatively, and the cost to each individual will be reduced accordingly. Plans for homemade spreaders are available and may be obtained at the county agent's office.

RATE OF APPLICATION

The amount of limestone which should be applied will depend upon the degree of acidity and the texture of the soil. Fine textured soils require larger amounts of lime for neutralizing acidity than coarse textured soils. Slightly acid soil will usually require one to two tons; moderately acid soil, one and one-half to three tons; and strongly acid soil, two to four tons per acre. No limestone is needed for a basic or neutral soil. The amounts of lime required for soils of varying texture and degree of acidity are shown in Table I.

Table I.—Limestone Requirement for Soils of Varying Texture and Degree of Acidity.

Degree of Acidity	SOIL TEXTURE AND LIME REQUIREMENT IN TONS PER ACRE				
	Sand	Sandy Loam	Loam and Silt Loam	Clay Loam	Clay
Slightly acid	.5	.8	1.0	1.5	2.0
Moderately acid	1.0	1.5	2.0	2.5	3.0
Strongly acid	1.5	2.0	3.0	3.5	4.0
Very strongly acid	2.0	3.0	4.0	4.5	5.0

FREQUENCY OF APPLICATION OF LIME

The frequency of application of lime will depend to some extent upon rainfall and the kind of crops grown on the land. Under average conditions, a single application of agricultural limestone will usually last from 10 to 15 years.

CROP NEEDS

Lime (Calcium) requirements are not the same for all crops. Legumes require larger amounts of lime than non-legumes. Practically all legumes are heavy users of lime, and some of the common ones cannot be successfully grown on acid soils.

Alfalfa and sweet clover have a very high lime requirement, and these crops should not be seeded on soils that are acid in reaction until sufficient quantities of ground limestone have been applied to correct the acid condition in the soil. Bur Clover, Black Medic, Red Clover, Dutch White Clover, and Austrian Winter Peas have high lime requirements and will

grow best in soils well supplied with calcium. Vetch, Lespedeza, Hop Clover, Soybeans, Alsike Clover, and Crimson Clover have medium lime requirements. Cowpeas and common lespedeza have a fairly low lime requirement and will grow in acid soils. Other crops which have high lime requirements are barley, garden peas, lettuce, spinach, cabbage, and onions.

LIME AND ANIMAL NUTRITION

Many diseases and ailments of livestock can be traced to mineral deficiencies in the soil. Grasses grown on depleted soils contain smaller amounts of essential minerals and protein than when grown on soils which are well supplied with minerals. Also, as soils become depleted of their mineral reserves, the more palatable and nutritious grasses are destroyed by overgrazing and are gradually replaced by less palatable grasses and by weeds. Thick, vigorous stands of legumes which are high in the essential proteins, minerals, and vitamins can be obtained only on soils which are well supplied with calmium (lime), prosphorus, and other necessary minerals.

SOURCES

There are several companies that operate quarries and produce high quality agricultural limestone. This material can be obtained at the quarry at a low cost per ton. Carload shipments can be delivered to any desired point. Organized programs for making farm deliveries of lime are in operation in many counties. The local county agent can give complete information in regard to the availability of lime and how it can best be obtained.

PRACTICE PAYMENT FOR USE OF LIME

The soil building allowances established by the Agricultural Adjustment Agency offer assistance to every farmer in starting a soil improvement program on his farm. The application of agricultural limestone to acid soils is one of the practices for which assistance has been given.

LIMESTONE AND SOIL IMPROVEMENT

Proper use of limestone in a soil improvement program is necessary in order to obtain the greatest benefit from an application of this material. Lime supplies only one of 11 elements, essential for plant growth, which plants must obtain from the soil. It will not in many cases increase the yields of corn, small grains, cotton, and sorghums when these crops are grown continuously on the land. The lime should be used primarily to increase the growth of legumes which will add organic matter and nitrogen to the soil. Many farmers in central and eastern Oklahoma have used lime and phosphorus on mineral deficient soils in order to grow sweet clover and other legumes for soil improvement, after which much larger yields of grain crops are usually obtained.

It should be kept in mind that the use of lime to correct soil acidity is only one of several practices which may be required to restore and maintain the fertility of a soil. It will not replace other essential elements such as nitrogen, phosphorus, or potash; nor will it substitute for crop rotation or other good farming practices. Soils that are strongly acid are often very low in available phosphorus, and phosphate fertilizer, in addition to lime, must be added before legumes can be successfully grown. The application of soil and moisture conservation practices, the use of agricultural limestone and phosphate fertilizer, and the growth of legume crops for soil improvement are all necessary to develop and maintain a more permanent system of agriculture, on a high percentage of the cultivated land in central and eastern Oklahoma.

Table II.—Estimated Quantity of Agricultural Limestone Required to Neutralize the Acidity in the Cultivated Soils of Oklahoma Counties.*

County	Acreage of crop land, 1940 census	Tons of limestone per county
Adair	52,124	69,012
Alfalfa	339,955	117,980
Atoka	88,135	113,165
Beaver	514,455	0
Beckham	246,993	24,872
Blaine	289,159	100,309
Bryan	215,761	313,587
Caddo	418,114	83,622
Canadian	305,719	272,579
Carter	120,988	80,299
Cherokee	84,096	106,297
Choctaw	118,162	113,199
Cimarron	351,767	0
Cleveland	114,618	53,755
Coal	80,211	133,150
Comanche	211,031	49,993
Cotton	217,120	66,872
Craig	198,924	333,913
Creek	140,868	160,166
Custer	311,226	47,773
Delaware	101,444	233,929
Dewey	239,624	25,160
Ellis	273,379	0
Garfield	430,588	435,539
Garvin	222,250	152,574
Grady	342,860	227,487
Grant	427,240	203,152
Greer	196,088	0
Harmon	179,247	0
Harper	254,545	14,763
Haskell	100,498	77,544
Hughes	151,378	191,039
Jackson	302,774	19,983
Jefferson	153,034	50,960
Johnston	85,701	68,003

* Data supplied by the Oklahoma Agricultural Experiment Station.

Table 2.—(Continued.)

County	Acreage of crop land, 1940 census	Tons of limestone per county
Kay	330,251	407,199
Kingfisher	327,516	159,991
Kiowa	352,809	85,556
Latimer	33,412	72,119
Le Flore	140,896	266,857
Lincoln	211,240	214,831
Logan	197,463	193,316
Love	83,109	20,278
Major	241,944	51,050
Marshall	78,616	35,848
Mayes	163,092	270,080
McClain	186,475	112,444
McCurtain	125,372	140,792
McIntosh	163,152	186,156
Murray	54,908	29,485
Muskogee	219,441	333,989
Noble	214,593	287,769
Nowata	124,680	208,090
Okfuskee	152,016	174,666
Oklahoma	135,471	106,886
Okmulgee	148,997	268,045
Osage	175,612	254,286
Ottawa	117,043	196,281
Pawnee	122,527	162,838
Payne	163,757	199,456
Pittsburg	156,228	244,496
Pontotoc	114,278	66,966
Pottawatomie	167,663	139,663
Pushmataha	57,321	101,630
Roger Mills	229,375	31,424
Rogers	144,917	232,736
Seminole	125,154	115,266
Sequoyah	102,434	133,676
Stephens	191,585	122,997
Texas	685,708	0
Tillman	357,824	44,728
Tulsa	138,230	177,210
Wagoner	170,301	378,749
Washington	76,623	104,054
Washita	387,564	37,981
Woods	316,234	15,495
Woodward	265,236	18,831
TOTAL		10,344,886

Cooperative Extension Work in Agriculture and Home Economics
Oklahoma Agricultural and Mechanical College and United States Department of Agriculture Cooperating

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