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# The Use of Lime on Iowa Soils

LIMESTONE AND FERTILIZER DEALERS

AGRICULTURAL EXPERIMENT STATION  
IOWA STATE COLLEGE OF AGRICULTURE  
AND MECHANIC ARTS

AGRONOMY SECTION  
SOILS



Ames, Iowa

# THE USE OF LIME ON IOWA SOILS

## LIMESTONE AND FERTILIZER DEALERS

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Soil acidity is one of the most important problems before Iowa farmers at the present time. The following questions regarding lime and its use on land are constantly being asked:

How may I determine whether my soil is acid and in need of lime? Is lime a fertilizer? How much lime is needed per acre? What is the most desirable form of lime to use? Where may I get limestone and how much does it cost? What is the best method of spreading lime and when should it be applied? Will it injure the land? How often will lime need to be applied? Does it pay to use limestone?

This circular has been prepared to answer these questions and to give further information on this subject.

## IOWA SOILS NEED LIME

According to recent tests of soils from all sections of Iowa, fully 60 per cent are acid and need lime. There are three principal reasons for the loss of lime from the soil. First, there is a constant removal of lime from the soil in drainage water; second, the organic matter in the soil produces acids when it decays, and a small amount of lime is used up by these acids; third, crops, especially the legumes, remove large amounts of this material from the soil. These losses cannot be avoided because soils should be well drained, should be supplied with large amounts of organic matter, and should contain lime for the use of crops.

## TESTS FOR ACID SOILS

Acid soils may be indicated by the presence of such plants as horse-tail rush, sheep sorrell, corn spurry and wood horse-tail. These weeds grow unusually well in acid soils and where they are present in large numbers farmers should test their soils to determine whether they are acid.

Some legumes such as red clover, sweet clover and alfalfa will not make their best growth on "sour" soils. If red clover fails to grow on soils where good stands of this crop were once secured, it is a fairly good indication that the soil is in need of lime.

By far the most reliable means of determining whether a soil is acid is to test it or send a sample to the Iowa Agricultural Experiment Station and have it analyzed. A simple method of testing a soil for acidity is by means of blue litmus paper, which may be purchased from most any druggist.

To make the litmus paper test, take a handful of wet soil and make it into a ball. Break the ball in halves and insert a strip of blue litmus paper. Press the halves firmly together, and allow to stand twenty minutes. At the end of that time break the ball apart and examine the paper. If it is pink, the soil is acid. If no change has taken place in the color of the paper the soil does not need lime. This test, while it is fairly reliable in determining the presence of acids, gives little indication as to the amount of lime which should be applied. The Soils Section of the Iowa Agricultural Experiment Station will test soils for their lime requirement, by the Truog method, free of charge, and make recommendations as to the proper amount of lime to use. \*

\*The Soils Section is frequently called upon to make a complete analysis of soils and fertilizers. At the present time tests can only be made for the lime requirement of soils and the carbonate content of limestone, as no appropriation is available with which to carry on individual analyses for nitrogen, phosphorus, potassium and other plant food elements. Complete analyses of soils are made, however, in connection with the soil survey and the results thus secured are published in reports for each county surveyed.

In collecting soil samples for the acidity test, care should be taken to choose them from areas representative of the entire field. Clear the surface of any vegetation and dig a sample to a depth of seven inches. Take a sample of the subsoil from seven to 18 inches at the same location. Make ten other samplings a few rods apart in the same manner and on areas representative of the same kind of soil. All surface samples are then thoroly mixed. About one pint of the mixture is placed in a bag, can, or other convenient receptacle. The subsoil samples are handled in the same manner. Both surface and subsoil samples should be labelled, securely wrapped and sent to the Soils Section, Iowa Agricultural Experiment Station, Ames, Iowa.

### KIND OF LIME TO USE

There are four forms of lime but all of these cannot be recommended for correcting soil acidity.

**Burned Lime** is made by heating limestone to a red heat. As a result of this heating a caustic lime is produced.

**Water slaked lime** is formed when water is poured over burned lime. This material has a burning effect on plants if not properly applied.

**Air slaked lime** is formed when burned or water slaked lime is exposed to the air.

The three forms of lime mentioned should not be used for correcting soil acidity unless completely slaked, applied in small amounts and allowed to remain in the soil for some time before seeding any crop.

Burned lime, water slaked lime or air slaked lime may be spread on plowed land in the fall and by spring the material will have become sufficiently slaked.

**Ground limestone** is the most common and desirable form of lime to use for agricultural purposes. It is made by grinding raw limestone rock such as may be found in the quarries throughout the state. For best results, this material should contain 85 to 95 per cent carbonate with 60 to 70 per cent of the stone in a powdered form.

Ground limestone is not considered a direct fertilizer but a material to be used for correcting the acid condition which exists in many soils. Limestone may be purchased from the firms listed at the end of this circular.

### AMOUNT OF LIME TO USE

The amount of lime to use depends upon the extent of the acidity and the quality of the limestone. No definite amount can be recommended for all soils as the lime requirement will vary from less than one ton to more than seven tons per acre. Farmers should have their soils tested in the manner already suggested and supply the proper amount of limestone, as shown by the test.

There are no data that indicate just how often lime should be applied to soils, therefore, farmers are urged to have their fields tested every four or five years to determine whether lime is needed.

### TIME TO APPLY LIMESTONE

Ground limestone or limestone screenings may be applied at any time the land is being prepared for a crop without injury to that crop or to the soil. For best results it should be well worked into the surface soil, but never plowed under. The most desirable time is, perhaps, in the fall on plowed ground. Limestone may be spread on cornstalk

land in either the winter or early spring and disked in when the seed bed is prepared for the following oat crop. It is often desirable to make applications of lime one or two years before seeding clover, for in this way the lime becomes well incorporated with the soil and conditions made more desirable for the growth of the clover crop.

If potatoes are grown, limestone should be applied following the removal of this crop as there is a tendency for lime to favor the growth of potato scab.

### METHOD OF APPLYING LIMESTONE

Limestone may be conveniently applied with the manure spreader, providing a layer of soil or manure is placed on the bottom of the spreader before loading the stone. The beater chain may be removed, the apron run slowly and only a thin layer of stone allowed to spread. The speed of the apron and amount of stone distributed to the acre will need to be judged in each individual case as this will be governed by the condition of the stone, make of spreader and size of the load.

Spreading the material from a wagon by means of a shovel may be found satisfactory for small areas, although there is usually an uneven distribution of the lime.

For the benefit of those who desire to purchase a distributor for limestone, a list of dealers is given at the end of this publication.

### ALL CROPS DO NOT NEED LIME

Many experiments have been conducted to determine whether all crops need applications of lime. From the results of these experiments it has been found that some crops are not injured by the presence of acids in the soil, as for example, potatoes, redbud, hairy vetch, rye and alsike clover.

Inasmuch as most ordinary farm crops are benefitted by lime, applications of this material may be safely made on all cultivated soils.

### IOWA LIMESTONE SUITABLE FOR CORRECTING SOIL ACIDITY

There are many quarries in Iowa that contain limestone suitable for correcting soil acidity. This material is being ground by individuals and in some communities cooperative grinding is being done. By the use of portable crushers, ground limestone may be produced at a moderate cost. A list of firms offering limestone crushers for sale is given in the latter part of this circular.

The Soils Section is prepared to test limestone to determine whether it is desirable for agricultural purposes. Samples of limestone should be taken with care as the stone is exceedingly variable in different parts of the same quarry. Select samples from 10 different parts of the same quarry, grind and mix thoroly. Place about one half pint of the mixture in a clean container and send to the Soils Section, Iowa Agricultural Experiment Station, Ames, Iowa.

The test is made free of charge and results of analyses will be reported as promptly as possible.

### LIMESTONE APPLICATIONS PAY

Limestone will not injure the land in any way; it benefits soils by making them sweet, improves their physical condition, aids in the growth of desirable soil bacteria, makes more plant food available and increases yields of crops, especially clover and alfalfa.

The following summary of results secured by making one application of limestone to acid soils, indicates that this is a profitable material to use.

## THREE YEAR TEST AT BRYANT, IOWA

	Bu. per acre		Tons per acre
	1916 Oats	1917 Oats	Clover and 1918 Timothy
No treatment .....	58.6	61.7	1.81
Limestone .....	60.4	69.5	2.61
Limestone and Manure .....	63.4	88.3	2.65

## FOUR YEAR TEST AT CALAMUS, IOWA

Treatment	Bu. per acre			Tons per acre
	Wheat	Corn	Oats	Clover
No treatment .....	1915 17.7	1916 38.5	1917 32.2	1918 1.78
Limestone .....	18.5	47.6	35.6	2.43
Limestone and Manure .....	24.0	55.5	55.9	3.38

## EFFECT OF LIMESTONE ON SOY-BEANS, DAVENPORT, IOWA

Treatment	Yield, 1918
No treatment .....	3,345 pounds per acre
Manure .....	3,980 pounds per acre
Manure and Limestone .....	4,760 pounds per acre

The results show that limestone not only increased the yield of clover, but also brought about a considerable increase in the yield of soy-beans, wheat, corn and oats. Other results from all parts of the state show that limestone when applied to acid soils, gives profitable increases in crop yields.

Lime will not take the place of manure or other fertilizers. It should however, have a place in all systems of permanent fertility, which include the rotation of crops, the use of limestone, manure and legumes and turning under the last crop of clover and all crop residues.

## NOTES

The following list of firms is given for the benefit of those who desire to purchase limestone and limestone distributors and crushers. The names of firms offering commercial fertilizers for sale is also given.

Freight rates on limestone vary depending upon the distance the stone is hauled. This, as well as the quality of the product, should be taken into consideration when ordering lime. The price of limestone per ton, laid down at any station will be furnished by the dealers upon request.

## LIMESTONE DEALERS.\*

- Burlington Quarry Co., 19 So. 7th St., Keokuk, Iowa.  
Quarries at Montrose, Iowa.
- H. Dearborn's Sons, Stone City, Iowa.  
Quarries at Stone City, Iowa.
- Dolese Bros., 10 So. La Salle St., Chicago, Illinois.  
Quarries at Buffalo, Iowa.
- Hawkeye Quarries Co., Cedar Rapids, Iowa.  
Quarries at Stone City, Iowa.
- Linwood Quarries Co., Davenport, Iowa.  
Quarries at Linwood, Iowa.
- Hale Roberts Stone Co., Iowa Falls, Iowa.  
Quarries at Alden, Iowa.
- McManus Quarries Co., Keokuk, Iowa.  
Quarries at Ballinger, Iowa.
- Bettendorf Stone Co., Davenport, Iowa.  
Quarries at Bettendorf, Iowa.

Potsville Clay Products Co., Chicago, Illinois.  
 Quarries at Mt. Pleasant, Iowa.  
 Earlham Land Co., Des Moines, Iowa.  
 Quarries at Earlham, Iowa.  
 State Reformatory, Anamosa, Iowa.  
 Quarries at Anamosa, Iowa.  
 Hugh Murphy Construction Co., Louisville, Nebraska.  
 Quarries at Louisville, Nebraska.  
 Ft. Dodge Portland Cement Corporation, Gilmore City, Iowa.  
 Quarries at Gilmore City, Iowa.

\*The names of many local dealers may be secured from the County Agricultural Agents.

#### LIMESTONE DISTRIBUTERS

Name of Distributer	Firm
"Superior," "Farmer's Favorite" and "Buckeye."	American Seeding Machine Co., Springfield, Ohio.
"National"	Champion Drill Co., Avon, N. Y.
"Excelsior"	Excelsior Drill Co., Springfield, Ohio.
"Holden"	Holden Mfg. Co., 805 Park Ave., Peoria, Illinois.
"McWhorter"	McWhorter Mfg. Co., Riverton, N. J.
"Peoria"	Peoria Drill and Seeder Co., Peoria, Illinois.
"Spangler"	Spangler Mfg. Co., York, Pennsylvania.
"Success"	Deere and Co., Moline, Illinois.

The above firms all make two-horse distributors suitable for applying both fertilizers and limestone.

#### LIMESTONE CRUSHERS

Allis-Chambers Mfg. Co., Milwaukee, Wis.  
 Day Pulverizing Mfg. Co., Knoxville, Tenn.  
 Jeffry Mfg. Co., Columbus, Ohio.  
 New Holland Machine Co., New Holland, Pa.  
 Universal Crusher Co., Cedar Rapids, Iowa.  
 Wheeling Mould and Foundry Co., Wheeling, West Va.  
 Williams Patent Crusher and Pulverizing Co., St. Louis, Mo.  
 Worthington Pump and Machinery Corp., Cudahy, Wis.

The following firms are offering commercial fertilizers for sale.

#### ROCK PHOSPHATE

Mt. Pleasant Fertilizer Co., Mt. Pleasant, Tenn.  
 Central Phosphate Co., Mt. Pleasant, Tenn.  
 Farmers' Ground Rock Phosphate Co., Mt. Pleasant, Tenn.  
 Federal Chemical Co., Louisville, Ky.  
 Natural Phosphate Co., Nashville, Tenn.  
 The Robin Jones Phosphate Co., Nashville, Tenn.  
 Ruhm Phosphate Mining Co., Mt. Pleasant, Tenn.

The raw ground rock phosphate for sale by the above firms contains a minimum of 12 to 14 per cent phosphorus and cost from \$4.25 to \$5.00 per ton f. o. b. cars at mines. The freight to various points in Iowa will bring the total cost of the phosphate up to \$8.50 to \$13.00 per ton in carload lots. When rock phosphate is applied to the soil the phosphorus becomes available slowly.

#### ACID PHOSPHATE

Swift and Co., Chicago, Illinois.  
 Armour Fertilizer Co., Chicago, Illinois.  
 Sears, Roebuck and Co., Chicago, Illinois.  
 Chicago Fertilizer and Chemical Works, Chicago, Illinois.  
 Darling and Co., Chicago, Illinois.

Acid phosphate is made by treating raw rock phosphate with an acid. This material contains 7 to 9 per cent phosphorus which is in an immediately available form and costs \$23 to \$27 per ton.

**COMPLETE COMMERCIAL FERTILIZERS**

Chicago Fertilizer and Chemical Works, Chicago, Illinois.  
Swift and Co., Chicago, Illinois.  
Armour Fertilizer Co., Chicago, Illinois.  
Darling and Co., Chicago, Illinois.

✧ The Soils Section does not recommend the use of complete commercial fertilizers, which contain nitrogen, phosphorus and potassium. They may be used if found profitable, by tests on individual farms, without injury to the land. Information regarding the use of commercial fertilizers will be furnished by the Soils Section upon request.