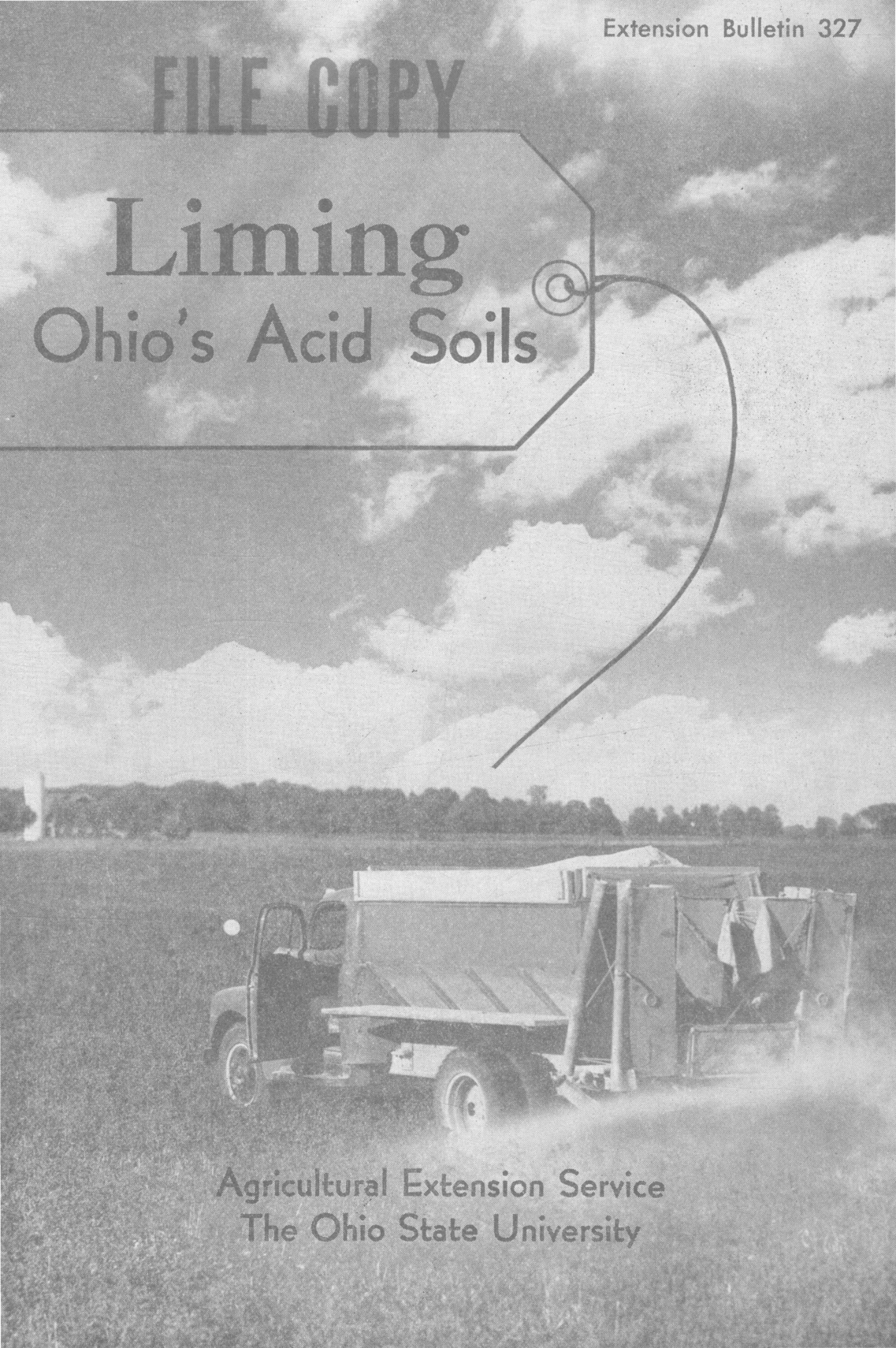
Extension Bulletin 327

Liming Ohio's Acid Soils



Agricultural Extension Service
The Ohio State University

Liming Ohio's Acid Soils

Earl Jones, Extension Agronomist, and
Garth W. Volk, Chairman Department of Agronomy,
Ohio Agricultural Experiment Station

ACID soils need adequate liming if satisfactory productivity is to be attained. Liming changes an acid soil to one more favorable to crop growth, supplies calcium and magnesium as crop nutrients, and changes soil phosphorus to a more available condition. There is no known substitute for liming.

80% of Ohio Needs Lime

About 80 percent of the unlimed soils in Ohio need liming materials so that alfalfa and sweet clover can be grown satifactorily. Many acres of limed soils need more lime before present treatments can be considered adequate.

Most of the soils of eastern Ohio never contained much lime. Lime that built up in the organic matter on the soil surface in original forests enabled pioneer farmers to grow good clover for some years until acidity became a problem. Soils of western Ohio and small areas of soils in eastern and southeastern Ohio developed from the decomposition of limestones and originally were not acid.

Leaching of limestone from upper soil layers by rainwater and removal of nutrients by crops has led to the development of soil acidity on most of the light colored soils in Ohio which originally contained limestone. (Acidity usually develops more slowly on the dark colored soils, but there are many dark colored soils in Ohio which are acid.)

How Soil Loses Lime

Topsoil loses lime in three ways: By crop removal, by leaching (dissolved in soil water and carried into subsoil and deeper), and by erosion.

Common crops remove lime in the following order: Alfalfa, clovers, soybeans, corn, timothy, and the common grain crops. Legumes used for hay or pasture remove calcium and magnesium at a high rate.

For example, consider a 4-year rotation of corn, wheat, and 2 years of alfalfa mixtures. Yields are 50 bushels of corn, 25 bushels of wheat, and 3 tons of hay. Crops remove calcium and magnesium equivalent to 150 to 160 pounds of calcium carbonate per acre each year.

With an annual rainfall of 36 inches, leaching removes about 200 pounds of calcium carbonate from the topsoil. A small portion of this is not lost entirely since it neutralizes the acid subsoil which is beneficial to crop production.

Erosion may be the greatest cause of loss of lime.

Table 1. Yields in Different Rotation with Light Liming and Complete Liming, Average Yields 1939-1944, Ohio Agricultural Experiment Station, Wooster, Ohio

Rotation	Crop Yields in Bushels or Tons per Acre			
	Liming	Corn	Wheat	Hay
Corn, wheat, red clover	Partial*	68.4	30.4	2.75
	Complete†	79.2	44.7	3.08
Corn, wheat, alfalfa	Partial	72.5	32.6	2.28
	Complete	85.8	49.1	3.50
Corn, wheat, alfalfa-clover-timothy	Partial	73.7	27.4	2.93
	Complete	81.0	39.9	3.97

* Limed to pH 5.5 † Limed to pH 7.0

Proper Liming Pays Off

Many do not always appreciate the necessity of *adequate* liming so the reaction of the entire plow layer is brought up to or close to neutrality. However, Table 1 shows increases in yields which came from proper liming.

Fertilizer and manure treatment of crops shown in Table 1 was as follows: 150 pounds 0-14-7 on corn, 300 pounds 0-14-7 on small grain, 4 tons of manure on corn, 4 tons as top-dressing on small grain.

All crop yields were highest when the soil was limed to neutrality.

Muck and Peat Soils—Liming is not recommended for vegetable crops on muck and peat soils unless the pH is below 5.0.

Liming Acid Soils Increases the Yields of All Crops—We often say we lime the land so we can grow better clover and alfalfa. Many farmers have seen the difference in the stands of clover on limed and nearby unlimed areas of meadows in acid soil areas. A good indication of a poor liming program is the failure to get good stands of alfalfa or clover regularly. Sometimes failures or partial failures may be caused by something other than soil acidity.

Except for potatoes, all field, vegetable, and canning crops, and the common fruit crops benefit by the liming applications necessary to prepare the soil for alfalfa.. Some, however, may not be as sensitive to soil acidity as are alfalfa and sweet clover. Potatoes grow all right on soils naturally neutral or slightly acid. Scab is not a problem on many such soils, and scab is usually not serious on acid soils. But, it becomes a problem when such soils are limed to a pH of 5.3 or above.

Soils with a pH below 5.0 which are to be used exclusively for potatoes need applications of 1000 to 2000 pounds per acre of agricultural ground limestone or equivalent every 4 or 5 years.

Alfalfa and sweet clover are so sensitive to strong soil acidity that they will not yield well until the acidity is largely corrected. Until this is done, meadow mixtures should be made up largely of clovers—red and alsike—and grasses.

Strong acidity is necessary for the satisfactory growth of a limited number of fruit crops and flowers—blueberry, cranberry, rhododendron, azalea, mountain laurel, and other members of the Heather family.

Table 2. Comparative Yields of Field Crops on Unlimed and Adequately Limed Land. (See Table 1 for fertilizer treatments, etc.) Data taken from same experiment as that in Table 1.

Crop	Adequately Limed Land* Percent	Unlimed Land† Percent
Alfalfa and sweetclover	100	5 to 10
Red, alsike and mammoth clover	100	20 to 30
Barley	100	23
Timothy	100	40
Corn	100	73
Soybeans	100	75
Wheat	100	75
Oats	100	90

*pH 7.0 † pH 5.0

Crops on limed land benefitted by residues of the preceding good hay crops. This gave them an advantage over the crops on the unlimed land.

Amount to Use Varies

Lime Needs Depend on Soil Type — Application of liming material needed to produce a definite change in the reaction of the soil varies with soil type.

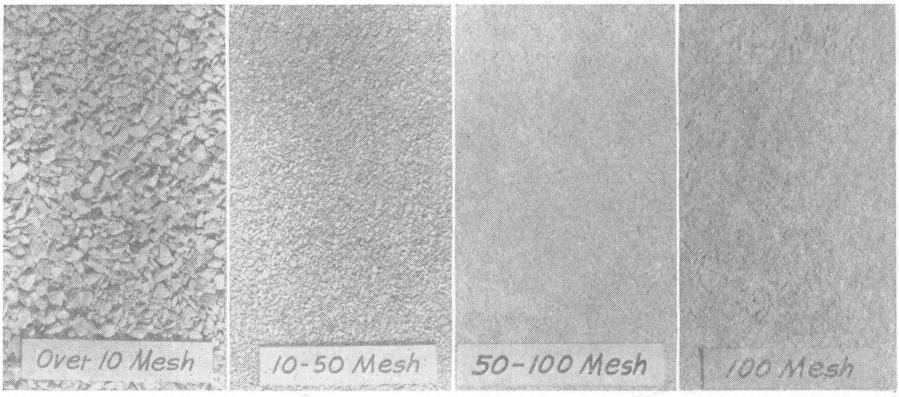
Reaction of sandy soils can be changed with the smallest application of liming materials. The same change in silt loam soils requires heavier applications and silty clay loams and clays need even more lime. Soils with a high content of organic matter as acid peats and mucks require much more.

In general, the lime requirement of a soil is dependent on the original pH or acidity, the clay content, the type of clay, and the organic matter content of the soil.

Approximate Tons of Agricultural Ground Limestone Needed to Change Reaction of Soils of Different Type

pH	Sandy Loam	Silt Loam	Silty Clay Loam
5.0 to 5.5	0.5 T.	0.9 T.	1.0 T.
5.0 to 6.0	1.0 T.	1.5 T.	2.0 T.
5.0 to 6.5	1.5 T.	2.3 T.	3.5 T.
5.0 to 7.0	2.5 T.	3.8 T.	6.2 T.

Comparative Values of Different Liming Materials—Soil acidity is corrected only when the liming material applied comes in close contact with the soil particles. The finer the liming material, the more contacts it will make with soil particles and the more rapidly it will correct soil acidity. Heavier applications of coarser materials are therefore required, as compared with finer materials.



Price per ton of any liming material is determined by its fineness. The finer the material, the more it is worth. Shown above are limestone separates. Always note the amount of each present in the liming material you buy.

Table 3. Availability of Limestone Particles of Different Sizes

Percent Available in 1 to 3 years	
Passing through No. 60 and No. 100 screens	100%
Passing No. 40 but not No. 60 screen	74%
Passing No. 20 but not No. 40 screen	54%
Passing No. 8 but not No. 20 screen	18%
Held on No. 8 screen	7%

Maintenance Applications—Fields growing alfalfa mixtures or other desired crops satisfactorily need 1 ton per acre of agricultural ground limestone or its equivalent every 4 or 5 years. Good bluegrass pastures need 1 ton every 6 to 8 years.

Over-liming does not pay because there is no profit from liming that is not needed. Under some conditions (especially in the case of sandy, muck and peat soils) minor element deficiencies may develop on over-limed land.

Acidity Corrected in Layers

An application of liming materials first corrects the acidity of the soil layer with which it comes in contact. There is no lateral movement of lime, and hence movement is limited to that caused by leaching which is a slow process.

Cultivation causes some movement of lime, but the acidity is corrected in layers. Two or more applications are necessary to correct the acidity of the entire plow layer unless one application is thoroughly mixed mechanically with the plow layer.

How to Apply Lime

When unlimed acid soils are limed on the sod before plowing for corn and the liming material is plowed under, apply a second application so there will be some lime in the surface soil where the clover and alfalfa start to grow.

Half of the lime needed could well be applied in this way. If this cannot be done, apply at least 500 to 1000 pounds per acre of fine, dry liming material so it will be in the surface soil where the clover and alfalfa seed start to grow.

The second application is not necessary if the field is plowed before seeding clover or alfalfa. Plowing brings some of the lime back to the surface. When a field grows good alfalfa or sweet clover, liming materials necessary to maintain this condition can be applied satisfactorily on meadows before plowing or at any other time in the rotation.

Table 4. Equivalent Applications of Different Liming Materials (Assume same Total Neutralizing Power unless otherwise noted.)

Material	Percent of Material Passing Thru No. 100 Sieve	Pounds of Material Equal to 1 Ton of Agr'l Ground Limestone
Coarse agricultural meal	20–29	3200
Fine agricultural meal	30–39	2600
Agricultural ground	49–59	2000
Agricultural pulverized	60–79	1700
Agricultural superfine	80–100	1600
Hydrated lime (TNP* = 135)	100	1333
Hydrated lime (TNP* = 165)	100	1000
Granulated slag (screenings grade)	less than 20	2000
Limestone and slag (air cooled) screenings	less than 20	4000 to 6000

* Total neutralizing power. The TNP of limestone is about 100.

It is difficult to get satisfactory soil samples from fields which have been limed once and then plowed because of the foregoing situation. Acidity has been corrected in layers and these layers scattered irregularly through the furrow slice. Subsoil in samples from limed fields makes tests inaccurate.

Watch Your Driver

Careful Driving Necessary—In much of Ohio, limestone is spread from the truck that brought it to the farm. Many of these trucks have a spinner spreader which throws the material in a semi-circle at the rear. Ground limestone cannot be spread uniformly when it is thrown since the larger particles go further than the finer ones.

A new type truck spreader drops the liming material from a horizontal pipe 1½ feet above the soil at the rear. This spreads the liming material more uniformly and there is less blowing. The spreader was developed for fine kiln dried materials, but spreaders of this type, which will spread either coarse or damp material, are now on the market.

Careful driving and lapping is essential to satisfactory spreading with all types of spreaders. Streaks of good and poor stands in meadows often indicate careless driving.

All Year Liming—When the use of liming materials started in eastern Ohio, materials were spread with horse-drawn lime sowers. Most farmers applied lime just before seeding wheat.

Demand for liming materials has

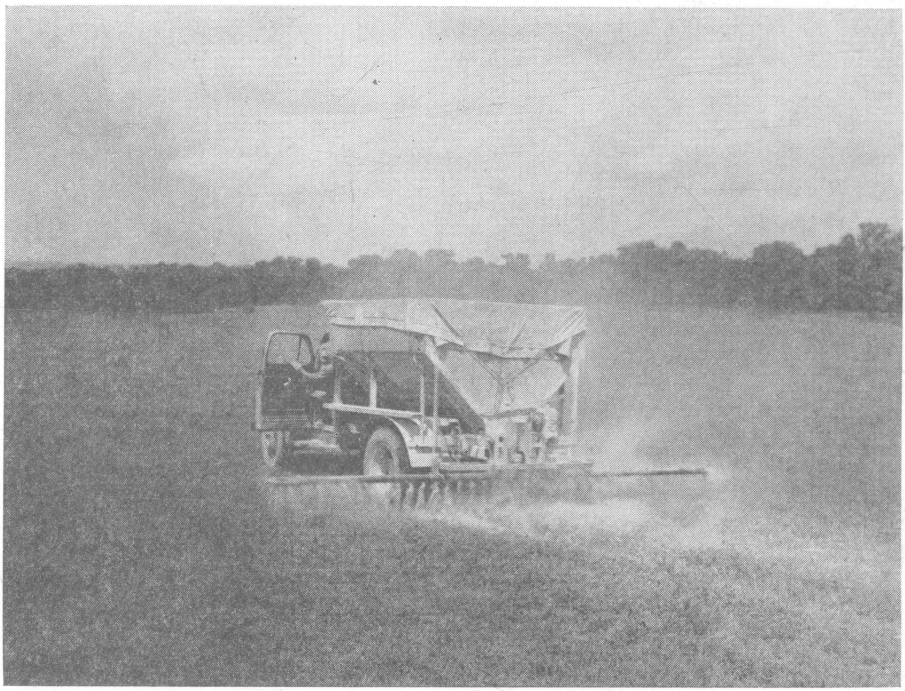
Results of uneven spreading, shown here after spreading, can be spotted easily when crops are growing.

increased greatly in recent years. In order to supply demand, it has been necessary to spread the use and deliveries throughout the spring, summer, and fall. Work at the Ohio Agricultural Experiment Station has indicated this could be done satisfactorily. Spreading lime during the summer and fall after hay harvest on meadow to be plowed the next spring is recommended. Trucks can get over sod fields more easily than they can over other fields.

In 1945 and 1950, long-continued rainy weather in late summer and fall noticeably reduced lime usage as compared with the same period previously. It is best not to delay to a later period unless necessary, since rains may interfere with deliveries and spreading.

Liming materials can also be applied:

1. After plowing for corn or other cultivated crops.
2. After planting corn.
3. On corn stubble before plowing or disking for oats or wheat.
4. On oats stubble before plowing or disking for wheat.
5. After plowing or disking for wheat or oats.
6. After planting wheat or oats seeded to a meadow mixture (Not good on acid soils).
7. On meadows in the spring when the hay crop will not be damaged.
8. Bluegrass pastures can be limed in the spring and early summer when rotated fields cannot be limed.



This is one method of spreading limestone.

Stockpiling—Lime comes directly by truck from stockpiles near the quarry to the farm in those parts of Ohio located near quarries. Where shipments are made by rail, local dealers often build a stockpile near the tracks so that there will be liming materials to supply the demand in late summer and fall. Unloading and loading equipment is necessary for economical operation. Bulk liming materials can be stored in tall piles since rains do not penetrate such piles to a great depth.

Local Dealers and Truckers—Key men in increasing and maintaining the use of liming materials are the truck drivers who deliver and spread direct from the quarry and the local dealers who collect orders for shipments to the railroad station and offer a delivery and spreading service. Canvassing farmers for orders is an essential part of their business.

Loading a truck spreader from stockpile at a railroad station.

What You, The Farmer, Can Do

1. Order liming materials for the season before May 1.
2. Accept deliveries early.

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