Oregon Agricultural College
Extension Service

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RATIONAL USE OF LIME

Lime has been used in agricultural production since early agricultural history. The chief reason for its use is now recognized to be that of correcting soil acidity. Practically all the soils in the more humid sections of Oregon are acid and will respond in increased crop yields to applications of lime. As indicated on the accompanying map, practically all the soils of the Willamette Valley and the Coast counties are acid. The soils in Southern Oregon are also found to be acid to some extent. In the counties east of the Cascades, however, acidity, except for limited marsh areas, is almost negligible.

The State Lime Board is ready to furnish ground limestone, and orders may be placed with the Secretary, Mr. C. A. Murphy, at Salem. The price is $1.75 a ton F. O. B. Rock Point, Oregon. Grit for poultry can also be furnished sacked at $10.00 a ton. In many instances it will be convenient and desirable to pool limestone orders and secure car lots through the County Farm Bureau, or County Agent.

This circular is calculated to answer questions most commonly asked regarding the practice of liming.

EFFECTS OF LIMING SOILS

Soils that are acid are not in proper condition for maximum crop production. The primary purpose of applying lime to a soil is to correct this acid condition. Lime will sweeten the soil so that favorable bacteria may develop and aid in the work of making plant food available for the growing crop. Lime is especially necessary for the proper development of the bacteria in the nodules on the roots of the legumes such as the clovers and alfalfa. Lime will also combine with some of the plant food materials already in the soil to make them more readily available, and will supply any lack of calcium as a plant food that may exist in the soil. To some extent certain forms of lime will make heavy soils more friable, thus aiding aëration, cultivation, and drainage.

FORMS OF LIME

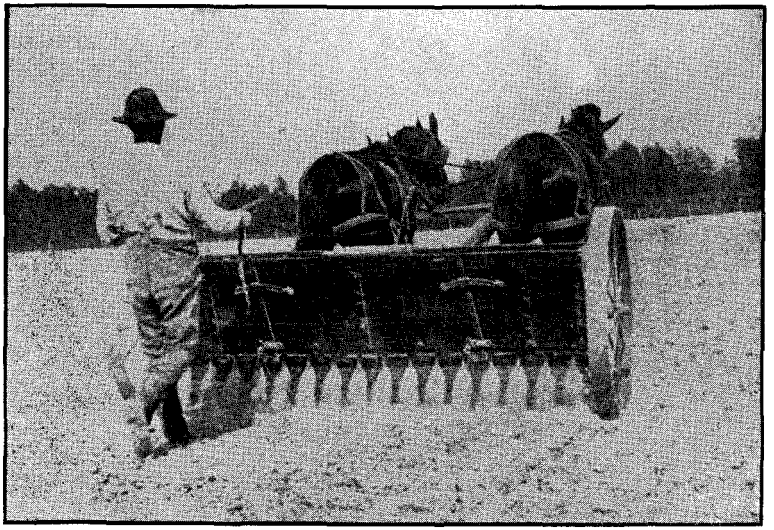
The forms of lime in Oregon, available for agricultural use, may be divided into two groups; the natural carbonates of lime, and burnt lime and its altered products.

NATURAL FORMS

Ground Limestone. This is the natural carbonate of lime and is commonly referred to as "agricultural lime". It furnishes lime in the natural state, since the lime already in the soil is usually the result of decomposed limestone. High-grade limestone, ground so that all the material will pass through a screen with ten meshes to the inch, will contain more than fifty percent of material that will pass through a forty-mesh sieve. Ground limestone is not caustic. It can be used without danger of injury either to the organic matter of the soil, or to the crop. It is the most satisfactory form of lime to used wherever it can be obtained at a moderate price.

Shell Beds. The shell beds found near the Oregon coast may be cleaned, crushed, and used locally for correcting acidity in soils.

Landplaster or Gypsum. Landplaster or sulphate of calcium does NOT correct soil acidity. When used, it should be applied in amounts of from 40 to 100 pounds for supplying the plant foods, sulphur and calcium. It may also act as a soil stimulant.



LIME SPREADER (Courtesy Ind. Exp. Sta.)

BURNT FORMS

Burnt or Quicklime. This is caustic lime, and is the most concentrated form of lime that can be applied to soils. Fifty-six pounds of quicklime is equivalent to seventy-four pounds of hydrated lime or one hundred pounds of high-grade ground limestone. Quicklime should always be used with caution. It breaks down organic matter very rapidly and thus may injure the soil.

Hydrated Lime. This is water-slaked lime, that is, quicklime to which water has been added. Hydrated lime is not as caustic as quicklime and therefore can be applied much more easily. In a less degree similar precaution should be used as with caustic lime. At present this material is being placed on the market for agricultural purposes by lime companies and sold under the trade name of "agricultural lime", but it should not be confused with the natural carbonate of lime.

THE BEST FORM OF LIME TO USE

The best form of lime to use is the one, all other things being equal, that can be applied to the soil at the lowest cost a unit of neutralizing power. Each of the forms described neutralizes or counteracts the acidity of the soil. Their differences lie in the rate of action, the amount necessary, and the ease of application. Quicklime has a quicker action in neutralizing the acidity than does ground limestone. The same is true to a lesser degree of hydrated lime. On the other hand, ground limestone is much easier to apply and there is no danger of burning the organic matter or injuring the seed. Ground limestone is generally the cheapest form of lime for agricultural use. In localities near burntlime plants, quicklime or its altered products may be had at a lower figure.

WHERE TO APPLY LIME

Lime may be expected to give best returns on acid soils with legume crops and with soils of low fertility. Liming will give most satisfactory results only when practiced in connection with crop rotation and the use of barn-yard manure or green manure. Careful trials with special soils and crops, where there are indications that liming will be profitable, help determine the value of this treatment. Results of such trials should be observed for more than a single season. Different amounts of lime on the Experiment Station Farm, at Corvallis, have increased legume hay yields from one-tenth to nine-tenths of a ton an acre over untreated ground.

The increase in yield from the application of lime to a soil depends upon three factors: the degree of acidity of the soil, the fertility of the soil, and the crop to be grown.

Leguminous crops require a plentiful supply of lime and are sensitive to acid in soil. Clover and alfalfa are more sensitive to acid than vetch. The majority of other crops may receive various benefits from liming, but applications should generally be made before seeding the legume crop. Cereals and grasses show much less response to lime than legumes. Most of the truck and fruit crops show little or no benefit from the treatment. The production of successful legume crops on the farm is important in connection with the maintenance of fertility.

The degree of acidity that a crop can withstand depends to a large extent upon the fertility of the soil. The poorer the soil the more detrimental is acidity. In the Willamette Valley, where lands are otherwise in fertile condition, we may find good crops of clover and of vetch

on soils that are distinctly acid. After these same soils have been cropped for some years it becomes more difficult to obtain a stand of clover, and the crop usually responds to liming. Soils in the sections of extremely heavy precipitation may have suffered from loss of lime by leaching. A high lime content is commonly accepted as an indication of good fertility.

Lime should be applied only to soils that are acid and in need of such treatment. Soils from those sections of the State where the rainfall is relatively high show by test that they are acid and may be expected to respond to lime when it is properly applied.

Old residual soils such as the red hill lands usually contain acid compounds, probably derived from complex silicates. Such soils, where high in iron or having heavy texture and heavy subsoil, may be expected to respond to liming. The red shot soils have responded well to liming in Western Oregon. Such acid soils containing iron compounds are frequently low in available phosphorous, and lime may help to release this element.

Sandy soils may frequently have less need for liming, and attention should be given to maintenance of organic matter where such soil is limed. Overflow and marsh soils, when provided with good drainage, are usually relieved of the excess of organic acids. Their further accumulation is generally controlled by such drainage. Such soils are ordinarily fertile in this State, when drained, and liming is not often profitable. Drainage of wet alluvial soils should precede the use of lime, since drainage may lessen the lime requirement.

TESTING SOILS FOR ACIDITY

The litmus test has been widely used in testing soils for acidity. This test is quite simple and gives satisfactory results when properly made. With soils that are highly acid, however, the reaction is not very distinct and in inexperienced hands may lead to wrong conclusions.

The test for acidity is made by placing a strip of blue litmus paper on the bottom of a clean glass container and then cover with soil. Press the soil down on the paper and allow it to remain five to ten minutes. If the soil is dry, it should first be moistened with distilled water. Any change in color of the litmus paper can be seen through the glass without removing the paper. If the litmus paper becomes entirely pink or pink in spots, it indicates acidity.

An acidity test recently originated by E. Truog, of the Wisconsin Experiment Station, gives very satisfactory results. Some special apparatus and materials are necessary for carrying on this test. Each County Agent in Western Oregon is equipped to make these tests, and will be pleased to do so for any farmer in his county.

The Experiment Station is also making these tests for farmers in any section of the State, if the soil samples are taken properly. Soil sampling directions will be sent on application.

TIME OF APPLICATION

Lime can be applied to the soil at any convenient time of the year when the surface is dry. Where clover is to be seeded on winter grain, the lime will need to be applied and disked in after the plowing and ahead of the grain seeding. Where possible, it is economy to haul lime direct from the car to the field. Application may be made ahead of the spring seeding and as early as the plowed land is dry enough to harrow. Fall liming is more certain than spring application to give the fullest benefit the coming crop year.

RATE OF APPLICATION

The amount of lime to apply to a soil depends upon the degree of acidity of the soil, the fertility of the soil, and the kind of lime. On our poorer soils showing slight to medium acidity an initial application of at least two tons an acre should be used. On soils showing a high acidity the amount should be increased to three tons. On acid soils of average fertility these amounts may be reduced about one-third, while on very fertile soils only about one-half the amount will be necessary. As a general rule an application of two tons to the acre every four or five years will be adequate.

METHOD OF APPLICATION

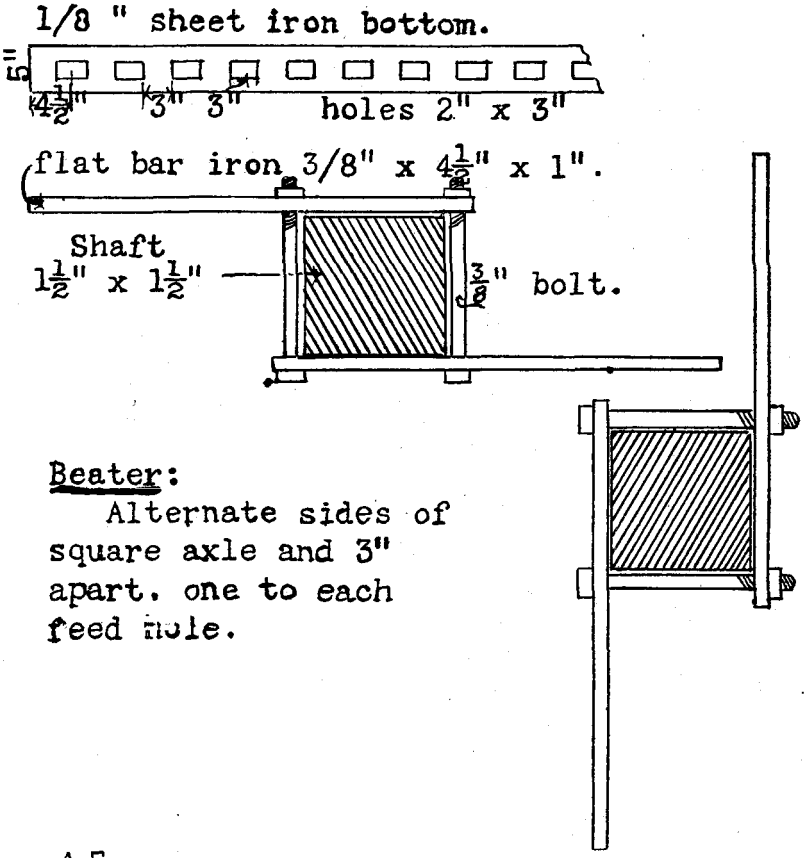
Limited areas can be limed by scattering by hand from a wagon. Small areas may be limed with a manure spreader. A layer of manure may be placed in the spreader and over this a layer of lime. If this method is employed, it is desirable to use a canvas, or to box in the beater at the rear of the spreader, to prevent the drifting of the lime dust. For large applications the lime spreader is both more satisfactory and more necessary. There are several spreaders on the market that have given satisfactory results. It is possible to build a home-made lime spreader at moderate expense. O. D. Center, Director of the Extension Service of the College, describes below an improved type of home-made lime spreader which he has built and used:

HOME-MADE LIMESTONE SPREADER

Make a hopper like that of an ordinary grain drill, 8¼ or 11 feet long, sides 20 or more inches wide, and at least 18 inches apart at the top—all inside measurements. Truss the sides with ⅜ inch rods running from the bottom at the middle to the top of the ends of the hopper. Make the bottom of the hopper 5 inches wide in the clear. This main or upper bottom should be ⅛ inch sheet iron. Cut in the bottom a row of rectangular holes 2 inches wide, 3 inches long. The center of the first hole should measure 4½ inches from the end of the bottom, bringing the others 6 inches between centers.

A second bottom with holes, made the same size, shape, and space of those of the main bottom, should be snugly fitted under the main

bottom, but so arranged that it can be shifted so that the holes register in any degree or completely close, as desired. The supports for the movable second bottom should be bands of strap iron 18 inches apart, carried from one side to the other under the hopper to strengthen it. The movable lower bottom should be smooth, seasoned hardwood 1 inch thick, reinforced with strap iron to prevent splitting or warping.



DETAILS OF LIME SPREADER

To this wood bottom firmly attach a V-shaped arm with the point of the V extending 1 inch in the rear of the hopper. The point of the V-shaped arm should have a ½ inch hole in which the lower end of a strong lever may be dropped. The lever should be bolted securely to the side of the hopper about 4 inches above the bottom. This lever, extending above the top of the hopper enough to afford a good hand-hold, serves as the shift lever which regulates the size of the openings

by moving the wooden bottom back and forth. A strap iron guide with holes through which a small bolt or a key may be thrust prevents the lever from shifting from the position set and regulates the feed.

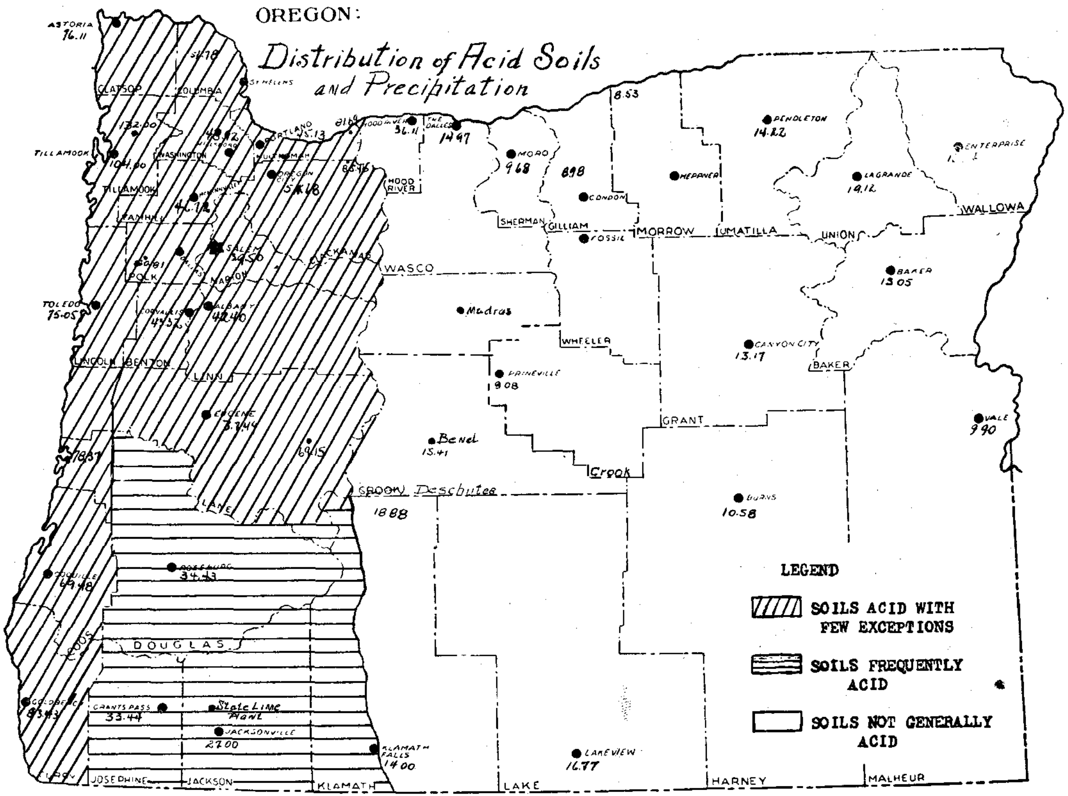
Make a frame for the hopper, with a tongue to it, similar to the frame of an ordinary grain drill. Get a pair of old mowing-machine wheels with the ratchets in the hubs and with pieces of round axles long enough to pass through the bearings bolted to the underside of the frame and through the ends of the hopper. To those round axles weld a 1½ inch square bar of iron the length of the hopper. To this square axle above each opening in the permanent bottom attach two short arms or feeders. These feeders are pieces of ⅜-inch by 1-inch by 4½-inch flat bar iron bolted to opposite sides of the axle. They should alternate on the sides of the square axle over the holes in the botton. This makes a reel that is a positive feed, so adjusted that it revolves freely between the sides of the hopper but almost scrapes the bottom at each turn. The accompanying cut shows the arrangement of holes in the bottom, and the plan of attaching the feeder arms to the axle. Any farmer with some mechanical skill can construct this limestone spreader with little cash outlay except for the blacksmithing. It is strong, serviceable, and cheaply made.

WHAT TO EXPECT OF LIME

One year is not long enough to demonstrate the value of liming. The fullest benefit does not usually show until the second year, and experiments show that the beneficial effects are distributed over many years. Lime will not take the place of drainage, manure, fertilizers, or the proper preparation of the seed bed; nor can these factors take the place of lime. It should be used in conjunction with these other factors. Liming is one of the necessary steps in keeping up the fertility of our already fertile soils and in building up our worn-out acid soils.

OTHER SOILS LITERATURE AVAILABLE

Furrow Irrigation for Sandy Soils .....Ore. Exp. Sta. Cir. No. 3
Report of Expt. Work, Branch Expt. Station, Moro .....Ore. Exp. Sta. Bul. No. 118
Improving Sandy Soils by the Use of Green Manure Crops ..Ore. Exp. Sta. Bul. No. 120
Irrgation and Soil Moisture Investigations in Western Oregon, ...
..... Ore. Exp. Sta. Bul. No. 122
Drainage of White Land and Other Wet Lands in Oregon ...Ore. Exp. Sta. Bul. No. 137
Economic Use of Irrigation Water .....Ore. Exp. Sta. Bul. No. 140
Dry Farming Investigations Sherman County Branch Experiment Station, ...
..... Ore. Exp. Sta. Bul. No. 144
Dry Farming Investigations Harney Branch Experiment Station, ...
..... Ore. Exp. Sta. Bul. No. 150


OREGON:
Distribution of Acid Soils and Precipitation
ASTORIA
CLATSOP
COLUMBIA
TILLAMOOK
WASHINGTON
MULTNOMAH
YAMHILL
POLK
MARION
CLACKAMAS
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
UNION
WALLOWA
BAKER
WHEELER
GRANT
Crook
LINCOLN
BENTON
LINN
LANE
Deschutes
DOUGLAS
COOS
CURRY
JOSEPHINE
JACKSON
KLAMATH
LAKE
HARNEY
MALHEUR
PORTLAND
SALEM
TOLEDO
CORVALLIS
ALBANY
EUGENE
COQUILLE
ROSEBURG
GRANTS PASS
State Lime Plant
JACKSONVILLE
KLAMATH FALLS
THE DALLES
MORO
CONDON
FOSSIL
HEPPNER
PENDLETON
LA GRANDE
ENTERPRISE
BAKER
Madras
PRINEVILLE
CANYON CITY
VALE
Bend
BURNS
LAKEVIEW
LEGEND
SOILS ACID WITH FEW EXCEPTIONS
SOILS FREQUENTLY ACID
SOILS NOT GENERALLY ACID