Whether or not to lime—
SOIL ACIDITY TESTS
and their practical uses

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ALL plants respond in a decided way to their chemical environment, and for this reason the importance of soil reaction has long attracted much attention. Two conditions are generally recognized in this respect—soil alkalinity and soil acidity. The latter condition is very prevalent in humid sections.

Nature of Soil Acidity

Soil acidity may be considered for practical purposes as an unfavorable condition for plant growth arising in the soil through a lack of certain active bases such as calcium and magnesium. This condition may be corrected by the application of some form of lime.

Technically three reasons may be assigned to account for the harmful effects of soil acidity. (1) hydrogen ion concentration or the actual presence of an acid; (2) the presence of active poisonous bases harmful to plant growth such as aluminum, manganese and others; and (3) the actual shortage of calcium and magnesium as a nutrient.

The tendency of all soils in a humid area is toward acidity. The four important factors generally specified as encouraging acidity are: (1) loss by leaching; (2) loss by cropping; (3) absorption within the soil; and (4) fertilizer residues.

Tests for Soil Acidity

It is highly desirable that we have means of determining the degree of acidity in soils. Such tests have been provided. The following are five types of tests which are being used to a considerable extent:

1. Hydrogen ion. This is the most accurate of all tests. It is a laboratory test, however, and for that reason is hardly adapted to the use of the layman. With this test the neutral point is represented by the figure 7. Below that point is acidity and above it alkalinity. Most of the soil samples with which the farmer and greenskeeper has to deal may be tested fairly accurately with one of the other tests.

2. Truog. This test requires several minutes to complete, but it is one of the most dependable.

3. Soiltex. This is one of the "quick" tests and may be regarded as one of the best in that group. An advantage of this

Southern California Greenkeepers got together at Palos Verdes May 6 for one of their profitable sessions. Here are some of the fellows who are making this section a garden of golf.

test is that it indicates alkalinity as well as acidity.

4. La Motte Teskit. Another "quick" test of approximately the same degree of accuracy as the Soiltex.

5. Potassium thiocyanate. This test is put out commercially under the name of "Richorpoor." Our experience with this test is that it is no more accurate and less convenient than the Soiltex. With a sandy soil or a soil deficient in iron, this test may give inaccurate indication.

Acid Tolerance of Various Plants

As it is well known, some plants will stand a higher degree of acidity than will others. Alfalfa, for instance, seems to demand nearly a neutral soil in order to do its best. Bent grass apparently will thrive in the presence of a high degree of acidity. The limit of acidity, or the degree of acidity a crop will stand without showing marked decrease in yield, is given in the following table for the more important field and vegetable crops. The figures at the left are in Ph values. These may be translated into the common terms describing acidity as follows: Soils running between 7.0 and 6.3 have a slight acidity; between 6.3 and 5.5, medium acidity; between 5.5 and 5.0, strong acidity; below 5.0, very strong acidity.

6.5 Sweet clover.
6.2 Red clover.
5.8 Bluegrass, white clover.
5.5 Alsike clover, crimson clover, soybean, vetch.
5.2 Cowpea, red-top, rye, timothy.
5.0 Bent grass.

Various Forms of Lime

When limestone rock is run through a crusher and made into pulp, it is called ground or pulverized limestone. When 2,000 pounds of limestone rock is burnt in a kiln it undergoes a chemical change and comes out as 1,120 pounds of lump or stone lime. Excepting for the impurities in the original rock this lump lime represents actual lime or total oxides of calcium and magnesium. When this 1,120 pounds is water-slaked or hydrated, it takes up water until it weighs from 1,350 to 1,500 pounds; when it becomes air-slaked, it goes back to the same chemical form as the original limestone rock, and weighs about 2,000 pounds.

Lump lime is sometimes ground and sold for agricultural purposes. There are certain "agricultural limes" or "by-product limes" which are largely air-slaked. They contain varying amounts of actual lime and should be purchased only on an analysis basis. There are pulverized oyster shells which contain about as much actual lime as ground limestone. There are also the lime marls which are in the same chemical form as ground limestone but do not, as a rule, run as high in actual lime.

The kind of limes largely used in this region are hydrated pulverized limestone and pulverized oyster shells. The value of each of them depends largely upon two points. (1) The amount of oxide or actual lime present, and (2) the fineness.

Hydrated lime is usually in good mechanical condition having been reduced to a very fine powder by grinding and water-slaking. In actual lime it varies considerably ranging from 65 to 80%. The reason for this rather large variation is the varying character of the original rock and the varying methods of manufacture.

Ground limestone runs from 48% to 55% actual lime depending upon the character of the original rock. Fineness in ground limestone is desirable but extreme fineness is not necessary. If all goes through a twenty mesh screen ground limestone is fine enough for most purposes.

Ground oyster shells also vary in composition. Various analyses that have been made show that they do not run quite as high in actual lime on the average as ground limestone but this is made up by their having a small quantity of nitrogen and phosphoric acid. Since shells are softer and disentegrate faster, it is not necessary that they be ground quite as fine as rock.

The presence of magnesium in lime is not considered to be objectionable. In fact, the magnesium is even more effective than calcium in correcting soil acidity.

How Much Lime to Apply

It may be seen from what has gone before that the amount of lime to use depends, to a considerable extent, upon the crop or crops involved and the degree of acidity of the soil. There are other factors to be considered also including soil texture, amount of organic matter in the soil, and the fertilizer which has been applied. It may be seen, therefore, that the amount of lime to use cannot be arrived at very exactly and that there is opportunity to exercise a great deal of judgment and discretion in this matter. An application of 700 pounds of hydrated or 1,000

pounds of ground limestone per acre is looked upon as a light application; 4,500 pounds of hydrated or 6,000 pounds of ground limestone as a heavy application. The best procedure is to determine the acidity of the soil then gauge the amount of lime to use with reference to the crop involved and the kind of lime employed.

What Is Cheapest Form of Lime to Buy?

A good answer to this familiar question is: Use the form of lime which can be put on the land *at the lowest cost per unit of oxide.*

According to state law every manufacturer of agricultural lime must guarantee on the bag the content of his product in lime (CaO) and magnesia (MgO). The sum of these two figures will indicate the *total oxide.* By referring to the state chemist's bulletins you may see how near the various manufacturers come to satisfying the guarantee. Dividing the cost per ton by the total oxide will give cost unit of oxide. Comparing different kinds or makes of lime by this method, however, will give only an approximate idea of their relative cheapness, since cost of hauling has not been considered. Each man will have to figure what his cost will be to get the lime from the railroad station to his place. In the figures below we have assumed a haul of four miles at a cost of $0.22 per ton mile. We have also assumed that a man has received quotations from four different lime companies. Putting the figures down on paper they would look about as follows:

A. A high-grade pulverized limestone
Cost delivered to club's R. R. station $7.00
Hauling four miles..... .88
Total cost $7.88
Total oxide 52% or 52 units; $7.88 divided by 52=15.1 *cents per unit.*

B. A high-grade hydrated lime
Cost delivered to club's R. R. station $12.00
Hauling four miles..... .88
Total cost..... $12.88
Total oxide 75% or 75 units; $12.88 divided by 75=17.1 *cents per unit.* Some high-grade hydrated actually run as high as 79% oxide, in which case the cost would be 16.3 *cents per unit.*

C. A low-grade hydrated lime
Cost delivered to club's R. R. station $11.50
Hauling four miles..... .88
Total cost..... $12.38
Total oxide 63% or 63 units; $12.38 divided by 63=19.6 *cents per unit.*

D. Pulverized oyster shells
Cost delivered to club's R. R. station $6.00
Hauling four miles..... .88
Total cost..... $6.88
Total oxide 46% or 46 units; $6.88 divided by 46=14.9 *cents per unit.*

It may be seen from the above figures that pulverized oyster shells would be slightly the cheapest of the four kinds. These are merely assumed figures, however, set down to show the method of getting at the answer to the problem. Although there will be some difference in cost of applying the different forms of lime it will not be considerable; hydrated lime weighs less than pulverized limestone or oyster shells per unit of oxide but it occupies practically the same volume and takes about as long to distribute.

Lime on Turf

Kentucky bluegrass seems to be greatly stimulated by lime as is white clover. The bents and fescues are not much affected by lime on most soils. As putting grass must necessarily be kept highly fertilized there may be no objection to using a certain amount of lime to increase nitrification in the soil as well as to control certain types of turf disease. On the other hand, lime may stimulate certain weeds as well as Kentucky bluegrass and white clover, and to this extent lime is a detriment.

On fairways there is no reason to doubt the excellent effect of lime where the turf is composed largely of Kentucky bluegrass and white clover especially where lime is used in conjunction with commercial fertilizer. If, however, the turf is composed of red-top, bent or fescue, lime may not be necessary nor desirable.

J. B. Smith, Club Manager's Head, Dies in Hospital Blast

J. BARKER SMITH, secretary and general manager of the Cleveland Athletic club, and president of the Club Managers' association of America was among the victims of the Cleveland hospital explosion.