Practical Aspects of Lime Usage on Turf Grasses

By O. J. NOER

The reaction of the soil, expressed as pH, is the best yardstick for judging the probable need for lime. When a soil is medium acid, or stronger, that is below pH 5.7, the need for lime is definitely indicated and its use justified without regard to any other factor. Lime may be beneficial when the soil is slightly acid, pH 5.7 to 6.2, particularly on areas where Kentucky bluegrass predominates. But when the soil is not more than slightly acid (about pH 6.0) the large scale use of lime can await the outcome of applications on test strips. In that case, strips across the fairway measuring 10x100 feet are a convenient size. Rates of 25, 50 and 100 pounds are equivalent to ½, 1 and 2 tons per acre.

Several other symptoms aid in diagnosing possible need for lime. The failure of bent grass on greens to respond following an application of ammonium sulfate is strong evidence of the need for lime, provided all other conditions are favorable for growth. The prevalence of diseases such as brownpatch, dollar spot, and snow mold may be due in part to insufficient lime. This was demonstrated very strikingly on a turf nursery of Washington strain of creeping bent at Merion in Philadelphia more than 15 years ago. Lime was applied to a portion of the nursery as an experiment. Three weeks later the unlimed part was severely damaged by dollar spot. The limed area was hardly injured. Snow mold did little damage to a limed green on a course in the Province of Quebec, but all the others fared badly. The unlimed greens were strongly acid, about pH 4.5. Grass on moderate to strongly acid soil is the first to turn brown and suffer from the effect of drought. An application of lime on such soil invariably keeps the grass green longer, often a week or more, and the turf on the limed area is the first to recover following a good rain.

Acidity Reduces Plant Vigor

Apparently acidity reduces the vigor of the plant and adversely affects its ability to withstand disease, unfavorable weather, and the shock of chemicals used for the control of diseases, insect pests and weeds.

In some instances acid soil may have accentuated or contributed to the damage caused by 2-4, D. to bent, Bermuda, or other grasses. Excessive acidity reduced the amount of roots, or otherwise weakened the plant, and made it more susceptible to injury by the chemical. Time will verify the truth or falsity of this supposition.

When turf on greens is damaged by scald, an application of hydrated lime at 2 to 5 pounds per 1000 square feet is generally beneficial. The lime is not used to change soil reaction, but to kill any algae and to precipitate any deleterious soluble organic compounds formed as a result of anaerobic soil conditions. The soil becomes anaerobic because the pores are saturated completely with water and contain no air. Scald occurs mostly on poorly drained greens with a clay base, and happens during periods of excessive rains, or from over-watering. The low spots on badly contoured greens are apt to have scald because the soil becomes saturated with run-off water from adjacent slopes and banks.

In aggravated cases of scald the turf becomes so sparse that the soil is exposed and is covered with a green scum of algae. The use of hydrated lime, and deep forking or spiking destroys the scum and speeds recovery of the grass.

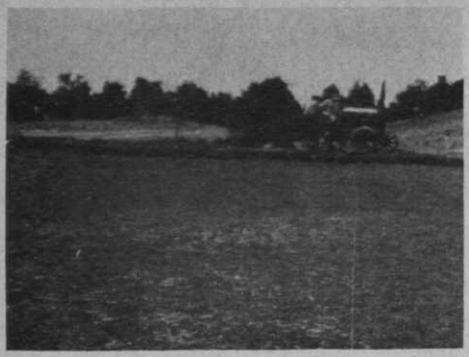
Soil reaction can be determined in the field with any one of several inexpensive test kits which are accurate to within several tenths of a pH. This is good enough for the purpose of judging lime requirements. Otherwise representative soil samples can be forwarded to the State agricultural experiment station, or to one of the commercial organizations equipped to do soil testing. Most laboratories also determine available calcium and magnesium which are generally lower in acid than in non-acid soil. Along the Atlantic seaboard and in some other regions the soil supply of available magnesium is frequently very low. Then magnesium deficiency may limit growth. A dolomitic lime of high magnesium content usually produces better results than one containing calcium only, when the soil supply of available magnesium is low.

What Lime to Use

The word lime has but one meaning chemically. It is the term for calcium oxide. But in agriculture lime includes all compounds of calcium and magnesium

1. The darker green strip at the right is volunteer Kentucky blue grass produced by lime inadvertently applied to a strip of rough at Tam O'Shanter in Canton, Ohio, when the tractor driver failed to close the shut-off on the lime spreader. The light colored unlimed area on the left was quack grass. The soil is too acid for blue grass to assert itself. 2. Fescue has stayed green longer in dry weather along a limed strip on a strongly acid fairway in Troy, New York. Lime was used to mark the boundary where balls could be lifted because of a local rule. Because of the striking benefits the first summer the entire hillside was limed in the fall. The picture was taken the next summer at the start of the dry season. 3. Lime used to mark the court lines improved the turf on the tennis courts at Marion Cricket Club in Philadelphia. There was noticeably less crab grass along the lime lines also. 4. Bermuda grass along the yardage lines on the football field at Rice Institute in Houston, Texas, was greener and denser than elsewhere on the field due to the effect of the lime. Benefits were accentuated during dry spells. The limed Bermuda stayed green longer.

used to rectify the physiological condition, or the reaction, of an acid soil. The compounds commonly used on turf are the hydrates and the carbonates. The hydrates change to carbonates in the soil. No objectionable residue is left in the soil when lime carbonates react with the colloidal soil complex. The calcium and magnesium are absorbed by the complex with the production of carbonic acid. It is a weak unstable acid which breaks up into water and carbon dioxide gas. The application of gypsum (calcium sulfate) to the soil is not generally recommended. The reason is simple. When the calcium is absorbed by the acid soil complex a



Above: Hydrated lime prevented serious damage from dollar spot on a nursery of Washington bent grass at Marion in Philadelphia. The soil was strongly acid. Hydrated lime was applied to the turf on the right-hand side about three weeks before the attack of dollar spot.

strong acid (sulfuric acid) is liberated and is not as easily disposed as carbonic acid. While gypsum may give good results at first, its continued use is likely to develop undesirable residues and thus defeat the purpose for which it was applied.

Blast furnace slag is another compound of lime which can be used to neutralize soil acidity. It is mainly calcium silicate. The calcium is active and the silicate residue is not objectionable in the soil. Usage is limited and confined to the vicinity of blast furnace operations.

Liming materials seldom appear on the market as single compounds of calcium or of magnesium. The carbonate forms of lime have a number of different sources and vary in purity. Some of them are by-products of chemical industry, but most are derived from deposits of limestone rock. The impurities are silt, sand and organic matter. Limestones which are less than 85 per cent pure are not used for agricultural purposes. The lime rock is ground to various degrees of fineness.

Lime is usually sold on a basis of its chemical composition. The guarantee may be expressed as the actual percentages of calcium and magnesium, either as the carbonates, or both. Sometimes the composition guarantee is stated as " calcium oxide equivalent" or as the "neutralizing power." The calcium oxide equivalent states the strength of the lime in one figure, namely calcium oxide (40 pounds of magnesium oxide has the same neutralizing strength as 56 pounds of calcium oxide).

The so-called neutralizing power of a lime is nothing more than a statement of its strength in terms of calcium carbonate. The neutralizing power of a dolomitic limestone may exceed 100 because 100 pounds magnesium carbonate are equivalent to 118 pounds calcium carbonate in capacity to neutralize soil acids.

Hydrated lime generally carries the conventional oxide guarantees. The statement includes the percentage content of calcium and magnesium expressed as the oxides. A chemically pure hydrated lime contains 76 per cent calcium oxide.

Guarantees for ground limestone usually show the separate percentages of calcium and magnesium carbonates. The closer the sum of the two figures approaches 100 the better the quality of lime. The carbonate content should approach 90 or over.

Hydrated lime is an impalpable powder so its fineness is always satisfactory. Pulverized limestones vary in size of particles and in hardness. It is desirable to know something about the degree of fineness because solubility is a function of particle size. The finer the state of division the more rapid is the rate of solution. The manufacturers aim to make a product with a large percentage of fine particles for immediate action but to include enough of the coarser grades to insure lasting qualities. A fineness guarantee is desirable when comparing the probable effects of different limestones. A mechanical analysis is made by using screens of different mesh. For example, a 10 mesh screen has openings approximately one-tenth of an inch in diameter. The guarantee shows the percentage which passes through the various screens. A typical guarantee of a reasonably fine limestone is: 100 per cent through a 10 mesh screen, 75 per cent through a 50 mesh, and 60 per cent through a 100 mesh. Some limestones are considerably coarser and others are finer.

The tendency is to use hydrate or very finely ground limestones in the Atlantic seaboard states. A so-called agricultural lime, consisting of equal parts hydrate and finely ground limestone is common there. In the Ohio, Indiana, Michigan region, finely ground limestones seems to be favored, whereas farther west more coarsely ground materials are used, and rates are increased accordingly.

Hydrate and finely pulverized limestones are the most expensive. However, they are faster acting so lighter rates can be used. But effects do not last as long so the interval between applications must be shorter. A rate for hydrate in excess of 1 ton per acre at any one time is questionable practice because of its greater activity which may adversely affect the solubility of manganese, iron, boron and other trace elements—besides reducing phos-

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Lime

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phate availability. Ground limestone can be applied in quantity without producing these effects.

Rate of Application

Soil texture and kind of grass affects the rate for applying lime. It takes less lime on a sandy soil than on a loam or clay soil to produce the same change in pH. Kentucky bluegrass requires more lime than fescue or bent grass. Three factors, beside pH, are taken into account in table I for the use of lime on fairways. The rates are for finely ground limestone. They should be increased by 25 to 50 per cent for coarser material. But the rate for hydrated lime should be reduced by 25 to 30 per cent because 70 pounds of hydrate are equivalent to 100 pounds of pure lime carbonate in neutralizing value.

The use of lime on greens should be based on reaction. A finely ground material should be used and a dolomite of high magnesium content selected when a soil test shows low content of available magnesium. (500 pounds per acre or less, by the Hellige-Truog method.) Suggested rates for finely ground limestone as pounds per 1000 square feet are given in table II.

Fall, winter and early spring, are the best times to apply lime. Ground limestone can be applied at any time, but it is unwise to apply hydrate in excess of 1000 pounds per acre on fairways in summer. The rate of hydrate on greens should not exceed 5 to 10 pounds per 1000 square feet when the turf is in active growth, and then it should be watered-in promptly to prevent any possibility of scorching the grass. Hydrated lime should never be applied immediately before, or right after, using a fertilizer containing compounds of ammonia, such as ammonium sulfate, ammo-phos, or ammonium nitrate.

When soils are strongly acid, lime should be applied as long as possible before fertilization with soluble phosphates. Otherwise the phosphate may be fixed in the soil as relatively unavailable iron and aluminum phosphate.

TABLE I

Rates for applying Finely Ground Limestone to Fairways

Soil Reaction		Rate in Pounds per Acre			
The yardstick used to express acidity or alkalinity of soil		Blue Grass and Bermuda		Fescue and Bent Grasses	
pH Value	Degree of Acidity	Sands and Sandy Loams	Loams and Clays	Sands and Sandy Loams	Loams and Clays
7	Neutral				
6.3-7.0	Very Slight	0	0	0	0
5.8-6.2	Slight	1000	1500	0	0
5.3-5.7	Medium	2000	3000	1000	1500
4.8-5.2	Strong	3000	4000	2000	3000
4.0-4.7	Very Strong	4000	6000	3000	4000

TABLE II

Rates for applying Finely Ground Limestone to Greens

Soil Reaction	Limestone Rate Pounds per 1000 Sq. Ft.
4.0 to 4.5 pH	60-80 Pounds
4.6 to 5.0 pH	40-60 Pounds
5.1 to 5.5 pH	20-40 Pounds
5.6 to 6.0 pH	10-20 Pounds
6.0 to 6.5 pH	0-10 Pounds