AGR-214

University of Kentucky
College of Agriculture,
Food and Environment
Cooperative Extension Service

Liming Kentucky Lawns

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Most homeowners desire an aesthetically pleasing landscape and will take steps to ensure success. Proper fertilizing, watering, and pest control are all steps that will lead to a quality lawn. However, some confusion surrounds when and why lime should be applied to a lawn. Many homeowners believe that lime needs to be applied on an annual basis for a quality lawn. The purpose of this publication is to explain why lime is needed and whether it is required on your lawn.

Getting Your Soil Tested

The only way to know whether the soil in your yard requires lime is to get it tested. Reference publication AGR-212: *Fertilizing Your Lawn* for the complete steps on taking a soil test.

Soil Test Report

Whether you submit your soil samples to university or private soil test labs for analysis, the report will contain the status of essential plant nutrients in the soil as well as the soil pH. The report also will include recommendations on how much of a particular nutrient or lime you should apply. For a thorough explanation of soil testing, see AGR-57: *Soil Testing: What It Is and What It Does*. Figure 1 shows a sample soil test report from the University of Kentucky Regulatory Services for a tall-fescue lawn. The report lists soil pH (sometimes referred to as water pH) and buffer pH. The soil pH is the number that indicates the amount of active acidity present in the soil solution. This number will directly influence nutrient availability and potential plant health. The buffer pH, on the other hand, is a number generated in the lab to determine the lime recommendation and indicates the amount of reserve acidity in the soil. The higher the amount of clay or organic matter in the soil, the more a soil is buffered (resistant) against changing its pH. Soils that are high in clay or organic matter will require more lime to change the pH (Table 1).

Figure 1. A sample soil test report.

From:
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UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report
Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 6983

REPORT FORM: H

To:
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Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
1/15/2014	LAWN	6119	111	914

Nutrient	Lab Results	Level of Adequacy: Very Low · Low · Medium · High · Very High
Phosphorus (P)	12	>>>>>>>>>>>>>>>>
Potassium (K)	256	>>>>>>>>>>>>>>>>>>>>>>>>>>>
Soil pH	6.0	
Buffer pH	7.0	
Calcium (Ca)	2716	
Magnesium (Mg)	891	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Zinc (Zn)	2.4	
Other Test		

Plants to be Grown	Location (turf grass only)	New or Maintenance	Sunny or Shade
Tall Fescue		Plant Maintenance	Mostly Sunny Location

RECOMMENDATIONS:	Nitrogen	Phosphate (P2O5)	Potash (K2O)	Lime
	1.0 to 1.5 lb/1000 sq.ft.	1 to 3 lb/1000 sq ft	0 to 1 lb/1000 sq ft	30 lb bagged lime/1000 sq ft

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH is calculated from 1 M KCl soil pH using: 0.91 x 1 M KCl soil pH + 1.34. 1 M KCl soil pH and Sikora II buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). Bagged lime may not show an RNV value. An RNV of 84% is assumed (common for bagged lime). You can calculate RNV by finding % calcium carbonate equivalence (%CCE), % 10 mesh size,and % 50 mesh size on the bag and use: %CCE/100 x (0.5 x (%10 mesh + %50 mesh)).

Apply 1 to 1.5 lb actual N/1000 sq.ft. per application. The timing and frequency of nitrogen application depends on level of overall maintenance. Low and medium levels are best with little or no irrigation. For LOW maintenance, add one N application in Oct to Nov. For MEDIUM maintenance, add two N applications. One in Sept to Oct and another one in Nov to Dec.

If lime is recommened, apply no more than 70 to 100 pounds of lime per 1000 sq.ft. at one time. Additional lime may be supplied as repeated applications at 3 to 6 month intervals.

The recommended nitrogen(N), phosphate (P2O5), and /or potash (K2O) can be obtained by applying one of following:
SAMPLES OF PREMIXED FERTILIZERS FOR HOME LAWNS AND GARDENS (USE PER 1000 SQ. FT.)

Fertilizer Analysis N-P2O5-K2O	lbs to apply	lbs actual nutrient N-P2O5-K2O	Fertilizer Analysis N-P2O5-K2O	lbs to apply	lbs actual nutrient N-P2O5-K2O
34--0--0	3	1---0---0	15.5--0--0	7	1---0---0
10-10-10	10	1---1---1	46---0--0	2	1---0---0
..5-10-15	20	1---2---3	12-12-12	8	1---1---1
19-19-19	5	1---1---1	15-30-15	7	1---2---1
28--3--3	4	1--0.1--0.1	5-20-20	20	1---4---4

*If more P2O5 and/or K2O is needed than is supplied by one application, this nutrient can be supplied in the next application.

Table 1. Approximate quantities of calcitic lime required to raise a 6-inch rootzone to a pH of 6.5 prior to planting.

Original soil pH	Soil texture: Sand and loamy sand	Soil texture: Loam	Soil texture: Clay loam and clay
	pounds/1,000 ft²		
4.5	30-50	80-130	150-190
5.5	20-30	45-75	90-100

What is pH?

The pH can be thought of as describing the power of hydrogen. pH is defined as the negative logarithm of the hydrogen ion concentration (or –log [H^+]), meaning pH is a logarithimic scale from 0 to 14 (Figure 2). The lower the pH, the more acidic something is, and the higher the pH, the more alkaline or basic. A pH of 7 is considered neutral. Because the pH scale is logarithimic, a change from 7.0 to 6.0 is a tenfold change in [H^+] while a change from pH 7.0 to 5.0 is a 100-fold change in [H^+] (i.e. 100 times more hydrogen ions). Small changes in pH actually result in large changes in the acidity or alkalinity of a soil. Because of this scale, all soils may be classified as acid, neutral, or alkaline. Most plants grow best near neutral to slightly acidic pH. If the soil pH becomes too acidic, steps must be taken to raise the pH. Conversly, if the soil pH becomes too basic, it will need to be lowered. Several methods can change the pH of soil.

Figure 2. The pH scale.

←	5.5	6.0	6.5	7.0	7.5	8.0	8.5	→
Acidic pH				Neutral pH	Alkaline pH			
strong	medium	slight	very slight		very slight	slight	medium	strong

Soil pH Affects Nutrient Availability and Plant Growth

Soil pH is the single most influential aspect that determines nutrient availability in the soil. The majority of essential plant nutrients are most available at soil pH values between 6.0 and 6.5 (Figure 3). As soil pH decreases, acidic elements such as aluminum and manganese and most micronutrients become more available for plant uptake. The increased availability of aluminum and manganese can damage plant roots, which will reduce their ability to take up essential nutrients and water; as soil pH increases, their availability and detrimental effects decrease. Phosphorus availability is reduced when pH is less than 6 or greater than 7 and maximized near pH 6.5. At low pH values, phosphorous will form complexes with aluminum and iron that reduces plant-available forms. At high pH values, phosphorous will form complexes with calcium that also reduces the plant available forms. Micronutrient availability is increased at low soil pH values, except molybdenum, which increases at high soil pH. Since these nutrtients are only needed in small amounts, sufficient amounts are able to be acquired at near neutral pH values so that plant growth is not limited. Further, most grass species do not require large amounts of these nutrients for adequate growth.

Do I Need to Apply Lime?

Several factors can acidify the soil. Rainfall and irrigation cause calcium (Ca) and magnesium (Mg) to leach from the soil. When these elements leach, hydrogen ions will replace Ca and Mg on soil exchange sites, which will in turn lower soil pH (increase acidity). Ammonium forms of nitrogen fertilizer, plant roots exuding acidic compounds, and decomposition of organic matter can all cause a reduction in pH. In contrast, nitrate forms of nitrogen, wood ashes, and other amendments that contain carbonates will increase soil pH. Depending on the turfgrass species grown on your lawn, you may need to take steps to raise the pH if it drops below 5.5-6.0 (Table 2).

If the pH reported on the soil test is in the acceptable range, there is no benefit to applying lime. As a matter of fact, applying lime when it is not necessary may actually hinder plant growth by reducing nutrient uptake. However, if the pH is moderately acidic, the soil test report will identify a need for lime.

Liming Lawns and Lime Sources

Your soil test report will tell you the amount of lime needed to decrease acidity and raise pH to the 6.0 and 6.5 range. Achieving the desired pH is possible through a variety of sources as shown in Figure 4.

Agricultural Limestone

Agricultural limestone (ag lime) may be either calcitic lime (mainly calcium carbonate ($CaCO_3$) or dolomitic lime (mixture of calcium carbonate and magnesium carbonate [$CaMg(CO_3)_2$]). These limes can be purchased at rock quarries and are cheap but are difficult to apply in normal lawn spreaders. Quarry lime probably is applied most easily by shovel from the back of a pickup.

Figure 3. The influence of soil pH on nutrient availability.

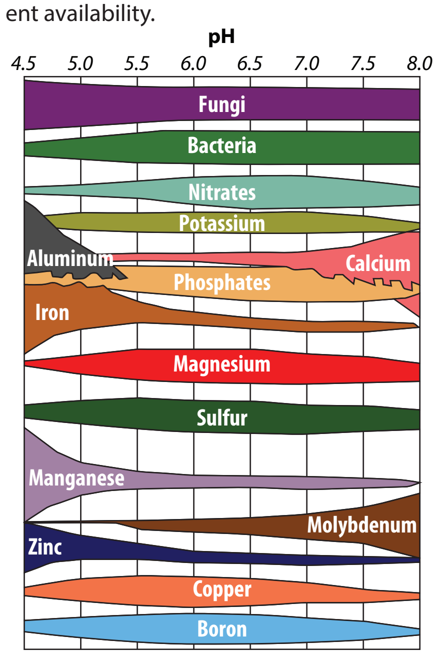

Table 2. pH ranges for optimum growth of several lawn species grown in Kentucky.

Lawn species	Optimum pH range
Bermudagrass	6.0 - 7.0
Chewings fescue	5.5 - 6.5
Creeping red fescue	5.5 - 6.5
Hard fescue	5.0 - 6.5
Kentucky bluegrass	6.0 - 7.0
Meadow fescue	5.0 - 7.0
Perennial ryegrass	6.0 - 7.0
Tall fescue	5.5 - 6.5
Zoysiagrass	6.0 - 7.0

Figure 4. Various sources of agricultural limestone. Calcitic (a), pelletized (b), dolomitic (c).

Ag lime often is sold through garden centers in 50-pound bags as finely ground ag lime or dolomitic limestone. The finely ground particles also are difficult to apply with lawn spreaders in sufficient quantities, and they are dusty. These lime sources are slow to affect soil pH, but will remain active in the soil for quite some time (Table 3). The dolomitic limestone is usually slightly more expensive because of the magnesium it contains. Since our Kentucky soils contain enough magnesium, the higher cost of dolomitic limestone does not mean it is better in chemical quality.

Pelletized Lime

A more convenient pelletized lime is available in many lawn and garden centers. This product flows freely through lawn spreaders and is not extremely dusty. Pelletized lime is made by bonding fine lime particles together with lignosulfonates to create a pellet that is more easily handled than ag lime. Pelletized lime usually has a higher purity than typical ag lime and is more expensive, but can be used at slightly lower rates that typical ag lime. Since it has a higher purity many people believe that it will react faster than ag lime at equivalent rates. This idea is typically not the case, since the lignofulonate bonds must be broken down for neutralization to occur. Pelletized lime is much easier to use than ag lime when spreader trucks are not an option for application.

Table 3. Characteristics of liming materials.

Liming material	Initial release rate	Length of residual	Burn potential
Calcium carbonate	slow	long	low
Dolomitic limestone	slow	long	low
Hydrated lime	medium	short	high
Quicklime	fast	short	high

Hydrated Lime and Quicklime (Burned Lime)

Hydrated lime (calcium hydroxide [$Ca(OH_2)$]) and quicklime (calcium oxide [CaO]) also are found frequently at garden centers. Although lesser quantities are needed to reduce acidity, some leaf burn problems may occur, and the residual effect is much less than ag lime. Because of the burn potential of quicklime and hydrated lime, it is best only to use these products prior to establishing a lawn. These products are very fine or dusty, therefore handling is often difficult unless specialized equipment is used.

Gypsum and Sulfur

Often, gypsum ($CaSO_4$) is sold in garden centers, but although it is readily soluble in soil, it is not effective in changing pH or improving the structure of Kentucky soils.

Sources of sulfur (e.g. elemental sulfur, aluminum sulfate, etc.) also are available and are utilized to reduce soil pH. Although reducing pH is important for many landscape plants, turfgrasses are not generally affected by high pH in Kentucky soils.

Liming Rates

As much as 100 to 200 pounds can be required per 1,000 square feet of lawn. On new lawns prior to establishment, it is recommended to apply the full amount of lime required and till to a depth of 6 inches. On established lawns, however, only 100 pounds or less is recommended to be applied in a single application to avoid burn damage on established grass. If more than 100 pounds per 1,000 square feet is required, the remainder of the recommended lime can be applied three to six months later.

References

Beard, J.B. *How to Have a Beautiful Lawn*. 1983. Beard Books: College Station, TX.

Beard, J. B. *Turf Management for Golf Courses*. 2002. Ann Arbor Press: Chelsea, MI.

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