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Lime: Common Soil Additives to Raise Soil pH in Virginia

Authored by: Mark Reiter, Associate Professor and Extension Soils and Nutrient Management Specialist, Eastern Shore Agricultural Research and Extension Center, Virginia Tech; and Rory Maguire, Professor and Nutrient Management Extension Specialist, Virginia Tech.

Introduction

Agricultural limestone is utilized to neutralize soil acidity [H+ cations] in Virginia agricultural production systems; which raises soil pH. Optimal soil pH for most grain, oilseed, fiber, and vegetable crops ranges from 6.2 to 6.5. The quality of agricultural lime is determined by its purity and fineness of grind (mesh size). Purity impacts the amount of ag lime required per acre in adjusting soil pH to a given level. Mesh size impacts the rate of reaction of lime in neutralizing soil acidity, as described below. A comprehensive fact sheet that explains lime and how it works is available through Virginia Cooperative Extension publication #452-510 (SPES-158P; Mullins et al., 2019).

The calcium carbonate equivalent (CCE) of agricultural lime is directly related to its purity. Pure calcite is 100 percent calcium carbonate ($CaCO_3$) and has a CCE value of 100%; whereas pure dolomite ($CaCO_3 \cdot MgCO_3$) has a CCE of 108%. Therefore, pure dolomite can neutralize 8% more acid than pure calcite. The CCE and chemical composition of several common liming materials are shown in Table 1. Equivalent amounts of different liming materials can be determined by using the effective neutralizing value (ENV). For example, if 2 tons of calcitic lime with a CCE of 100% are recommended, and marl with a CCE of 75% is to be used, the CCE of calcitic lime (100%) divided by the CCE of marl (75%) times the recommended rate per acre of calcitic lime (2 tons/acre) equals 2.66 tons of total marl lime needed. This is the amount of marl that would need to be applied to equal the acid neutralizing potential of two tons of calcitic lime. The lime recommendations of soil testing laboratories are generally based on liming materials that have a 100 CCE.

Liming Materials Marketed in Virginia

Companies marketing agricultural liming materials in Virginia must be registered with the Virginia Department of Agriculture and Consumer Services, Richmond, VA 23209 (http://www.vdacs.virginia.gov/). Further, the liming materials sold must pass the specifications stipulated in the Virginia Agricultural Liming Materials Law; Chapter 37 in the Code of Virginia (Code of Virginia, 2021).

There are both ground and pulverized limestone sold in Virginia, and they have different particle sizes based on mesh screen analysis. Mesh size is a measure of the number of openings in one square inch of screen. A 20-mesh screen contains 400 openings per square inch, whereas a 100-mesh screen contains 10,000 openings. Crushed limestone material passing a 100-mesh screen is finer and therefore reacts with soil acidity more rapidly than 20-mesh material. Pulverized limestone is, therefore, more reactive than ground limestone. However, reactivity rate does not increase greatly for particle sizes smaller than 100 mesh.

The main two different kinds of limestone used in Virginia are calcitic and dolomitic. Sometimes on soil test reports you will see recommendations for “AG” or agricultural lime, and this means you can use either calcitic or dolomitic, depending on local availability and pricing. In Virginia, agricultural limestone that contains 85% or more of the total

neutralizing value in the calcium carbonate form is classified as calcitic; whereas limestone that contains 15% or more of the total carbonate content as magnesium carbonate is classified as dolomitic. Both are excellent liming materials; however, dolomitic lime should be used on soils testing low in magnesium to increase magnesium soil testing values.

When buying lime, one must be aware of the cost per unit of calcium carbonate equivalency. Neutralization potential increases with the increase in calcium carbonate equivalency value. In reality, ag lime users are buying acid neutralizing potential that is associated with both calcium carbonate equivalence and fineness of grind. Be sure to compare actual product labels to better understand the neutralizing value of the particular products available in your area.

Tables

Table 1. Common lime sources used in Virginia. See VCE publication #452-510 for a more detailed discussion of lime sources, calculations, use, and precautions (SPES-158P; Mullins et al., 2019). As always, utilize product labeling for exact formulations and content.

Lime Material	**Chemical Formula**	**CCE (%)**	**Approximate Fertilizer Nutrients[a] (%)**
Calcium carbonate (pure)	$CaCO_3$	100	40% Ca
Calcitic lime	$CaCO_3$	80-100	30-40% Ca; 3% Mg
Dolomitic lime	$CaCO_3 \cdot MgCO_3$	85-108	20-25% Ca; 6-14% Mg
Byproducts and biosolids	Variable	Variable	Variable
Burned or quick lime	CaO	150-175	71% Ca
Cement kiln dusts	Ca oxides	40-100	29-46% Ca; 1-3% S
Gypsum (does not lime)	$CaSO_4$	0	22% Ca; 17% S
Ground oyster shells	$CaCO_3$	90-100	34% Ca
Hydrated or slaked lime	$Ca(OH)_2$	110-135	54% Ca
Marl	$CaCO_3$	70-90	28% Ca
Poultry litter	Ca, Mg, and K Oxides	0.3-4	1-5% Ca; 0.5-2% Mg and others
Poultry litter ash	Ca, Mg, and K Oxides	12-31	12-18% Ca; 3-6% Mg and others
Power plant ashes	Ca, Mg, and K Oxides	25-50	Variable
Slags	$CaSiO_3$	60-90	Variable
Wood ashes	Ca, Mg, and K Oxides	26-59	7-33% Ca; 2-7% K and others

[a]These are natural occurring minerals or byproducts; therefore, exact nutrient concentrations vary by individual source. Approximate values obtained from Adaska and Taubert (2008), Baker Lime (2021), Ajith (2016), Griffin (2006), Middleton (2015), Mullins et al. (2019), New Enterprise Stone & Lime Co. (2021), and Rockydale Quarries Corporation (2021).

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