



## Lime and Liming Management

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Soil pH is an index of soil acidity, measured as the concentration of hydrogen ions (H<sup>+</sup>) in a soil water mixture. Since the measure is a small number, on a logarithmic scale, the smaller the pH value the more acid the soil. When soils are very acid (pH less than 5.5 to 5.8) soil bacteria and nitrogen fixing bacterial in legumes are adversely affected and soil biological activity is reduced. Also, at low pH the solubility of aluminum and manganese increases. These minerals are toxic to plants and aluminum ties up phosphorus and make it less available to plants.

### Legume Response to Soil pH

Different plant species are affected differently by soil pH. Blueberries and rhododendrons grow best at low pH. However, forage legumes such as red and white clover do best when the soil pH is greater than 6.0 and alfalfa does best when the pH is greater than 6.5 (Fig. 1). Since these legumes are a primary source of nitrogen through nitrogen fixation it is important that the soil pH be maintained for the healthy production of legumes in pastures and hay fields so that they can provide nitrogen to the grasses and forbs for growth.

### Agricultural Limestone

The main way to increase soil pH (reduce soil acidity) is through the use of agricultural limestone. The quality of an agricultural limestone is determined by the purity of the limestone measured by its calcium carbonate equivalent (CCE) and by how fine the lime is ground measured by the percent of the ground lime passing different sizes of standard sieves. The WVU

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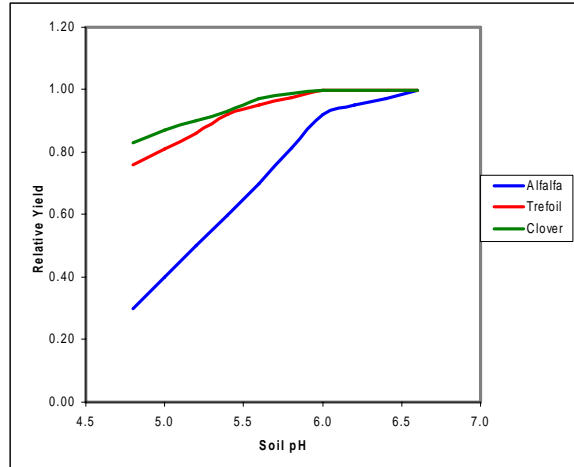


Figure 1. Legumes differ in their growth response to soil pH. Alfalfa needs a soil pH greater than 6.5 while clovers and birdsfoot trefoil need a soil pH greater than 6.0 for maximum production.

Extension Service fact sheet *The Value of Agricultural Limestone* provides details on calculating the cost effectiveness of a ground agricultural limestone based on its CCE and particle size.

### **Management of lime application**

The soil pH response to lime application is determined by how lime is placed in and incorporated in the soil. For pastures and long term hay fields that are not plowed lime is usually surface applied without incorporation. In this situation the lime reacts with the soil surface and is slowly incorporated by worm, other soil organisms, and by frost heaving. The surface pH changes fairly quickly and stays up for a period of time (Fig. 2). When lime is applied to tilled cropland and incorporated in the soil, the soil pH response in the tilled zone increases then depending on how much lime was incorporated decreases with time (Fig. 3). Also, since top dressed lime is not incorporated into a 6 or 8 inch plow depth it has less soil to react with and so less lime is needed to achieve the desired pH in the surface layer of the soil.

Lime requirement of a soil is often expressed as the amount of 100% ENV lime needed to raise the soil pH in a 6-8 inch plow layer to 6.6. When using tillage and incorporation of lime to establish alfalfa this is the amount of lime needed. However, when surface applying lime or when liming soil for clover, which only needs a pH of 6.0 or greater, lower rates of lime can be used to achieve maximum yield and reduce costs. How much to adjust the liming rate depends on the initial soil pH and the pH desired relative to the standard pH of 6.6 (Fig 4).

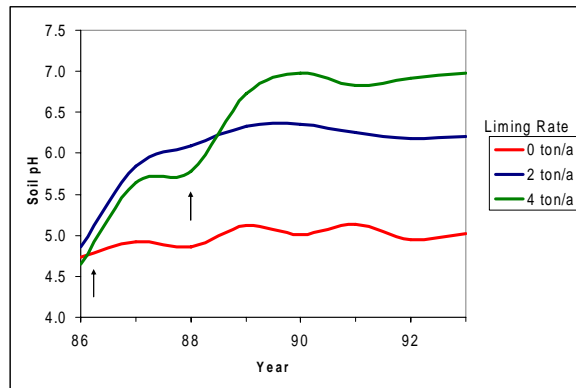


Figure 2. Agricultural lime applied to the soil surface reacts fairly quickly over the first 12 months (arrows indicate when lime was applied at 2 tons/acre, once for the 2 ton and twice for the 4 ton rate). The change in soil pH in the top 2 inches of the soil is relatively long lasting.

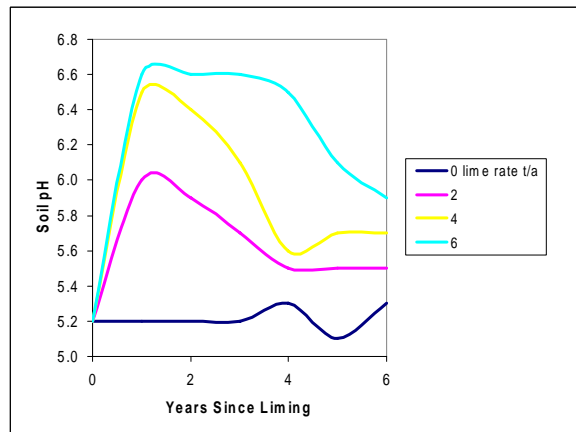
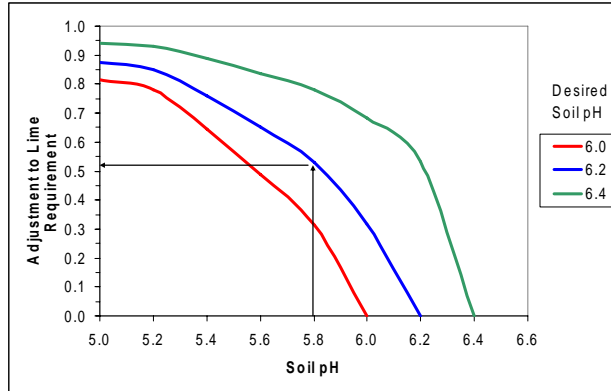


Figure 3. Agricultural lime applied and incorporated into the soil reacts very quickly over the first 12 months. The change in soil pH in the 8 inch incorporation zone is relatively long lasting at high liming rates but relatively short lived at the low liming rates.

For example the WVU soil test lime requirement is for raising the soil pH to 6.6. For grass-clover a pH of 6.0 is adequate. Use Figure 4 to find the adjustment factor for the required liming rate. On the horizontal axis find the current soil test pH (example 5.8). Move up to the line representing the soil pH desired (example 6.2). Go over to the left axis and read the liming rate adjustment factor (example 0.52). Multiply this factor by the WVU soil test report lime requirement to obtain the lime requirement which should raise the soil pH to 6.2. If the soil test called for a lime requirement of 4 tons per acre, multiply 4 x 0.52 and the rate would be 2.08 tons ENV lime per acre.



**Figure 4.** Adjustment to a lime requirement to raise te soil pH to 6.6, based on current soil pH and desired adjusted soil pH.

Lime is one of the most cost effective soil amendments to supply calcium and magnesium fertility to plants, increase soil pH, improve the soils biological life, and improve availability of other soil plant nutrients. However, to achieve this most cost effective use of lime, the manager needs to ensure that quality lime is purchased based on the lime’s purity and fineness and that the lime is applied to the soil at the rate needed to meet the needs of the crop being grown. Then regular soil testing can be used to monitor the success of this management.