Managing Soil pH and Fertilizer Cations

The importance of soil pH to the health of plant crops is well known. But of more importance than the actual pH is having appropriate levels of the cations calcium, magnesium, and potassium in the soil colloidal complex. For example, three different fields with the same pH growing the same crop may have very different levels of calcium (Ca), magnesium (Mg), and potassium (K). One field might have optimum levels of Ca and Mg. The second field might have an excess of Ca and a deficiency of Mg. The third field might have an excess of Mg and a deficiency of Ca. Any number of combinations of Ca, Mg, K, sodium (Na), and aluminum (Al) compounds may contribute to any given soil acidity or alkalinity (pH) level. The amount needed to change the pH value varies by compound. For example, magnesium carbonate, pound for pound, raises pH 1.7 times as much as calcium carbonate.

Plants are tolerant of a fairly wide range of Ca, Mg, and K in the soil, if sufficient levels of each are present. However, if soil Mg tests excessive and pH needs to be raised, use high calcium (calcitic) limestone. Conversely, use dolomitic limestone (calcium magnesium carbonate) for raising pH if soil Mg tests low or deficient. Do not use liming material on high pH or nearly neutral pH soil as over liming can tie up micronutrients and possibly inhibit the activity of soil micro-organisms that help make soil minerals available (mineralization). Be careful to avoid over liming. Too much limestone can make manganese (Mn) and other trace elements unavailable to crops.

Liming Guidelines

- Lime only when pH drops to 5.5 or less. Apply only 500 to 1,000 lb./acre (12 to 23 lb./1,000 sq. ft.). Test every year and only apply when pH is 5.5 or less.
- Use high calcium (calcitic) limestone if Mg in the soil tests above optimum.
- Use dolomitic limestone (calcium magnesium carbonate) if Mg in the soil tests below optimum.
- If the soil Mg tests close to optimum, use a mixture of dolomitic and calcitic limestone, or alternate between the two in successive applications.
- Lime in conjunction with carbon based organic inputs for maximum benefits. Organic matter holds minerals and makes them more available to plants. Organic matter is the only part of the soil colloidal complex that holds fertilizer anions as well as cations. Organic matter is the best soil component to prevent leaching, but at the same time, minerals are readily released to plant roots as needed by the plants.
- Blueberries take up nitrogen in the form of ammonium and need an acid soil with a pH about 5.0. A pH of 5.5 or higher will readily induce iron deficiency.
- Re-test the soil every crop season to determine whether more limestone is needed and, if so, what type.

Watch for Excessive Potassium

Potassium (K) is held at lower levels in the soil base saturation compared to Ca and Mg, even though plants generally require more K than any other mineral. A certain level of soil K is necessary, but excessive soil K blocks plant uptake of Ca and Mg. Higher levels of Ca in plant tissues help protect plant crops against fungal and bacterial diseases, but excessive tissue levels of K cancel this effect. Balance is the key because K also protects against fungal and bacterial diseases when present at optimal levels.

If the soil pH is too high (testing at 7.0 or higher), use sulfur at low rates of 2 to 3 pounds per 1,000 sq. ft. (75 to 100 pounds per acre) and immediately water in. Sulfur will temporarily lower pH and tie up the cation most responsible for the high pH.

Low inputs of limestone and sulfur on a regular basis as needed are better than large quantities every two or three years to try to instantly adjust soil acidity or alkalinity. You want slow steady soil adjustments, not extreme pH swings like a roller coaster. Slow, steady corrections will provide the activity needed in the soil matrix and protect the microbial life in the soil.

In summary, perform a complete soil test for pH and minerals at least once per season. Use low, regular inputs of dolomitic and/or calcitic limestone to raise pH and sulfur to counteract high pH. For the most beneficial soil response, use carbon based/organic inputs in conjunction with liming and fertilization.