



Soil Test Note No. 3 – Liming and Fertilization of Cool-Season Forage Crops

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Introduction

The only way to accurately predict lime and fertilizer needs in forages is through soil testing, as explained in “Soil Test Note No. 1 – Explanation of Soil Tests,” Virginia Cooperative Extension publication 452-701. See www.soiltest.vt.edu.

Lime

Nearly all soils in Virginia are naturally acidic and require regular liming to maximize forage production. Soils become more acidic with time due to leaching of cations (such as Ca^{2+} [calcium] and Mg^{2+} [magnesium]), their removal in harvested hay, and applications of acidic fertilizers. Liming is especially important for legumes because they cannot efficiently fix nitrogen from the atmosphere at low soil pH. Root growth and the availability of nutrients can also be decreased at low pH, decreasing forage production.

New Stand Establishment Where Incorporation Into the Soil Is Possible

Where Less Than 2 Tons per Acre Are Recommended

A single application after plowing will usually give good results. Lime applied before plowing should first be disked into the soil and then plowed in to ensure good mixing. Lime applied after plowing should be disked into the soil as thoroughly as possible.

Where More Than 2 Tons per Acre Are Recommended

Apply one-half of the lime, disk it into the soil, and plow it under, then apply the second half of the lime and disk it into the soil. This method offers the best incorporation of lime into the soil and is important when the soil pH is very low and large amounts of lime are needed.

Establishment of New Stands Using No-Till

Research with no-till forage establishment shows that surface-applied lime is effective in reducing soil acidity in the surface 2 to 4 inches of soil, especially in fields that have been limed to tillage depth in previous years. For no-till establishment where the lime will not be incorporated into the soil, follow the guidelines for pasture and hayfield maintenance, below.

Pasture and Hayfield Maintenance

A surface application of up to 2 to 3 tons of lime per acre will normally reduce acidity in the upper 2 to 4 inches of soil. When more than 3 tons of lime per acre is required, additional lime — more than the 3-ton rate — applied to the surface will have little beneficial effect on crop growth. If the field is level enough to till without danger of excessive erosion, consider plowing up the old sod and reseeding, at which time you can incorporate the lime (see New Stand Establishment Where

Incorporation Into the Soil Is Possible, above). Otherwise, surface-apply half the lime now and the remainder in six to 12 months.

Nitrogen, Phosphate, Potash Fertilization

For help calculating fertilizer rates, see Virginia Cooperative Extension publication 424-035, “Fertilizer Types and Calculating Application Rates.” If you are considering fertilizing with poultry litter, see publication 418-142, “Fertilizing Cool-Season Forages With Poultry Litter Versus Commercial Fertilizer.” These can be found online at www.pubs.ext.vt.edu or at your local Virginia Cooperative Extension office.

The need for phosphate (phosphorus) and potash (potassium) is determined by using a soil test to measure the concentration of these nutrients in soils. Soil nitrogen concentration is **not** a good predictor of nitrogen availability to forages, so the need for nitrogen is determined by forage species to be grown, soil type, and the presence of legumes. Recommended rates for all three are provided in soil test reports. Legumes fix nitrogen from the air into a plant-available form that is shared with grasses in mixed pastures.

If your hayfield or pasture contains 25 to 30 percent legume cover (such as clover or alfalfa), additional nitrogen fertilization is usually not needed to boost forage yield. Nitrogen fertilizer promotes grass growth and can produce significant yield increases when used on pastures or hayfields that are predominantly grass. For hay production of cool-season species like tall fescue or orchardgrass, nitrogen is used most efficiently when it is split-applied in early spring (e.g., mid-March) and early fall when forages are actively growing. In a grazing system, spring applications of nitrogen should be later than hay production (e.g., mid- to late May). Later nitrogen application can help extend forage growth in summer, which is beneficial for grazing. Nitrogen also leaches easily from the soil, which is another reason split applications are better.

In contrast to nitrogen, phosphate and potash are well-retained in the soil and can be applied at any time of the year. In most cases, it is economically advantageous to apply phosphate and potash at the same time nitrogen is being applied. Where possible, plowing or disking in these two nutrients (e.g., at seeding) will give the best results, but surface application is fine for established forages.

Phosphate stimulates root growth, especially on young plant seedlings. Therefore, use higher rates of phosphate when establishing forages for hay or pasture as compared to maintenance phosphate applications for established stands. These higher rates will be included in your soil test recommendation as long as you indicate that you are establishing rather than maintaining forage. Applying the extra phosphate at establishment is a very important step in getting healthy seedlings for a vigorous stand of forage.

Field management greatly affects nutrient needs, especially when comparing pasture to hayfields. If you use the field for a pasture system, a considerable amount of nutrient recycling takes place, especially for phosphate and potash. Almost 90 percent of the forage phosphorus consumed by livestock is returned back to pasture in manure. Potassium in forages is also heavily recycled but mostly through urine deposition. Because nitrogen can be lost to the atmosphere and leached, regular nitrogen additions will still be required in pasture systems unless legumes are present, as described above.

If you cut the field for hay, you will remove large amounts of plant nutrients. A ton of tall-grass hay may contain 50 pounds of N (nitrogen), 16 pounds of P_2O_5 (phosphate), and 52 pounds of K_2O (potash). Thus, in a hay system, greater amounts of nutrients — especially phosphate and potash — will be needed over time to replace the nutrients removed in the harvested hay and maintain soil fertility and forage productivity.

Sulfur deficiency has not been documented in forage in Virginia; however, it has been documented

in several other crops, and sulfur deposition from rainfall has decreased in the past several decades due to lower emissions from power plants. Tissue samples are more reliable than soil tests if sulfur deficiency is suspected. To rectify sulfur deficiency, an application of 5 to 10 pounds of sulfur per acre should be adequate. Sulfur deficiency would not be expected where manure has been used as a fertilizer source because manure contains sulfur.

Trace Element Needs

The most common trace-element deficiencies found in Virginia are for boron and molybdenum in alfalfa. Soil testing is conducted to determine the need for boron fertilizer for alfalfa. A recommendation for broadcasting 2 to 4 pounds per acre of elemental boron is made when it is less than one part per million in the soil test.

However, soil tests are not a reliable predictor of crop response to molybdenum. A recommendation for molybdenum is made when soil pH is less than 5.8, but a better strategy is to increase soil pH to more than 6.0 to avoid this deficiency. Molybdenum may be applied as a foliar spray at the rate of 1/2 pound of elemental molybdenum per acre or as a seed treatment at the rate of 1 ounce of elemental molybdenum per acre.

Important: Molybdenum is toxic to livestock!
Do not graze forage until after a soaking rain if molybdenum is sprayed on forage.

Additional Information

For more information, contact your local Virginia Cooperative Extension office or see www.ext.vt.edu.