Lime

Lime is the primary material used to adjust soil pH to the level that is optimum for the crop. Most forest soils in Virginia are strongly to slightly acidic, and are suitable for most tree species. Therefore, liming forest soils is not a common practice. In some instances, however, raising the pH may be warranted. Good examples are black walnut and royal paulownia, which grow best at a pH of around 6.5. The proper soil pH has a large effect on the availability of other nutrients in the soil. For example, nitrogen is most readily available between pH 6.0 and 8.0. Phosphorus is most readily available between pH 6.0 and 7.0. Some micronutrients are only available at higher pH (molybdenum), while others are only available at lower pH (boron and copper).

The best time to apply lime is prior to planting, when it can be incorporated into the soil by tilling. Later applications are possible, but the effect is much slower.

PLANT TISSUE ANALYSIS

The concept of using plant tissue to assess the nutrition of crops has been around for many years. Nutrient concentration in plant tissue, such as current year's needles and leaves, can be compared to normal, expected levels, or critical levels. Based on these comparisons, fertilizer recommendations can be made. Tissue analysis is especially well suited to assessing the nutrition of trees, especially since trees are a long-term crop and have wide-spreading root systems. Unfortunately, a tissue analysis program for trees does not exist in Virginia. However, it is possible to collect samples and have them processed at private plant testing laboratories.

Foliar sampling from pines involves collecting a representative sample of current year's needles in the fall or winter. The samples should be refrigerated or dried soon after collection, and sent immediately to a testing lab. Critical levels for loblolly pine have been set at 1.2% for N and 0.1% for P. Concentrations of N and P below these levels indicate that fertilizer is warranted.

ADDITIONAL INFORMATION

For more information, contact your local Virginia Cooperative Extension (VCE) office or access the Internet and connect to VCE's web site at http://www.ext.vt.edu.

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Soil Test Note 12: Commercial Hardwood and Pine Tree Crops

(Supplement to Soil Test Report)

Plantations of commercial hardwood and pine tree crops need proper nutrition for best growth and health. The native soils of Virginia are generally fertile enough to meet the nutrient demands of trees; however, there are exceptions. Eroded, burned, or other severely disturbed areas may lack sufficient organic matter, and may be deficient in one or more nutrients. Likewise, tree species vary in their nutrient demands. For example, black walnut, a high-value hardwood, has very high nutrient demands. Pines, such as loblolly and shortleaf, have much lower nutrient demands, but may still be very responsive to fertilizer on some sites. Since trees grow over long rotations of 40 to 80 years, nutrient demands likewise vary over time. Generally, the highest demand is early in the life of the stand, about the time that the tree crowns close and shade the forest floor. Fertilization is most easily done prior to planting, when the site is open, but is more effective later on in the rotation.

SOIL SAMPLING

Forest soils tend to be quite variable, so it is best to take samples that reflect this variability. Generally, separate samples should be taken from areas that differ in soil type, slope, drainage, land use, and species type. Within a given area, samples should be collected from the surface six inches of soil, mixed thoroughly in a bucket, and a small sub-sample removed and boxed. As a general rule, 7 to 10 samples should be composited, and should cover

around 5 to 10 acres of land. More details are available from your county extension agent.

PLANTATION ESTABLISHMENT

Prior to tree planting is the only time in the life of the plantation that area-wide treatment of the soil is possible. For example, both phosphorus and lime are far more effective if they are incorporated into the soil by tilling. This cannot be done after the trees are planted. Soil sampling and testing done prior to plantation establishment allows the opportunity to apply fertilizer and/or lime, and till it in over the area or band it in along the planting rows. Site assessments done at this time also are useful in determining the suitability of a particular tree species for the site. For example, the following soil properties have been identified as optimum for black walnut:

Soil Property	Level
pH	6.5
organic matter (%)	3.5
nitrogen (%)	0.3
phosphorus (lbs/ac)	80
potassium (lbs/ac)	275
calcium, sandy soils (lbs/ac)	3,000
calcium, silty soils (lbs/ac)	4,000

Soil testing prior to planting will allow you to determine whether the nutrient levels are adequate for the crop, or if fertilization will be mandatory.

MAINTAINING SOIL FERTILITY LEVELS

Once the forest stand has been established, periodic soil sampling may be done to determine if fertilization is warranted. As a stand grows, there is a redistribution of nutrients from the soil to the trees, and in some cases this may result in deficiencies. In most cases, however, added fertilizer supplements the soil supply and increases growth by stimulating the production of more leaves or needles. Both in the case of establishment fertilization and with maintenance, control of competing vegetation is necessary, so that the added nutrients aren't tied up in the competition.

Maintenance fertilization of pines is recommended five to eight years before harvest. Nitrogen is the primary nutrient added at this time, however, some stands may also benefit from phosphorus. The stands to be fertilized should have from 70 to 120 square feet per acre of basal area, and a site index of 70 to 75 feet at age 25. Lower coastal plain pine stands may also be fertilized at ages from three to 10 years.

Hardwood trees, like pines, also respond to fertilization. For example, black walnuts may be fertilized when they reach a diameter of about five inches, at intervals of about five years. Weed and brush control prior to fertilization is essential.

MAJOR SOIL NUTRIENTS

Nitrogen

Nitrogen is the most limiting nutrient to tree growth, particularly at older ages. Nitrogen is important in foliage production and tree growth. Smaller leaves and needles and a yellowing, or chlorosis, of the foliage are the major deficiency symptoms. The soil test report does not prescribe nitrogen for establishment fertilization, but does prescribe the standard 50 to 100 lbs/acre for both hardwoods and pines for maintenance fertilization.

The most common nitrogen fertilizers are ammonium nitrate (NH_4NO_3), which has 33% N; urea, which has 46% N; and diammonium phosphate (DAP), which has 18% N. Fertilizer may be broadcast either aerially or using ground methods, including hand-held or machine-mounted rotary spreaders. Urea has a tendency to volatilize during warm, dry weather. Applying urea just prior to rain reduces this loss.

Phosphorus

Phosphorus is the second most common nutrient limiting tree growth. It is also important in tree growth, as well as in root development, budset, and seed production. Ideally, phosphorus should be applied prior to planting and tilled into the soil. Broadcast applications after planting, however, have also proven effective.

There are several common fertilizer sources of phosphorus. These include triple superphosphate (20% P), diammonium phosphate (20% P), and rock phosphate (9-13% P). The first two sources are highly soluble, while the last is very slowly soluble. If both N and P are needed, diammonium phosphate is a good source, since it supplies both nutrients.

Potassium

Potassium, or potash, is seldom limiting to tree growth. However, there are cases where soil levels may be low enough to warrant up to 80 pounds per acre. Potassium is an essential nutrient which aids in water relations and helps protect trees from drought. It is highly mobile in the soil, and may be applied to the soil surface. Potassium is normally applied as muriate of potash (KCl), which contains 60% potash (K_2O). It may be applied bulk-blended with other fertilizer materials.