MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK • EASTERN SHORE

HOME & GARDEN

HOME AND GARDEN INFORMATION CENTER ● 12005 HOMEWOOD ROAD ● ELLICOTT CITY, MD 21042 ● 1-800-342-2507

Home & Garden Mimeo # HG 11

Soil Test Basics

Test your turf and garden soil every 3-4 years to measure soil pH and nutrient levels and to make adjustments based on recommendations provided by a soil-testing lab. A basic soil test that gives readings for soil pH, phosphate, potassium and magnesium levels is sufficient for home gardeners. In most cases, special tests (nitrate, micronutrient and soluble salts) are unnecessary. Check with the Home and Garden Information Center to see if a special test might be useful. For information on **soil lead testing**, refer to HGIC Mimeo #18, "Lead in the Soil". This fact sheet describes some important soil nutrients and explains soil-testing terms.

Soil Texture and Structure- Soil texture is based on the percentage of sand, silt and clay particles in the soil. The largest particles are classified as sand, intermediate particles are classified as sand, intermediate particles are classified as silt, and the smallest particles as clay. Soil texture influences the amount of pore space, which in turn influences the amount of water and air in the soil. Soil texture also influences the nutrient holding capacity and the amount of lime needed to correct soil acidity. Soils with high percentage of clay have smaller pore spaces, and hold water and nutrients more tightly than sandy soils.

Soil structure refers to the way soil particles are held together in aggregates. Soil aggregation is an important characteristic of soil fertility. The greater the degree of aggregation, the greater the amount of pore space for air exchange and available water for plant roots. **Organic matter** is a vital contributor to soil aggregation. Yearly incorporation of organic matter is necessary to improve soil structure (3 cubic yards/1,000 sq. ft., or a 1 inch application, of composted leaves, grass, farm manure or other materials). Organic matter also slowly releases major and minor nutrients, and increases microbial activity in the soil.

Soil pH- Soil pH is a measure of how acidic (sour) or basic (sweet) your soil is. Soil pH directly affects nutrient availability. The pH scale ranges from 0-14 with 7 as neutral. Numbers less than 7 indicate acidity, while numbers greater than 7 are basic. Plants have different soil pH preferences. Azaleas, rhododendrons, blueberries and conifers prefer acid soils (pH 5.0-5.5). Vegetables, grasses, and most ornamentals prefer more neutral soils (pH 6-7). Soil pH values above or below these ranges may result in less vigorous growth or symptoms of nutrient deficiencies. Soil pH can be increased by the addition of lime or lowered sulfur.

Nutrients- Nutrients for healthy plant growth are divided into three categories- primary, secondary, and micronutrients. Nitrogen (N), phosphorus (P), and potassium (K) are primary nutrients that are needed in fairly large quantities. Calcium (Ca), magnesium (Mg), and sulfur (S) are secondary nutrients that are used in lesser quantities. Micronutrients are required in very low amounts and include copper (Cu), iron (Fe), boron (B), manganese (Mn), zinc (Zn), molybdenum (Mo), and chlorine (Cl). Most secondary and micronutrient deficiencies are easily corrected by adjusting the soil pH and adding organic matter. Nutrients become available to plants as electrically charged atoms or molecules called ions. Cations are positively charged (+) and anions are negatively charged (-). Ions are attached to clay and organic matter and dissolve in soil water.

Nitrogen (N)- Most soil nitrogen occurs in the unavailable organic form. Plant roots take up available nitrogen in mineral form as nitrate (NO_3^-) and ammonium (NH_4^+). Nitrogen testing is not recommended because the levels of available nitrogen are variable due to changes in temperature, soil moisture and microbial activity. The available forms of nitrogen are also very water-soluble and move rapidly through the soil profile which causes their levels to fluctuate over time. Plants use nitrogen for all aspects of growth and development. Recommendations are based on the requirements of the particular plants you are growing.

Phosphorus (P)- The most common forms of phosphorus in the soil are the phosphates, (e.g. HPO_4^- and $H_2PO_4^-$), which are expressed as (P_2O_5) on a fertilizer label. Phosphorus is not mobile in the soil, and can be relatively unavailable to plants if the soil pH is outside the optimum range for plant growth.

Phosphorus is used for root and fruit development and energy reactions.

Potassium (K)- Potassium occurs as K^+ ions in the soil and is expressed as potash (K_2O) on a fertilizer label. Like nitrogen, it is required in large quantities by growing plants. Potassium ions are more mobile than phosphates in the soil, but are not as mobile as nitrogen. Plants use potassium to increase drought and disease tolerance.

Magnesium (Mg)- Magnesium is an essential part of the green plant pigment chlorophyll. Dolomitic lime and Epsom salts (magnesium sulfate) are good sources of magnesium.

Liming Recommendation- Lime raises the pH of the soil and supplies calcium and magnesium. Liming recommendations are given, assuming 50% calcium and magnesium oxide content, as pounds of ground limestone per thousand square feet. You should not spread more than 50 lbs of ground limestone, or its equivalent in a single application on the soil surface. If the results indicate more than 50 lbs, split the ground limestone application into smaller amounts, e.g. if the amount is 85 lbs, apply the first 50 lbs now and the remaining 35 lbs roughly six months from now. Up to 70 lbs of limestone per thousand square feet can be applied in a single application if it is tilled into the soil.

Dolomitic ground limestone will raise the level of magnesium in the soil, but if these levels are satisfactory, you can use either calctic or Dolomitic ground limestone. Homeowners can choose from four types of ground limestone products: pulverized, granular, palletized and hydrated. Pulverized lime is finely ground. Granular and palletized limes are less likely to clog when spread with a fertilizer spreader over turf areas. The finer the grind of limestone the faster it will change the soil pH. Hydrated lime should be used with caution since it is caustic and can burn plants if misapplied.

Sulfur- If your soil pH is too high, sulfur can be added at the following rates per thousand square feet to lower the pH by a half a unit: apply 3 lbs of sulfur on sandy soils, 4 lbs of sulfur on loam soils, and 5 lbs of sulfur on silt or clay loam soils. Iron sulfate will cause pH to drop more quickly than elemental sulfur and should be applied according to the directions on the product label. Avoid using aluminum sulfate because aluminum becomes more available with declining pH values and may lead to plant toxicity problems.

Fertilizer Recommendations- The suggested application is the amount of fertilizer of a particular grade or analysis that will satisfy the fertilizer recommendations. **Fertilizer grades are always given as percentages of N – P_2O_5 –K_2O.** This is commonly referred to as the (N-P-K) ratio. For example, a 50 lb bag of 5-10-10 fertilizer contains 2.5 lbs. Of N, 5 lbs of P_2O_5 and 5 lbs of K_2O. The recommendation is usually given in actual number of pounds of nutrient needed per thousand square feet to satisfy any needs that may be indicated.

If you don't have a scale for weighing fertilizer, you can use the volume measures listed in **Table 1.**

Material	Weight (lb)	Volume[a] (pt)
Most mixed fertilizers (10-6-4, 10-10-20, 20-10-10 etc.) Ammonium sulfate (21-0-0), Muriate of Potash (0-0-60), Superphosphates (0-20-0. 0-45-0)	1	1
Activated sewage sludge, Processed manure, Urea-formaldehyde (38-0-0), Urea (45-0-0), Ammonium nitrate (33-0-0)	1	1.33
Sulfate of potash (0-0-50), Ground limestone, Powdered Sulfur	1	0.75

[a] ***For smaller quantities, 1 pt = 2 level cups = 32 level Tablespoons = 96 level teaspoons***

Authors: David L. Clement, Ph.D., and Jon H. Traunfeld, Regional Specialists, Home and Garden Information Center. 10/96

Reviewed by Joe F. Buriel, Supervisor, Soil Testing Labs, Agronomy Department, University of Maryland, College Park