 By Gordon Kauffman III, Ph.D.

Sample your Soil

SOIL TESTING may seem like a routine practice, but how many of you actually do it regularly? And then use the data to make management changes? Understanding the key concepts will allow you to make better educated decisions regarding fertilizer and/or soil amendment applications.

Traditional soil testing consists of a soil chemical analysis including pH, CEC, and exchangeable nutrient concentrations, likely with a fertilizer or lime recommendation, but little consideration given to nutrient solubility, organic matter and dominant cation percentages, irrigation water quality, and soil physical properties. Agriculture fertilizer recommendations are based on crop requirement, yield goals, weather and soil characteristics. Recommendations for turfgrasses are more comprehensive and based on crop requirement, quality goals, playability, establishment, species competition, disease management, weather, water quality, and soil characteristics.

Rely on the careful consideration of the most meaningful soil test data to generate the best and most practical management considerations.

Sampling

Most error associated with soil testing occurs during sampling, therefore doing it right and staying consistent is important. Pull samples (10-12) at the same depth and randomly at a given location. Sample to a desirable depth, generally where most roots inhabit the soil, and typically 4-6 inches for grasses mowed at 1-2 inches. Combine sub-samples into a single, composite, sample and send to the laboratory for analysis.

Carefully discard any thatch and place the soil in a labeled brown paper bag. Allow the samples to dry thoroughly. Pull soil cores for analysis at the appropriate time to maximize your opportunity to implement changes based on the information.

For example, test the soil if a nutrient deficiency is suspected and routinely during a growing season in order to generate baseline levels, and then to determine if management strategies implemented are working to alter/correct soil physical or chemical problems/concerns. Sampling a minimum of two times annually is usually sufficient.

Laboratories often use different methodologies (extraction agents) for the same test or perform a different variety of tests to generate data. This data could subsequently be interpreted differently; therefore stay consistent with a laboratory once you have identified the best format and/or services provided.

Testing soil physical properties will provide information pertaining to soil drainage, aeration, and/or compaction. A rootzone particle size analysis, infiltration rate, total porosity, and capillary pore space determination will be useful to assess drainage capabilities

Tests such as saturated hydraulic conductivity and bulk density provide an indication of the level of compaction. Labs can also test to determine the moisture content where the soil becomes prone to compaction. A complete analysis of soil physical properties will be helpful for evaluating the potential use and/or effects of added soil amendments such as organic matter, zeolite, calcined clays, or diatomaceous earth.

Interpretation

Soil testing laboratories can interpret chemical soil test reports differently because they often use different data to generate the interpretative feedback. *Correlative*data compares laboratory recommendations (known fertilizer applied) with actual plant uptake. *Calibration* data focuses on the relationship between known soil test values and plant response after fertilizer application, providing an indication of how much fertilizer is needed to meet plant demands. Calibration data is more meaningful in ag where increased growth typically leads to improved yields.

Turfgrass responses are different and often more complex. Calibration data on different soils types and using quantifiable turfgrass (species and cultivar) responses remains limited. As a result, caution must be taken when interpreting soil test data from too many laboratories or from too few tests.

For example, laboratories may report two primary types of data to indicate fertilizer requirements. One involves the percentages of basic cations [calcium (Ca), magnesium (Mg), and potassium (K)] that occupy exchange sites, called the base cation saturation ratio (BCSR). This interpretation reflects the notion that basic cations (target Ca ~ 65-75%, Mg~10-15%, and K~2-5% as a percentage of total CEC) dominate soil exchange sites and therefore dictate the extent to which other nutrients,

including hydrogen ions (H^+ and therefore pH), occupy exchange sites and ultimately find their way *into solution*. Another approach is to determine the amount of nutrients to sufficiently meet plant needs now, called the sufficiency level of available nutrients (SLAN). This interpretation uses established sufficiency levels (based on calibration data) for all nutrients other than N and if soil test reports show they are low, a positive plant response from fertilizer added can be expected. In either case, an integrated approach works best where many factors are taken into consideration and used as rough guidelines but in combination with your direct observation and data from soil physical tests.

Soil tests reports will provide data used to make additional fertilizer applications including the remaining primary macro nutrients phosphorus (P) and potassium (K), secondary macronutrients Ca, Mg, sulfur (S), and micronutrients. The most efficient method to supply adequate nutrients for optimum growth and performance is through foliar feeding.

Manage soil pH and CEC using the correct fertilizer, soil amendment, and/or correcting irrigation water problems. Apply lime ($CaCO_3$) as necessary to increase pH, gypsum ($CaSO_4$) to supply Ca without changing the pH, and acidifying fertilizers such as ammonium sulfate, or those that contain elemental sulfur. Increase CEC by adding organic matter (i.e. humus, peat, or compost) or zeolite clinoptilolite, which can be tilled to a 4-6 inch depth before establishment or incorporated as topdressing during aerification until the desired CEC is reached. ■

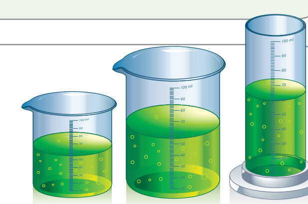
Dr. Gordon Kauffman III lives in State College, PA, coordinating university research for Grigg Brothers. He can be reached at gordon@griggbros.com.

Best Management Practices

Best fertility management includes the use of soil tests, an understanding of the nutrient requirements for each turf species, careful observation, and balancing aesthetics v. function. Proper interpretation of soil tests will allow you manage both components and develop the best fertility programs. Meticulous recording keeping of soil test reports, fertilizer applications (rates, formulation, dates), and turfgrass responses are essential to developing a strong and consistent fertility program.

When observing turf responses look for turf color, growth, quality, recuperative capacity, establishment speed and consistency, wear tolerance, playability and responsiveness to fertilizers. Use soil tests to uncover underlying poor turf performance or overt and negative turfgrass conditions like nutrient deficiencies. Soil chemistry and microbiology are complicated; therefore keep it simple use soil tests as a rough guideline with strong consideration to basic agronomic principles, including subsurface and surface drainage, promoting the correct ratios of air, soil, and water, adequate fertility, and thatch management using frequent mechanical cultivation. ■

Common lab tests for sports turf



Lab equipment illustration courtesy of istockphoto.com

Exchangeable nutrient data/Nutrient sufficiency levels. Represents the amount of each nutrient present in the soil and the extent to which plant requirement are met (sufficiency) for optimum growth (lb/A). Usually expresses as low/optimum/high.

Extractable Nutrient Data (i.e., soluble paste extract). Represents the nutrients that are easily extracted from the soil and therefore the best indication of plant availability (ppm).

Cation Exchange Capacity (CEC). Represents nutrient holding capacity (target 4 cmol/kg soil).

pH. Soil reaction affecting most notably nutrient availability and microbial activity

Organic Matter (OM) Percentage. Indicates degree of organic matter accumulation which can affect drainage, soil reaction, and presence/extent of localized dry spots (target ≤ 4%)

Soluble Salts/Sodium. Represents the level of salinity and sodium in the soil. High levels of salinity (various salts) will impact the soil reaction, infiltration in the top two (2) inches, and plant water relations. High sodium (≥ 3% of total CEC or sodium adsorption ratio > 2) will negatively impact soil structure and permeability. Salinity or sodium problems usually arise due to poor irrigation water quality or lack of rainfall, particularly in arid or semi-arid regions.

Irrigation Water Quality. In general it is good idea to test the irrigation water to determine if problems exist. Potential problems including high bicarbonates (HCO_3^-), or high Na^+ and Cl^- concentrations compared to calcium (Ca^{2+}) and magnesium (Mg^{2+}). ■