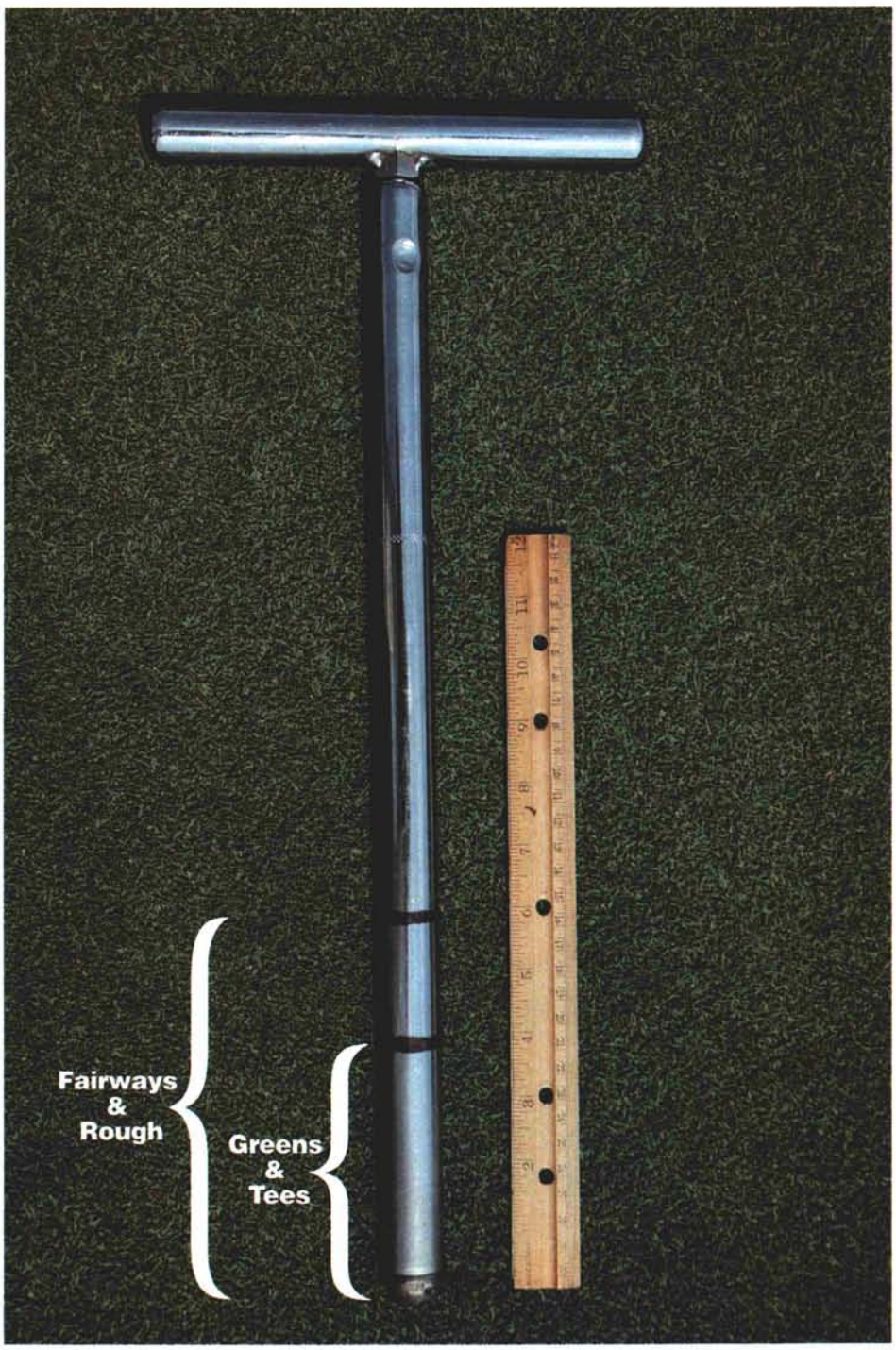
SAMPLING FOR RESULTS — The Methods Are Important

by KEITH A. HAPP
Agronomist, Mid-Atlantic Region, USGA Green Section

A PLANT requires a proper balance of water, oxygen and nutrients from the soil as well as a good growing environment to survive. Golf course superintendents' training in the basics of turfgrass, soils, physiology and pathology equip them to detect many of the problems that may cause imbalances and resultant turf loss. However, additional diagnostic tools are often employed to detect hard-to-solve turf problems.

In pursuit of healthy turf, cultural programs must first lay a strong foundation to maximize the benefits of any fine-tuning technique. One of the most basic agronomic programs is proper fertility. Balanced nutrition, for example, allows growth regulators to be much more efficacious. We know that a hungry, stressed turf is more susceptible to disease or pest problems (e.g., nematodes). Undernourished turf can succumb rapidly to pest pressures. An important component of designing and managing a fertility regime that helps meet the needs of the turf is to test and monitor the nutrient base (growing medium). Many superintendents submit soil samples for chemical and physical analysis regularly.

At times, problems can develop due to the dynamic nature of turfgrass management and changing weather patterns, even with a sound agronomic program in place. When they do, diagnostic clinics are often used to detect and identify plant pathogens and/or parasitic nematodes. When employing the services of a testing laboratory, sampling techniques are one of the keys to obtaining valid results. The purpose of this article is to provide practical guidelines for common agronomic field sampling practices. Procedures for four types of tests will be outlined: 1) physical soil analysis, 2) chemical soil



When evaluating soil test results from year to year, consistent sampling depth is a key factor in obtaining valid results.

analysis, 3) disease diagnosis, and 4) nematode assays.

The results received from a lab for disease diagnosis, chemical or physical soil analysis, or nematode assays can be no better than the samples that are sent to the laboratory. Testing laboratories pride themselves on the precision and repetition of the methods and procedures employed. This same precision needs to be utilized in the field when collecting samples and submitting them for testing. Formal sampling procedures must be established to gain accurate, reliable, and valid information from laboratory testing services.

General Guidelines

First and foremost, establish a formalized sampling procedure at your course so that the individual who collects the samples has clear guidelines to follow. The employee selected to pull soil samples may change from year to year, but the procedures followed in doing so should not. A written set of procedures will help to produce reliable results.

Knowledge of how samples were collected in the past is very important so that new information can be interpreted and reliably compared to trends of the past. Altering the sampling technique can significantly affect the results. In effect, without a formalized written sampling program, a new turf manager is starting fresh when it comes to the chemical analysis of the soil.

One of the first criteria to establish is the sampling depth. Sampling depth is very important and will vary with the testing discipline employed. Also, the height of cut of the turf helps determine the sampling depth. For example, longer turf often has deeper roots, and root depth influences the size of the available nutrient reservoir. Accurately meeting the needs of the turf depends on accurately sampling to the depth where roots are actively growing.

After the samples are collected, they should be clearly identified and packaged. Loosely packed samples can shift in transport and become contaminated. If a few samples are to be sent, pack the voids within the box used for shipment. Use packing materials (newspaper or styrofoam) to hold the sample bags or plugs in place.

Write down as much information about the sample as possible. Do not place the written information within the sample bag; it can become wet and is then of little use. Wrap the written information in plastic and insert it in a cardboard tube. Then label the tube.

When the samples are assembled, they should be mailed to the lab the same day. If this is not possible, the samples should be stored in a freezer to help keep them from deteriorating. If at all possible, prompt shipment should remain a high priority.

The following are a few additional specific guidelines.

Soil Testing: Chemical Analysis

Many soil testing laboratories perform both chemical and physical analyses. Chemical soil analysis is a basic component of a good turf management program. It involves extracting essential elements from the soil and correlating these levels with the nutritional needs of the turfgrass plant. Specific nutrient deficiencies can be detected and, if necessary, an appropriate corrective strategy developed and implemented.

The most common laboratory testing procedure performed in golf course maintenance is chemical soil analysis. To ensure reliable results, there are several sampling procedures that should be followed. Some details to include in a formalized program are:

- Determine whether or not to include the thatch with the sample. Some labs indicate that this material should be included, but most suggest discarding the thatch. At the lab, the samples are dried prior to analysis. The oven used to prepare the samples eliminates the green vegetation and thatch. For sampling purposes, consistency is the key. If the thatch is included in the first sample, then all of the samples should be extracted in a similar manner.
- Establish a sampling pattern. Soil samples should be indicative of the entire area. Using a soil probe, take several cores from the area. Using a cup cutter and sending in one large core or sending a collection of aerification plugs is *not* good sampling technique. Also, wet soils are difficult to handle and transport. When sampling, avoid wet areas.
- For greens, a 4-inch sample depth is most often recommended. In areas where the turf is maintained at a higher height of cut (fairways and rough), a 6-inch sampling depth is best. Placing a piece of tape on the soil probe allows for uniform sampling.
- Determine the size of the sample to send. Ten to 12 4-inch plugs, using a ¾-inch soil probe, from greens and tees will supply the proper volume of soil for analysis. This

should provide enough soil in case additional tests are needed at a later date. Most labs keep a soil sample on file for a period of time. Collect the same number of sample cores for fairways and rough areas.

• Use only waterproof soil sampling bags. These bags can be supplied by the soil testing facility.

• It is best to sample greens and tees separately. Mixing several green site samples with tee site samples to create a single sample does not provide valid information.

• Representative sampling from fairway areas (two to three adjoining holes) is a common practice. For fairways, topography is the key. Rolling terrain indicates more sampling sites are needed, and each area tested should be mapped for future reference. If the sample is lost or damaged for any reason, a second sample can be obtained.

• If representative testing is used, the same greens, tees and fairway areas should be sampled each year.

Consistency is the only way to monitor trends.

Soil Testing: Physical Analysis

Physical soil analysis pertains to the size and the distribution of the soil particles within a given profile. The short- and long-term physical characteristics (e.g., bulk density, porosity, stability, infiltration rates) of a soil are determined by physical analysis. This test is commonly performed on putting green soils. For example, knowing the physical makeup of the soil in an existing putting green is important when selecting a topdressing material. Applying the wrong topdressing material can cause significant problems, and physical soil analysis should be conducted to help determine the proper topdressing formulation.

Physical analysis is especially important for new construction, to ensure the best possible results. The USGA method of putting green construction was developed and refined to help establish the proper blend of materials to support optimal turf growth and provide consistently good quality playing conditions. Physical soil analysis is an essential ingredient in building a USGA green.

The best way to examine the physical properties of an existing soil is by submitting an undisturbed soil core for testing. An undisturbed sample provides more valid information than soil that has been dug up and submitted in a loose state. The sample can indicate problems due to low infiltration rates or the effects of soil layers, and corrective action can sometimes be recommended after this analysis.

A preferred sampling method for submitting an undisturbed soil profile sample from a green is by using a 2-inch-diameter PVC pipe.

• First, cut the pipe into two-foot pieces. Then one edge of each sample pipe should be beveled, allowing the pipe to move more easily through the soil when it is driven into the green.

• Next, drill two holes, opposite each other, at the non-beveled end of the pipe. A metal rod can be inserted through the holes to help remove the pipe from the sample area.

• When the pipe is inserted into the green, pound it deep enough to include, if present, the intermediate layer and drainage gravel. If these materials are not present, obtaining a 12-inch sample is sufficient. Laboratories will run particle analysis on portions of the profile, if requested. Most problems exist in the upper 3 inches of the soil profile. Significant differences in the physical characteristics within the soil profile can be detected only when an undisturbed sample is submitted.

• When the pipe is removed from the test site, any space at either end of the pipe should be packed with paper to prevent soil shifting. Next, cover each end with newspaper and then securely tape both ends.

• Along with the sample from the green, send a sample of the current topdressing mix, which can be tested to determine if it is compatible with the growing medium.

• If the topdressing is stockpiled on site, use a long piece of 1- or 2-inch PVC pipe and push it deeply into the center of the pile. This sample will provide a more accurate representation of the particle size distribution of the topdressing material.

The best way to examine a soil's physical properties is by submitting an undisturbed soil core. To aid in sampling, a metal rod can be inserted through the end of the PVC sampling tube to help remove the pipe from the soil. Clearly identify each sample with as much information as possible. Securely tape the ends of each sample tube to prevent soil shifting.

Sampling to Diagnose Disease

A pest is defined as an undesirable organism. Pests can take the form of diseases, plants or insects. Some diseases are easily identified, as are some insect and weed problems. Mycelium or fruiting bodies provide clear indications of disease identification and direction as to which control strategy should be implemented. On the other hand, some pests do not provide clear visual signs or symptoms to allow proper diagnosis. This is especially true when trying to identify soil-borne pathogens and parasitic nematodes. When dealing with such problems, definitive diagnosis requires the help of a diagnostic clinic and a plant pathologist. The information gained, combined with site observations, helps to formulate a plan of attack. Again, good sampling techniques are important to help ensure accurate identification. Here are some guidelines to follow:

• Send samples that are representative of the problem area. Collect several samples that show a continuum of symptoms. Sample to a 3- to 4-inch depth to include the roots.

• In this case, a cup cutter or 8-inch plug cutter works well to sample damaged areas. Select a sample site along the outside perimeter of the damaged area. Both damaged and healthy turf should be included. If the sample is dry, lightly moisten the soil. Wrap the entire sample in newspaper or aluminum foil and place it in a box with packing material to allow the sample to arrive at the lab intact.

• The sample should be fresh. To facilitate accurate disease diagnosis, it is critical to package and ship the sample promptly.

Sample decay can occur rapidly. If necessary, refrigeration can be used, but if possible, send the sample right away. Second-day air mail works very well. Also, mail the sample in the early part of the week to avoid having it sit in the post office or lab over a weekend.

• If several different problems are present, package the samples separately.

• The written information should include: type of grass, age of turf stand, date symptoms first appeared, pattern of damage in turf stand (if there is one), a description of the visual symptoms, prevalence in grass stand and severity of symptoms, and a picture of the sample site (if possible). Other written information should focus on the location (e.g., in shade, low spot, high spot, wet spot, etc.), soil conditions, weather conditions prior to symptoms and weather conditions when symptoms occurred, cultural practices (aeration, verticutting, grooming, spiking, etc.) carried out in the area prior to symptoms, and any chemical treatments that have been made to the area (fertilization, pesticides) within a month's time.

Nematode Assays

Another important laboratory diagnostic tool is the nematode assay. When diagnosing nematode problems in turf, the above-ground symptoms are of little value. An assay supplies information via a systematic extraction process. Identification and a total count of each species is then performed to determine if control measures are necessary. Nematicides are some of the most toxic materials used in turfgrass management. The application of these materials hinges upon accurate and valid information gained from a testing laboratory. The basis for the results, once again, lies with the field sampling techniques.

Not all nematodes are plant parasites. Some are beneficial soil organisms and are necessary to maintain a good microbial balance within the soil. When nematicides are applied, the "good guys" are not spared. The only way to determine if turf damage is directly attributable to parasitic nematodes and if treatment is warranted is to have a laboratory perform a nematode assay. Field sampling in this case is critically important. To better insure accurate results, consider the following:

• Use a ¾- to 1-inch soil probe and sample to a depth of 4 inches. When sampling for nematodes, remove the green vegetation. Assays provide only an estimate of the actual nematode populations. Nematodes are almost always unequally distributed in the soil, both vertically and horizontally. Samples from different areas on the same green will yield different results. Nematodes will tend to clump in a horizontal plane. This further emphasizes the importance of the sampling depth. For example, a 2-inch sample may show twice the concentration of parasitic nematodes as compared to a 4-inch sample.

• If damage is suspected, 15 to 20 samples should be collected. All the samples from the affected area should then be bulked (mixed together).

• If the intent is to monitor populations from year to year or between different locations, then an area no larger than 500 square feet should be used. When monitoring a site, 20 cores is adequate.

• The soil sample (at least 2 cups) should be placed in a plastic bag to prevent drying.

• If the tests are performed to monitor nematode activity, a specific time frame for sampling should be established. Nematode populations decline in the winter. As soil temperatures increase in the spring, nematodes begin to feed and the populations increase. Reproduction can occur rapidly during the summer. However, the samples should not be collected during high temperature extremes. Due to fluctuations in the nematode population, a single sample may be misleading. Follow-up samples should be taken every three weeks to gain more accurate information. This will help to monitor populations and determine if they are at dangerous thresholds.

• The written information should include: depth of sample, grass composition, estimated depth of root system, soil texture, symptoms and extent of damage, other stresses present, and any treatments that have been applied.

When submitting turf samples for disease diagnosis, the samples should include a continuum of symptoms from the area, from healthy to infected turf.

Conclusion

In these times of environmental awareness, using all of the available tools to diagnose and then accurately select a control method is very important. A recent GCSAA survey of golf course superintendents found that 90% of respondents are using or plan to use an Integrated Pest Management (IPM) program. Proper sampling techniques are a part of Integrated Pest Management and help to identify only those areas of the course where treatment is needed.

Laboratory testing can provide valuable information upon which many turf management practices are based. Consistent sampling leads to reliable results. To receive the most valid information from the laboratory, formalize your sampling techniques in the field. Ask yourself if you are "sampling for results."