sportsTURF
http://www.sportsturfonline.com

Tools for Sand-Based Rootzone Management

By Michael DePew

A common scenario for sand-based rootzone construction is installation, followed by turf establishment, quickly followed by the commencement of play. Once play begins, you likely concentrate efforts on trying to maintain a satisfactory turf cover that provides good playability and aesthetics. You can be quite successful for the first three to five years if the initial installation was reasonably well designed and constructed. However, it is after this "honeymoon period" that things often really begin to change.

By monitoring and recording rootzone conditions over time, you can begin to note trends in rootzone conditions and subsequent effects on turf growth and performance. When problems do arise, you are armed with information that can be very valuable if the decision is made to contract with an agronomist or soil scientist. To monitor rootzone conditions, there are a few tools that you can have on hand to assist you.

Initial Tools

The first tool in your arsenal is a good soil *core sampler*. The coring device of choice is a simple golf course putting-green cup cutter, because it takes a large core six to eight inches deep. Not only do you have a core if needed, but you also have a hole in the soil that is large enough to make direct observations of the soil profile. The large core is more versatile for evaluating short-order spatial variability across the four-inch diameter of the core.

Next, you'll need a *box* — such as an army ammo box, old briefcase, tool box or a cheap tackle box — that can be used to organize, store and transport other soil test items.

These start with a set of Munsell Soil Color Charts. The *color charts* are organized to provide a fairly comprehensive coverage of colors common to rootzones. Make sure your set includes the gleyed color charts. (One source for the charts is Macbeth Division, Kollmorgen Instruments Corp., 405 Little Britain Rd., New Windsor, NY 12553; phone: 1-800-MACBETH.)

Use the charts to note the color of the rootzone at construction and the changes over time. This includes changes in color with depth or in zones within the rootzone profile and of any nodules or mottles. Color characterizations should be noted at least down to six inches and preferably the entire depth of the constructed rootzone. Color determinations are done by matching the soil to the chart color that most closely matches.

Take care to make observations of color under similar light conditions each time. Generally speaking, avoid artificial light and especially florescent lighting. Mid morning on a bright, clear day works well. Whatever the lighting, the conditions should be as near the same as possible. If not, the light source or intensity differences should be noted and recorded along with the color determinations.

Soil moisture influences soil color, and in many soils, differences between dry and moist colors can be quite dramatic. If possible, report the colors of the soil both in a moist and in a dry state. If only one color is noted, it should be the moist color. Water from a *spray bottle* is often used to bring soil to near-saturation for moist-soil-color determinations.

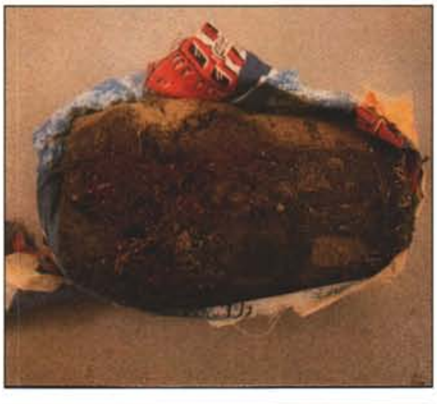
A good tool kit will also contain a *ruler* and/or tape measure. Use a ruler to note such things as depth of rooting or thickness and depth of any layering effects, or size and location of any distinct features in the rootzone. Notations of these thickness and depth conditions over time can be a valuable diagnostic tool for a turf manager or an agronomist. Use the metric scale for these determinations — not only is it the one familiar to agronomic professionals, but the resolution of scale is much finer within the metric system.

Chemicals

A few simple chemicals can go a long way in providing valuable information for turf management decisions. One of these is *hydrochloric acid* (HCl), commonly known as muriatic acid. When mixed to about 10 percent solution (~1.2 M), it is relatively safe to use. Muriatic acid is available at most hardware and home improvement stores, generally in the section containing concrete cleaners.

One of the most valuable uses of HCl is in determining carbonates. Carbonates may abound in many rootzone systems, and in course-textured soils such as sands, small amounts of carbonates can cause big headaches. It is a common misconception that carbonates are found only in the more arid parts of the world. While it is true that carbonates do occur more commonly in arid regions, they can also be found in rootzones in other regions, even in areas that have predominately acid soils.

If the hydrochloric acid is used at a consistently mixed concentration (10 percent), the rate and duration of reactivity of acid with the soil can be a diagnostic consideration. The test is normally completed by placing a drop or two of acid on the soil where a reading is desired. If testing the entire profile, start at the bottom and work up, gently spraying a small stream onto the profile. This may also be done on an excavated soil core placed in a hori-



This soil core has been treated with a dipyridyl indicator solution. The red staining on the core indicates the presence of reduced iron.

A field soil tool kit includes a cup cutter and a box large enough to hold a camera, color charts, thermometer, spray bottle, chemicals and other items. Photos courtesy: Michael DePew.

zontal position.

Acid (HCl) reactivity (aka "effervescence") descriptions for soils generally include four classes:

•Very slightly effervescent — few bubbles seen.

•Slightly effervescent — bubbles readily seen.

•Strongly effervescent — bubbles form low foam.

•Violently effervescent — thick foam forms quickly.

Sand rootzones "slightly effervescent" or stronger have a higher potential for rootzone problems.

Some soil scientists also use the term "moderate effervescent" to denote an intermediate phase between slightly and strongly effervescent. Which class you place your soil in is not nearly as important as consistency of evaluation when taking readings over time. If you adjust how you place a soil into one of the classes, the date of that change should be noted so that old readings and their interpretations can be distinguished from the new.

Hydrochloric acid is also useful as an indicator of amorphous iron sulfide. Amorphous iron sulfide, when present in sufficient quantities, is the mineral form of soil black layer. However, its formation does not always indicate a strong black color until it is extensive and well formed in the rootzone. The formation of black layer occurs in soils under anaerobic conditions of reduced chemical potential. This is known as "low redox potential."

While redox potential can be measured with an instrument similar to a pH meter, HCl can be used as a simple qualitative tool for determining reduced conditions in which amorphous iron sulfides are forming. Detecting the production of amorphous iron sulfides may help you make management decisions that will prevent the formation of black layer.

The HCl test for amorphous iron sulfides is simple. First, smell the sample before treating to get a background smell. It may already smell somewhat or strongly like hydrogen sulphide gas (rotten egg smell). Next, as in testing for carbonates, place a few drops of acid on the soil or rootzone portion in question.

The acid will chemically oxidize the

iron sulfides that may be present and in the process will release hydrogen sulphide gas. After placing the acid, draw your hand gently over the sample pulling air from the sample toward your nose. If iron sulfides are present, the rotten-egg odor should be very strong and distinct (like the geysers and hot springs in Yellowstone Park). As the acid reacts, also note any change in color of the soil. As the acid oxidizes the iron sulfides, the soil should lighten.

Another qualitative chemical test for anaerobic reduced soil conditions involves a *dipyridyl indicator solution*. When applied to the soil, it will indicate the presence of reduced iron. This test is more sensitive than the acid test for indication of reduced iron because iron sulfides do not have to be formed in order for reduced conditions to be indicated.

An awareness of high reduced iron forms in the soil before significant amounts of iron sulphide production occurs can be a much earlier warning signal for reduced conditions than HCl alone. (However, note that the lack of reduced iron in a rootzone is not always an indicator of reduced conditions. The reason is that reduced iron is soluble in the soil solution and may have moved out of the rootzone or portions of the rootzone with drainage water.)

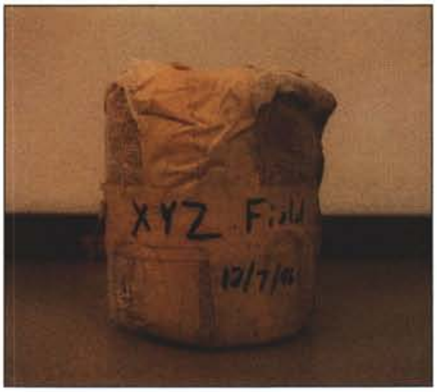
As useful as the dipyridyl indicator solution is, it cannot be readily obtained over the counter at a store. It is a specialty chemical and must be purchased through a chemical supplier along with a few other chemicals. That is not, however, difficult to do, and by using a little simple chemistry, it can be easily mixed up in the shop. (One source for chemicals is Aldrich Chemical Co., P.O. Box 355, Milwaukee, WI 53201; phone: 414-273-3850.)

The recipe is as follows as taken from C.W. Childs' 1981 article "Field Test for Ferrous Iron and Ferric-Organic Complexes" (*Australian Journal of Soil Resources*, 19:175-180):

(1) Add 5 mL acetic acid to 400 mL of deionized or distilled water.

(2) To the above (2.5 percent acetic acid) solution, add 1 g of alpha,alpha — dipyridyl.

(3) Add 77 g of ammonium acetate and mix to clear (using hot deionized or distilled water for the mixing solu-



This core is wrapped, labeled and ready for transport.

tion to start with will aid in ensuring that the ammonium acetate dissolves completely and goes into solution).

The mixed solution should be marked, dated and stored in dark bottles at about 35-40 degrees F. As with any chemicals, exercise caution when handling and follow any label precautions or warning on the MSDS, material safety data sheet.

When using the dipyridyl solution, you can obtain false readings on soil that has been in contact with ferrous iron. So, it's imperative the exposed soil face has not been in contact with iron of any kind. If you use an iron coring device, shovel or knife to remove a soil sample, a clean exposed surface must be prepared using a wood or plastic implement before applying the dipyridyl solution.

More Tools

The soil kit should also include a *means of measuring soil pH.* This can be done either colorimetrically with indicators and a correlated color chart or with an inexpensive pH meter.

A *thermometer* is also a good diagnostic tool as many soil processes are temperature dependent. Many types of thermometers are adequate if they include the appropriate temperature range for soils in your area.

A few other items to include in your kit include simple tools such as a cheap hunting-type *knife*, a small hand *shovel*, an assortment of zip-lock *bags*, permanent *marker* and a *notebook*. And, of course, one of the most valuable tools is a *camera*, which should be considered indispensable. A strong record keeping system backed up by photographic documentation is a very useful, powerful tool in diagnostic evaluations.

Often it is desirable to collect and preserve an entire soil core for further examination or shipping for laboratory analysis. In these instances, cheese *cloth* or an old bed sheet works well. Simply roll enough material out (double or triple layered if using cheese cloth) to wrap the core with. Next, as gently as possible, push the core out of the cup cutter onto the cloth. Then gently wrap the cloth around the core and tape it in strategic locations (two-inch-wide masking tape works well). Once secured in this fashion, the cores are fairly stable and can be handled or shipped without excessive packing or padding. Just make sure you mark the cores with a permanent marker on the tape after sampling.

Spatial Variability

As a final note, I should mention something about spatial variability across the playing surface — that is, changes in soil characteristics with distance and depth (space). Spatial variability is quite high in natural soil systems for a large variety of soil characteristics. Likewise, spatial variability is also high in human-made soil systems.

To measure this requires a knowledge of differences across the playing field. These differences include differential data output from such areas as soccer goal mouths, center field, sidelines or other areas that receive concentrated traffic. Variability can also include areas of microtopography differences, differential sprinkler distribution and so forth. Spatial variability may also occur without any readily apparent reasons.

This variability, however, is not necessarily undesirable as it may be telling you something that you are not aware of. Variability then can be your friend, especially when you learn how to interpret its significance and the story it is telling you.

It will be up to the individual turf manager to determine how many different areas he or she will have to evaluate separately and how many replications within each area. The important thing is that you monitor soil conditions, keep accurate records, make frequent observations and ask lots of questions. ❑

Michael W. DePew is an agronomist for ProTurf Environmental and Sports Turf Services, L.C., P.O. Box 1695, Provo, UT 84603.