SOME ROOM TO BREATHE: aerification is key to plant health

▲ **(Photo 3) Core-aerification** of an athletic field.

I like to think of the turfgrass plants growing on an athletic field as a crop, not unlike the potatoes that my father raised when I was a kid in southern Idaho. And just like the potatoes, the turfgrass plants need certain inputs and environmental conditions to maximize their performance.

It has long been my opinion that the long-term potential of a playing surface, and that of the turfgrass growing on it, is directly tied to the characteristics of the soil used to construct the field. I'm not talking about the simple soil test that you might submit annually to get an idea of where you stand with regards to the status of soil pH, organic matter content, and nutrient levels. The soil characteristics you need to pay particular attention to on your fields are the soil texture, bulk density, and the effective rootzone depth. While some of these are easier to manage than others, all of them either directly or indirectly impact plant growth and the resulting quality and durability of the sports field.

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Healthy turfgrass plants have actively growing rootzones that explore a large volume of the soil profile. There are a number of things that can reduce the rooting depth of turfgrass plants. For example, maintaining a turfgrass plant at a height of cut that is below its adapted range will result in reduced rooting depth as will the development of compacted layers within the soil profile. Any reduction in rooting depth will decrease the water and nutrient uptake of the plants, which ultimately has a negative impact on plant growth. Given the intense use of most athletic fields, this is obviously a situation we want to avoid.

There has been a significant amount work done to determine the ideal range of soil textures for use on athletic fields with recommendations often varying slightly depending on geographic location and intended use. I'm not going to get into that here. Chances are that you do not have the luxury of choosing the soil texture of the fields you are managing unless you are lucky enough to be involved in a new construction project or a significant renovation. That being said, I still feel it is important that you have a good understanding of where your fields stand with regard to soil texture. In most cases it will not be necessary to submit samples for textural analysis. However, it would be good to pull some soil cores to depth of 10 to 12 inches from a few random locations in each field to get a better idea of what you are dealing with, particularly if your field was constructed using native materials.

Pay particular attention to the consistency of soil texture from top to bottom of each core and from one location to the next. While you will expect some variability from one location to the next, particularly with a native soil field, you want to see a consistent soil texture throughout the depth of the soil cores (**photo 1.**). Note any changes in soil texture as they can lead to problems with water infiltration and root growth.

Abrupt changes in soil texture in the soil profile, often referred to as layering, can impede water movement through the profile leading to the surface staying wet longer after rainfall and irrigation events (**photo 2**). If the soil surface is at or near saturation while being used, the field will wear out more quickly. To make matters worse, the water in a soil at or near saturation acts as a lubricant for the soil particles allowing them to slip past each other more easily leading to increased compaction (bulk density) of the soil.

As bulk density in the soil increases it becomes more difficult for plant roots to penetrate the soil leading to a reduction in water and nutrient uptake. In extreme cases, soil compaction can result in surface hardness (Gmax) levels that increase the risk of impact injuries to athletes using the field. For example, the Clegg Impact Tester is used to monitor surface hardness on all NFL fields. The NFL has established a maximum threshold value of 100 Gmax for all natural and synthetic fields.

Given the intense use that most athletic fields receive, effective management of soil compaction on athletic fields is just as important as a well-developed fertility program.

Once you have a good understanding of the soil conditions you are dealing with on your fields you can begin to develop an aerification program to address any problems that exist. In general, aerification practices should be conducted on actively growing stands of turfgrass. For cool-season areas you can begin a heavy core aerification program in the spring before the first fertilization followed by light coring/pencil tining during the summer months when the grasses are under more stress and more aggressive aerification again in the fall.

Aerification of warm-season grasses should not begin until late spring or early summer once the grasses are growing vigorously. In both cases, high traffic areas should be cultivated 6-8 times a year at a minimum to maximize plant health.

▲ **Left: (Photo 1) A soil core** removed from an athletic field built with a sand-based rootzone. Note the consistent texture throughout the depth of the core, lack of any compacted layers and minimal organic matter accumulation at the surface.

Right: (Photo 2) A soil core removed from an athletic field depicting the layering of different soil types. At the bottom of the core there is a fine-textured soil that is high in clay, above that there is a 4-inch layer of sand that has been topped with an additional 3 inches of fine-textured topsoil.

There are a number of different types of equipment available that can be incorporated into an aerification program and depending on your specific circumstances you might find that you need to use more than one on a regular basis.

▲ **(Photo 5) Slicer** mounted to the front of a utility vehicle.

CORE AERIFICATION

This is arguably one of the most well-known and least appreciated approaches to maintaining high quality playing fields. Core aerification removes cores of soil from the profile to a depth of 4-6 inches using hollow-tines (**photo 3, on page 8**). There are two primary types of core-aerification: drum type and cam driven. Both come in various sizes ranging from small walk-behind units to self-propelled rider-operated units and larger tractor mounted units that attach to the three-point hitch. Drum-type aerators are less expensive and require less maintenance when compared to the cam-driven unites. However, the cam-driven units have an advantage in that they cause minimal surface disruption while achieving deeper tine penetration. The cam-driven units are also capable of much closer spacing of the holes which allows for more aggressive management of compacted soils (**photo 4**). Tine diameters for core aerators range from ¼ to ¾ inch in diameter. Larger tines will remove more soil and will have the largest impact on alleviating compaction. It is important to note that using large diameter tines on athletic fields, particularly at close spacing, is not recommended during times of active use due to the risk of reduced footing stability for the athletes.

▲ **(Photo 4) Surface view** of field following core-aerification. Note the holes where soil cores have been brought to the surface to alleviate soil compaction.

SOLID-TINE CULTIVATION

Also known as pencil-tining, solid-tine cultivation is an important management tool for use during the playing season in lieu of core aerification. Using the same c am-driven equipment that is used for core-aerification, solid-tine cultivation involves the use of small diameter (1/4-inch) tines set to penetrate the soil in a very closely-spaced pattern. By using solid tines on your high-traffic areas during the season you can improve root health by temporarily reliving compaction while causing minimal disruption to the surface. Solid-tine aerification is not a replacement for core aerification in your overall management program.

DEEP-TINE CULTIVATION

This approach to compaction management uses large diameter tines (3/4-inch) that penetrate the soil to a depth of 8-1 inches. Many manufacturers design their deep-tine cultivators in such a way that they cause fracturing (shattering) of compacted layers in the soil profile upon entry/exit of the tines. This is a great tool to use two or three times a year on fields receiving extensive use.

SLICING/SPIKING

This process involves the use of narrow elongated blades mounted to a drum and rolled across the surface of the field (**photo 5**). This causes minimal damage to the surface, stimulates plant growth and improves gas exchange with the rootzone. While this will not improve soil compaction it is a very important tool for improving plant health and should be used as often as possible.

DEEP DRILLING/DRILL-AND-FILL

Deep drill and drill-and-fill machines use a series of drill bits arranged in a grid to penetrate the soil to a depth of 10-12 inches. In many cases, this equipment allows turf managers to penetrate compacted layers that might exist deeper in the profile to improve subsurface drainage. Drill-and-fill machines have the added benefit of allowing turfgrass managers the option of filling the holes back with a soil amendment of their choice. In poorly drained soils and soils that with abrupt changes in soil texture within the profile it is common to fill the holes back with a coarse sand to improve infiltration rates. The primary disadvantage of these systems, if it is to be considered one, is that they are very slow taking 12 or more hours to cover an acre.

HIGH PRESSURE WATER INJECTION

These systems use high-pressure water that is directed through small-diameter nozzles in short bursts as the unit travels across the field. These short bursts of water can penetrate the soil to a depth of 6-8 inches depending on soil conditions. In at least one case, the equipment is designed to facilitate back-filling the holes with sand or other soil amendments. The primary benefit of high-pressure water injection systems is that they cause (almost) no visible damage to the playing surface and can be used all season long while the fields are active.

Regardless of which piece of equipment you plan to use, it is a good idea to make sure that the field is not too wet or dry before implementing your cultivation practices. Irrigate the field 12 to 24 hours before you plan to begin your work to ensure adequate soil moisture for proper penetration by the cultivation equipment while minimizing the risk of additional compaction developing as a result of your efforts.

No one piece of equipment will address each and every soil management issue that you might come across while managing your fields. It is my opinion that at a bare minimum, you should have ready access to a slicer and cam-driven core-aerator complete with sets of both hollow core and solid tines to use regularly for managing soil compaction on your fields. ■

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