Soil Management

Poorly drained soils with high bulk density and predominance of fine particles that restrict soil gas exchange reduce microbial activity. These dense, cool soils also restrict rooting to the surface, which further exacerbates the surface organic matter problem. Maintaining a permeable soil surface sustains adequate microbial activity, good deep root development, and proper infiltration. Taken together, these practices lead to a turf surface less likely to create runoff and more able to retain chemicals applied to turf top prevent leaching.

Understanding soil physical properties and amending the soil to minimize the potential for compaction is the key to proper soil management. Soil modification is best performed at establishment. Additionally, hollow-tine cultivation by removing existing soil and organic matter and adding coarse textured material such as sand or compost can be effective over time. Hollow-tine cultivation that removes 0.5 inch soil cores to a 4 inch depth has been shown to influence less than 5% of the turf surface during normal operation. Equipment modifications can be made to increase that percentage to as much as 20%, however, this is a tedious and long-term process.

Additional forms of cultivation such as solid tine, needle tine, or water injection cultivation that make a hole but do not remove soil can also increase soil infiltration. The benefits of these practices are short-lived and consequently must be repeated routinely to maintain a permeable surface. Due to golf traffic, soils prone to compaction will continue to become compacted and limit infiltration without soil modification.

The photos that follow illustrate soil management techniques.
Slice holes made from a putting surface spiking operation used to maximize infiltration and gas exchange. 

*Source: Frank Rossi.*
Core cultivation shown from a distance (top) and up close (bottom) is an ideal method for alleviating compaction, removing organic matter, and amending problem soils, which should increase infiltration and reduce the risk of runoff. *Source:* Frank Rossi.

Schematic representation of core hole over time. Note hole edges are different colors depicting change in bulk density around the core. Over time the core edges collapse as water and roots begin to infiltrate the core.
Deep slicing can aid with remediating large areas of soil in need of increased infiltration and gas exchange. *Source:* Frank Rossi.

Spiking attachments aid with increasing infiltration and can affect significant amounts of surface areas. *Source:* Frank Rossi.
Less invasive cultivation methods such as water injection significantly increases infiltration and gas exchange. 
*Source:* Frank Rossi.

Water injection cultivation is the ‘gold standard’ for increasing infiltration and improved gas exchange with minimal surface disruption. *Source:* Frank Rossi.
Hollow tine cultivation is an ideal method for amending soils. Source: Frank Rossi.

**Soil Modification With Topdressing**
Managing surface organic matter is best accomplished by prevention through proper fertilization and soil management. Many common golf turf grasses, however, under routine maintenance and adequate prevention still produce organic matter that requires some level of management. The most effective means of managing surface organic matter is through regular applications of sand or soil via topdressing. A light (0.1 to 0.2 inches) application of material applied and integrated into the surface of the turf dilutes the organic matter and creates a physical matrix that functions as a soil.

Topdressing is often performed in conjunction with some form of cultivation that either removes a core or makes a hole. The cultivation can not only provide minor removal of the surface material but also create space for topdressing to serve the purpose of dilution and creation of a pseudo-soil matrix.

Recent research suggests that under normal golf turf management, creeping bentgrass putting surfaces require between 18 and 22 cubic feet of sand per 1000 square feet per year to properly dilute surface organic matter. This application requires topdressing as frequently as every 5 days without any cultivation, to as many as 14 to 21 days with more routine cultivation. Ultimately, the goal of proper dilution is to ensure the adequate infiltration while preserving sufficient retention of the turf system to prevent leaching. The slideshow below illustrates soil modification with topdressing.
Although large scale sand topdressing operations can be costly, they aid in reducing runoff from soils with organic matter accumulation and heavy compaction. Source: Frank Rossi.

Sand topdressing helps provide high performance playing surfaces that also reduce the risk of runoff by increasing infiltration, reducing compaction, and diluting organic matter. Source: Frank Rossi.

Proper topdressing material selection and storage are vital for maintaining a permeable turf surface. *Source: Frank Rossi*