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RESEARCH UPDATE

Genesis And Prevention Of Layers In Putting Green Rootzone Profiles

A thin iron layer may form at the boundary where a low-pH sand sits atop a high-pH gravel

- **USGA-funded research found that iron and clay layers can form in sand-based putting green rootzones.**
- **An iron layer is more likely to accumulate where a low-pH sand sits atop high-pH gravel.**
- **Less is known about why clay-enriched layers form in sand-based putting greens.**
- **Not all observed iron layers reduce drainage and infiltration rate.**
- **Undisturbed, full-profile samples can be collected regularly to monitor changes over time.**

Construction recommendations for putting greens are designed to carefully detail performance characteristics for factors like saturated hydraulic conductivity and water-holding capacity. However, after putting greens are constructed, nature takes its course and performance characteristics change. The accumulation of organic matter near the surface is well-studied, but there has been increased awareness regarding layering issues that can occur deeper in the profile. In a USGA-funded study from 2014, researchers at the University of Wisconsin, Madison, documented subsurface layers cemented by iron oxides at six different golf courses across the U.S. Shortly after, they documented apparently similar layers at a golf course in Mississippi. However, the layers

were enriched with clay, not iron oxide. These observations have led to subsequent USGA-funded research to study the genesis and prevention of iron- and clay-enriched layers in putting green rootzones.

The researchers hope to identify factors that explain the formation of iron- and clay-enriched layers to ultimately develop best management practices and construction recommendations to prevent their formation. Lab studies are being conducted in plastic, transparent columns filled with rootzone mix that meets the standards outlined in the USGA Recommendations for a Method of Putting Green Construction. A mass-balance approach is being used to determine how factors like initial rootzone properties, irrigation water volume and chemistry, and iron fertilizer rate affect the physical and chemical properties of soils and the formation of layers. The researchers have also developed a novel X-ray fluorescence method to follow the movement of iron and clay inside the columns.

Preliminary results suggest that iron is more likely to accumulate where low-pH sand sits atop high-pH gravel. Any iron applied to the surface is highly soluble in the low-pH sand, but the increase in pH at the gravel layer causes soluble iron to precipitate at the sand and gravel interface. Researchers believe that soil pH controls iron movement in the short term, whereas soil redox potential (Eh) controls iron movement over a longer period. This explains why layers may still form in neutral or slightly alkaline rootzone mixtures. Formation of these layers is not restricted to soil profile designs that feature sand and gravel layers. Cemented layers may also form anywhere there is a textural boundary, including in bunkers, sand-based putting greens with no gravel layer or amended native soils (Figure 1).

Undisturbed, full-profile samples can be collected to monitor changes over time and address potential layering issues before problems arise. An important preliminary result of this research is that the visual presence of a layer does not necessarily mean that drainage and infiltration rate are compromised. Rather, it is a symptom of Eh-pH chemistry that is occurring at textural boundaries. Future research will lead to more refined recommendations and best management practices, and a better understanding of how soil and water chemistry interact in turf systems.

Source: Glen Obear and Bill Kreuser, University of Nebraska, Lincoln

Additional Information:

Iron-cemented layers in putting green soils

Genesis and prevention of iron-cemented layers in sand putting green soil profiles