Understanding the Hydrology of Modern Putting Green Contruction Methods

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Objectives:

1. Examine the effects of rootzone composition and putting green construction method on water drainage and redistribution within the profile.
2. Examine the effects of rootzone composition, soil depth and degree of water perching on turf water use and irrigation management.
3. Examine long-term changes in physical, biochemical and microbiological properties of the rootzone and relate these changes to the long-term hydrologic behavior of modern putting green designs.

Start Date: 1996
Project Duration: 5 years
Total Funding: $100,000
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The two most prevalent, modern putting green construction methods are the USGA and the California green construction techniques. The principal differences between these methods are the presence of a gravel drainage blanket in the USGA design and a higher recommended root-zone permeability in the California design. This research program investigates putting green construction issues and their impact on the hydrology of the root zone. The hydrologic processes include water infiltration, redistribution within the root zone, drainage, and uptake by the turf.

The study is subdivided into Phases 1 and 2. Phase 1 focuses on water redistribution and drainage as influenced by presence or absence of a gravel layer, root zone composition and green slope. Phase 2 focuses on turf water use in a USGA profile as influenced by root zone composition (unamended sand, sand + peat, sand + peat + soil) and depth (9 and 12 inches).

The Phase 2 research of this report was conducted as a water balance study wherein daily measurements were made for rainfall or irrigation amounts, root zone water contents, drainage volumes, and turf evapotranspiration (ET) from the experimental greens. Additionally, water was withheld for varying intervals at two times during the study. During these rain free intervals, turf response was recorded using digital photography for subsequent image analysis and using spectral reflectance measurements. End of season measurements include root weights and soil physical properties.

Sand texture (coarse vs. fine) of the unamended rootzones did not yield any appreciable difference in soil moisture throughout the study period. There was, however, an interaction between sand texture and amendment. For coarse sand mixes, progressively higher soil moistures were observed with increased levels of amendment. Thus, the peat + soil amendment yielded the highest soil moistures. For fine sand mixes, the ordering between peat + soil and peat alone was reversed so that amending fine sand with only peat resulted in the highest water contents.

During rain-free intervals, turf water uptake occurred throughout the root zone regardless of root zone depth. Consequently, the 9-inch root zone exhibited lower soil moistures than the 12-inch root zone for all measurement depths. Further, we did not observe strong evidence for the creation and/or maintenance of perched water in the experimental root zones during the entire study period. Selected treatments of this study yielded turf ET differences during the two rain-free intervals. During the first and more severe rain-free interval, the 12-inch root zone showed higher cumulative ET than the 9-inch root zone.

Additionally, the unamended sand had lower cumulative ET as compared with amending the root zone with peat. The peat + soil amendment was intermediate, particularly for the 12-inch rootzone. A similar amendment effect was observed during the second rain-free interval.

Rainfall simulators were used to evaluate the soil hydrology of two putting green rootzones at three different slopes in Phase I.

Summary Points

- Gravel layer does facilitate faster and more uniform drainage.
- As green mature they will hold more water (as a result of more organic matter in the soil mix).
- Did not observe a significant perched water table effect in a two-layer system. This phase will be repeated for a second year.
- During rain-free intervals, turf water uptake occurred throughout the rootzone.
- Unamended sad had lower cumulative ET compated with peat-amended root-zones.