Evaluating Sand-Capping Depth and Subsoil Influence on Fairway Performance, Irrigation Requirements and Drought Resistance

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Sand-capping golf course fairways is a trend driven by the need for improved turfgrass growing and playing conditions, especially on areas where low-quality irrigation water and fine-textured soils exist. Due to the significant cost sand-capping can add to a construction/renovation budget, less than optimal depths of sand are often placed atop the existing soil. The ideal placement depth ultimately depends on physical properties of the sand, environmental conditions, and providing a balance of water to air-filled porosity for optimal growing conditions. However, no specifications currently exist for sand-based construction atop an existing soil. This study seeks to develop science-based information that can contribute to development of such recommendations.

During 2016, data on the temporal dynamics of water movement within and through sand-cap treatments following summer irrigation/rain events have been closely monitored. Time domain reflectometry (TDR) probes were placed horizontally at various depths in both the 20 cm depth sand-cap plots (5 cm and 15 cm) and in the 10 cm sand-cap plots (5 cm). Figures 1 and 2 depict temporal volumetric water content changes between irrigation cycles during June 2016, both atop clay loam and sandy loam subsoils. When comparing soil moisture at the 5 cm depth between the 10 and 20 cm sand-cap treatments, moisture content decreased to a much greater extent between irrigation events within the 20 cm sand-cap. At the 15 cm depth, soil moisture fluctuated less between irrigation events, regardless of sand-cap depth. Sand-cap moisture content at the 15 cm depth remained higher atop clay loam as compared to sandy loam subsoils between irrigation cycles.

Point-in-time measurements were also obtained prior to irrigation events on multiple dates during the 2016 summer within 1x per week irrigation treatments to characterize available soil moisture at different depths within the sand-cap treatments (Fig 3). Moisture content was obtained using a handheld soil moisture meter with different probe lengths six days after plots were irrigated. Data spatially depict water retention across the sand profile for various sand-cap treatments. Although significantly less water is available within the 0-4 cm depth for the 20 cm deep sand-cap, a substantial amount of water is still available to plants deeper within the sand profile. This likely explains the few differences that have been observed in turfgrass coverage between caps of varying depths throughout the study.

Sodium adsorption ratio (SAR) of fairway subsoils (upper 10 cm) increased sharply within the initial 12 months of the study due to the high Na concentration (~270 ppm) of irrigation water, but declined over the winter months due to an abundance of natural rainfall (Figl 4). SAR has been delayed/mitigated to some extent by sand-capping.

Measurements of thatch development were made during December 2015 (15 months into the study). Data showed that the 20 cm sand-cap had significantly less thatch development compared to the 0, 5, and 10 cm sand-caps.

During 2017, a 60-day drought will be imposed across the study in order to determine treatment effects on drought resistance, with recovery evaluated after the summer drought has ended.

Summary Points

- The different subsoils, clay loam and sandy loam, are having an effect on moisture content in the overlying sand-cap, which may have implications on the ideal sand-cap placement depth.

- Although few differences were observed in year 1 due to either irrigation frequency or capping depth, some turfgrass drought stress was observed during 2016 on the 20 cm sand-cap as compared to the shallower capping treatments under 1x/week irrigation. This was most pronounced atop the sandy loam as compared to the clay loam subsoil, likely due to the different physical and hydraulic properties of the underlying subsoil.

- The Sodium Adsorption Ratio (SAR) is likely to gradually increase from growing season to growing season, which may have a negative effect soil structure and possibly root development within the subsoil as these systems age.

- Differences in the rate of thatch accumulation suggest that management of organic matter should not be overlooked when managing a sand-cap system, however, a delayed rate of thatch accumulation has been observed with the deepest (20 cm) sand-cap.

- A 60-day drought will be imposed during summer of 2017 in order to better understand sand-cap x subsoil treatment effects on drought resistance, recovery, and/or survival.

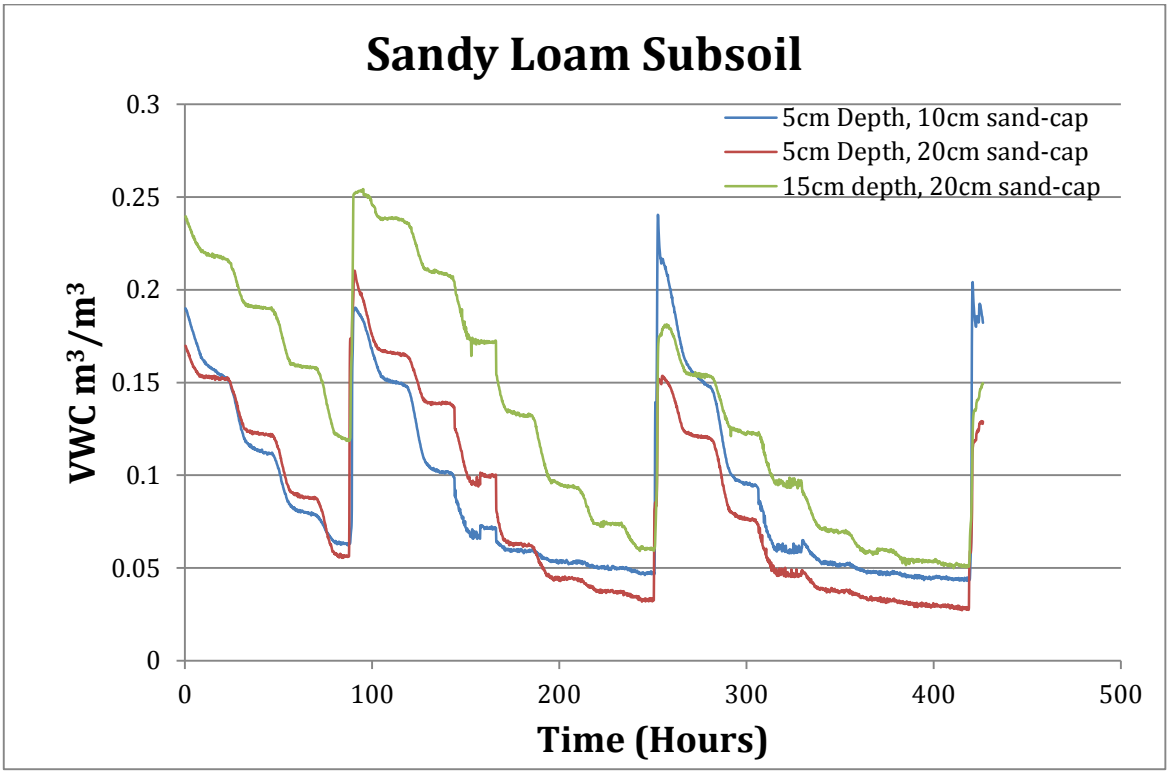

Figure 1. Temporal soil moisture dynamics between irrigation events at both 5 and 15 cm depths within 10 cm depth sand-cap (5 cm moisture only) and 20 cm depth (5 and 15 cm depth moisture) sand-cap treatments atop the sandy loam subsoil. Data are for 1x/week irrigation during the month of June 2016.

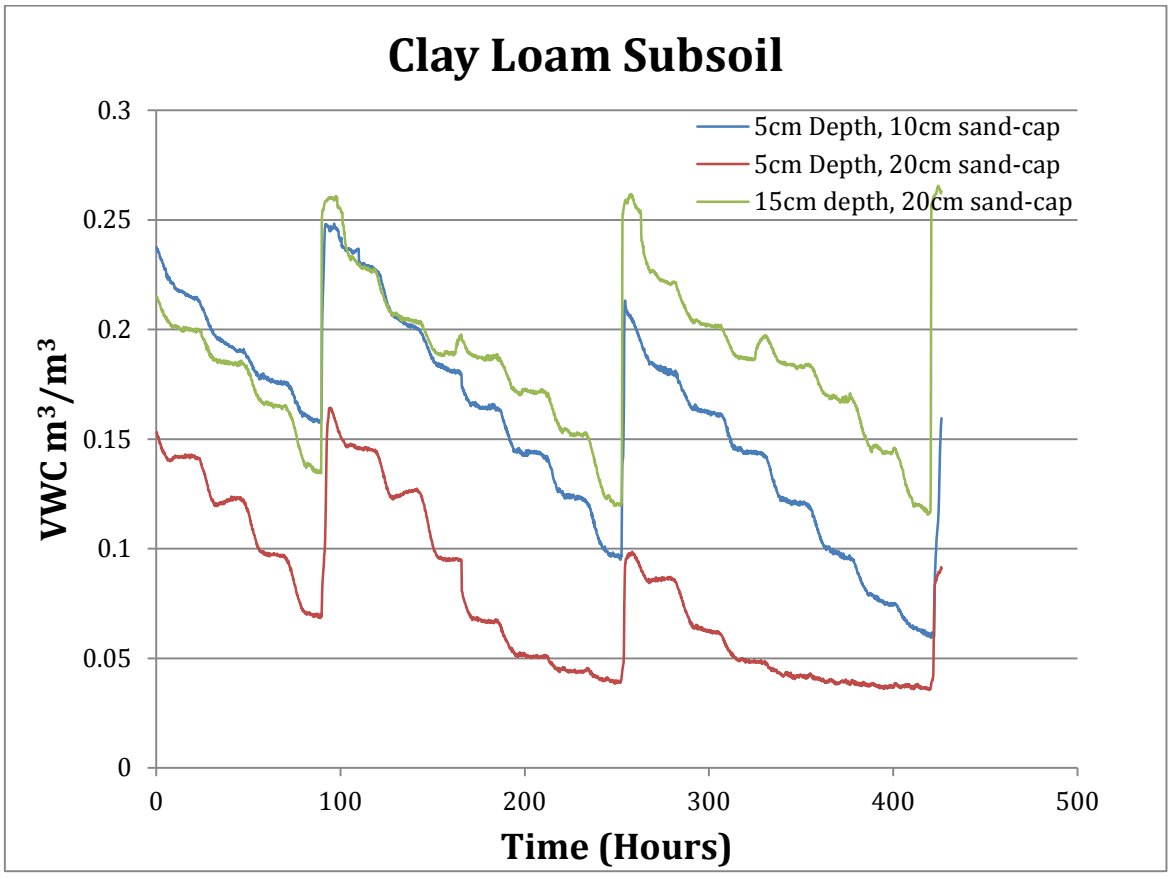

Figure 2. Temporal soil moisture dynamics between irrigation events at both 5 and 15 cm depths within 10 cm depth sand-cap (5 cm moisture only) and 20 cm depth (5 and 15 cm depth moisture) sand-cap treatments atop the clay loam subsoil. Data are for 1x/week irrigation during the month of June 2016.

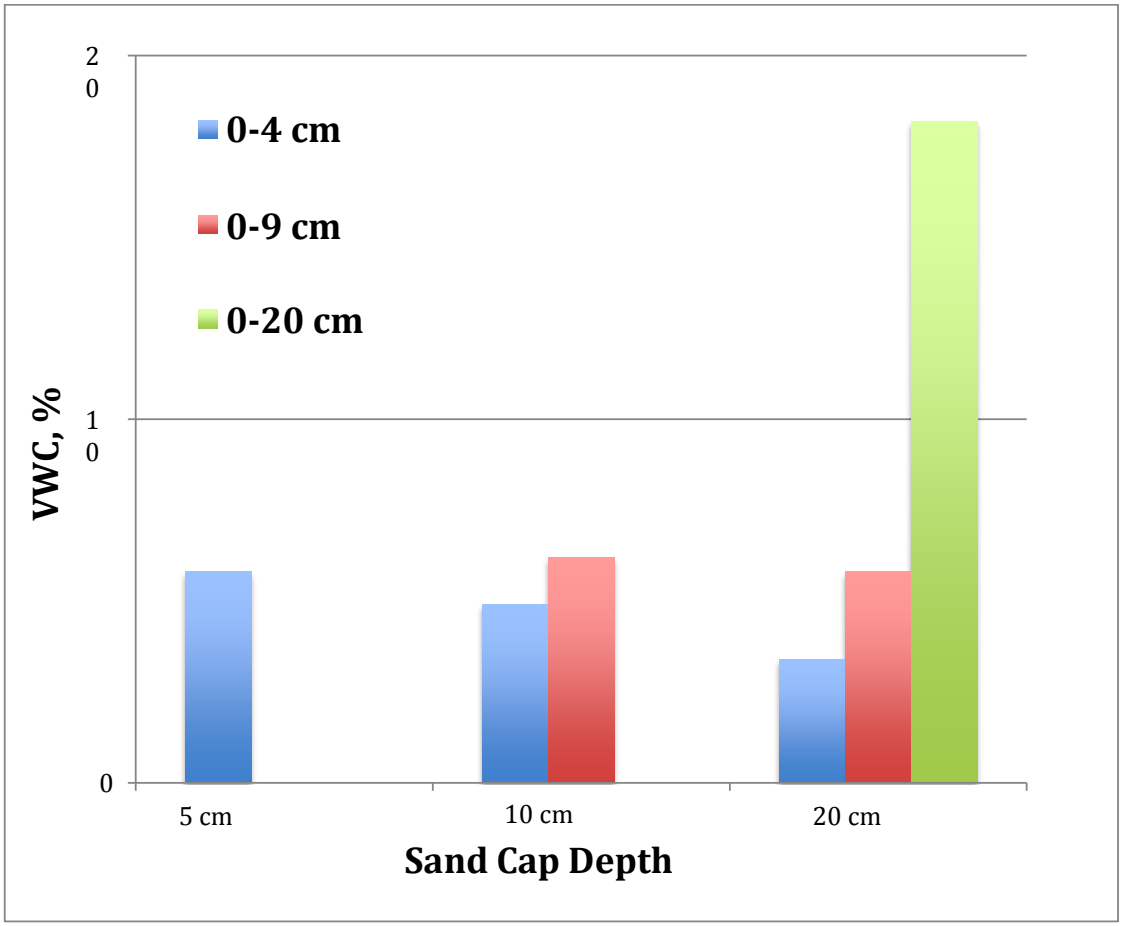

Figure 3. Volumetric water content across various depths within each of the three sand-cap treatments atop sandy loam subsoil. Data were taken six days after previous irrigation in 1x/ weekly irrigation treatments. Data are an average of two measurement dates during June 2016, and were obtained using a Field Scout Soil Moisture Probe with 4, 9, and 20 cm depth tines.

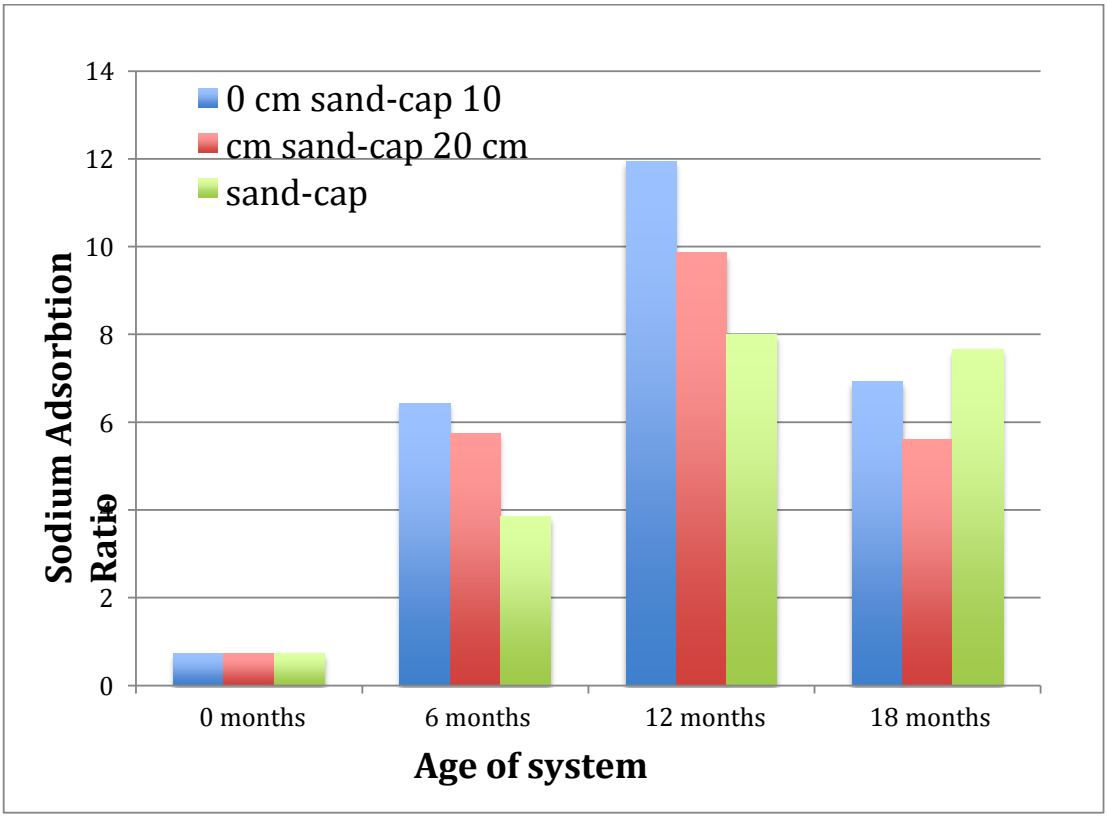

Figure 4. Sodium adsorption ratio of sandy loam subsoil underlying sand-caps at 0, 6, 12, and 18 months (study initiation, spring 2015, fall 2015, and spring 2016, respectively).