Measuring Saturated Hydraulic Conductivity of Coarse-textured Rootzone Mixes

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Objectives:

1. To determine the optimum moisture content for soil column packing.
2. To develop a packing procedure to ensure a uniform soil column.
3. To evaluate the uniformity of hydraulic conductivity, K_{sat}, of the soil column using the SIUC permeameter.

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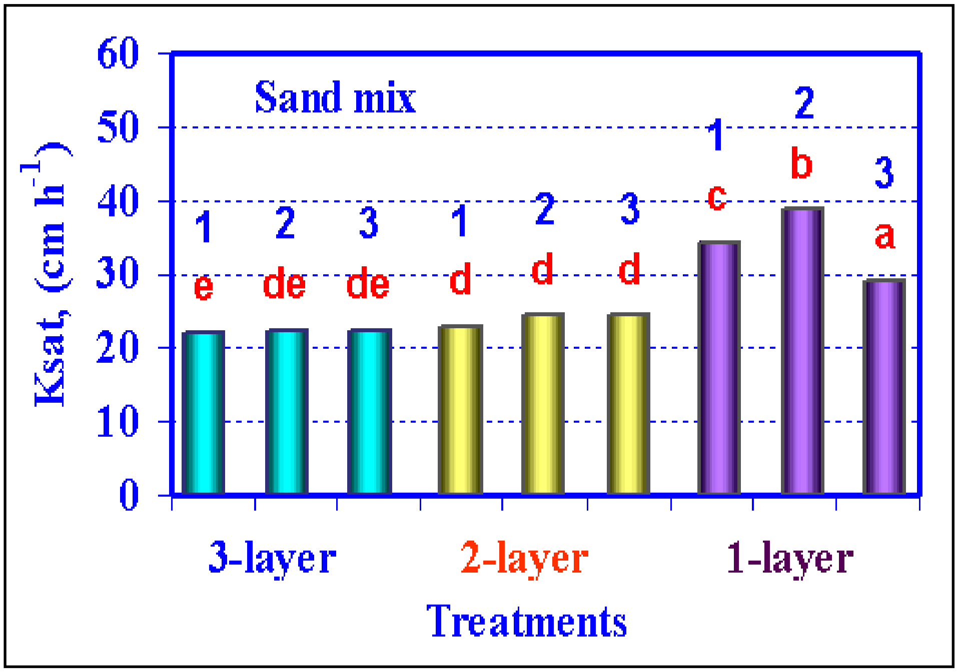
The 1993 USGA recommendations require that the K_{sat} of a rootzone sand mix be comparable to a severely compacted putting green to meet a specified value. Saturated hydraulic conductivity is related to the pore size, which, in turn, is dependent on the degree of sand mix compaction. The compaction of sand mix can be influenced by the moisture content at the time of packing, as well as the method of sample loading.

These factors are not clearly described in the recommendations. In order to obtain an accurate and consistent K_{sat}, it is necessary to achieve a uniform soil column. The goals of this research are to determine the optimal moisture content and to develop a consistent method for packing a uniform soil column.

The optimum moisture content for compaction was determined from the soil-moisture-density curve of sand and sand mix, similar to the Proctor's test. Six moisture levels (0.02, 0.04, 0.06, 0.08, 0.10 and 0.12 g g^{-1}) were controlled on two rootzone mixes (sand only and sand with 0.015 g g^{-1} of peat moss). Results indicated that the sand mix was less vulnerable to packing than sand alone.

Even though bulk density declined slightly as water content increased, the impact of soil moisture during packing was minimal. However, the influence of peat moss on sand compaction was much greater than that of the soil moisture. The mean difference in bulk density between sand and the sand mix was 0.133 g cm^{-3}. This indicated that sand alone is more prone to compaction as compared to sand that has been amended with peat moss. This may be attributable to the rebound of peat moss during packing.



Comparison of mean K_{sat} constructed by the 1-, 2- and 3-layer approach of loading sample in packing. 1, 2, and 3 indicates technician who conducted the test. Means with the same letter are not significantly different (P = 0.05).

The coefficient of variation of bulk density at the same water content showed that the sand mix had a higher variation than that of sand alone. Results also revealed that moisture contents between 0.05 to 0.07 g g^{-1} had the lowest variation for both sand and the sand mix. This indicated that optimal compaction could be achieved by controlling the moisture at packing between 0.05 to 0.07 g g^{-1}.

In order to simulate a sand mix comparable to a severely compacted putting green, the packing procedure similar to the Protor's test was used for constructing the soil column. Three sample loading methods, namely 1-layer, 2-layer, and 3-layer, were tested by three technicians separately to check the consistency and uniformity among the columns. Results revealed that large variations in K_{sat} were found in soil columns constructed by the 1-layer approach, while the 2- and 3-layer packed soil columns were rather consistent with acceptable differences among technicians (figure above). For practical purposes, the 2-layer approach is suggested for loading the sample in the packing soil column.

Summary Points

- Sand mix (containing peat) was less vulnerable to packing than sand alone.
- Results suggest that optimal compaction could be achieved by controlling the moisture at packing between 0.05 to 0.07 g g^{-1}.
- Large variations in K_{sat} were found in soil columns constructed by the 1-layer approach, while the 2- and 3-layer packed soil columns were rather consistent with acceptable differences among technicians. For practical purposes, the 2-layer approach is suggested for loading the sample in the packing soil column.