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Biochar as a Sand-based Rootzone Amendment

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Abstract
Bicohar may be valuable as an amendment in sand-based turfgrass rootzones. Currently, peat moss is the most common organic amendment mixed with sand when sand systems are constructed. Peat moss increases water retention and nutrient holding capacity of the sand; however, peat moss is prone to decomposition over a relatively short period of time. Biochar is very stable in the soil profile and may prove to be a viable organic amendment for sand-based turfgrass. In this study, fast pyrolysis switchgrass biochar was used. The objectives of this research were to 1) quantify soil water retention capabilities, 2) determine water infiltration rates, and 3) measure rooting depths of creeping bentgrass in sand and biochar soils.

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Biochar as a Sand-based Rootzone Amendment

RFR-A9051

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Introduction

Bicohar may be valuable as an amendment in sand-based turfgrass rootzones. Currently, peat moss is the most common organic amendment mixed with sand when sand systems are constructed. Peat moss increases water retention and nutrient holding capacity of the sand; however, peat moss is prone to decomposition over a relatively short period of time. Biochar is very stable in the soil profile and may prove to be a viable organic amendment for sand-based turfgrass. In this study, fast pyrolysis switchgrass biochar was used. The objectives of this research were to 1) quantify soil water retention capabilities, 2) determine water infiltration rates, and 3) measure rooting depths of creeping bentgrass in sand and biochar soils.

Materials and Methods

Soil water retention. This experiment was conducted in the Soil Physics Laboratory using pressure head methodology. Metal cylinders were filled with biochar and sand mixes, saturated, and placed in pressure chambers. Water was collected at each pressure level to calculate soil water retention. Six biochar and sand treatments were evaluated ranging from 0 to 25% biochar increasing by 5% increments. Four replications per treatment were evaluated at matric potentials -0.010, -0.025, -0.049, -0.098, -0.196, and -0.327 bars (n=4). Two replications per treatment were evaluated at -0.5, -1.0, -5.0 and -15.0 bars (n=2).

Saturated hydraulic conductivity. This experiment was conducted in the Soil Physics Laboratory using Marriott bottle methodology. The same cylinders were re-saturated from the soil water retention study. Water was allowed to flow through the cylinders maintaining a constant ponded water level. The volume of outflow was measured over a given time frame.

Rooting depth. This experiment was conducted in a controlled environment greenhouse in the Horticulture greenhouse complex. Four replications of the six biochar and sand treatments, ranging from 0 to 25% biochar increasing by 5% increments, were evaluated. T-1 creeping bentgrass was established via seed in 60 cm long root tubes containing the treatment mixes with a 20 cm layer of pea gravel at the bottom. After 110 days, the root tubes were sliced open and roots measured.

Results and Discussion

Saturated hydraulic conductivity. Biochar decreases saturated hydraulic conductivity in sand-based rootzones (Table 1).

Rooting depth. At levels greater than 10% (v/v) biochar in the sand, rooting depth is decreased (Table 1).

Soil water retention. Biochar increases soil water retention in sand. Biochar increases plant available water in sand-based rootzones (Figure 1).

Table 1. Saturated hydraulic conductivity and creeping bentgrass rooting depth evaluated in six biochar treatments. Rooting depth was evaluated using root tubes in which T-1 creeping bentgrass was grown in a greenhouse for 110 days. Saturated hydraulic conductivity values represent means of four replications.[x,y]

Biochar Percentage biochar (v/v)	Saturated hydraulic conductivity cm hr^{-1}	Rooting depth cm
0	85a[z]	46a
5	56b	45a
10	53b	43a
15	29c	34b
20	16d	30b
25	7d	25b

[x]Means within columns followed by the same letter are not different according to Fisher's Protected $LSD_{0.05}$.
[y]Rooting depth values represent means of twelve replications.

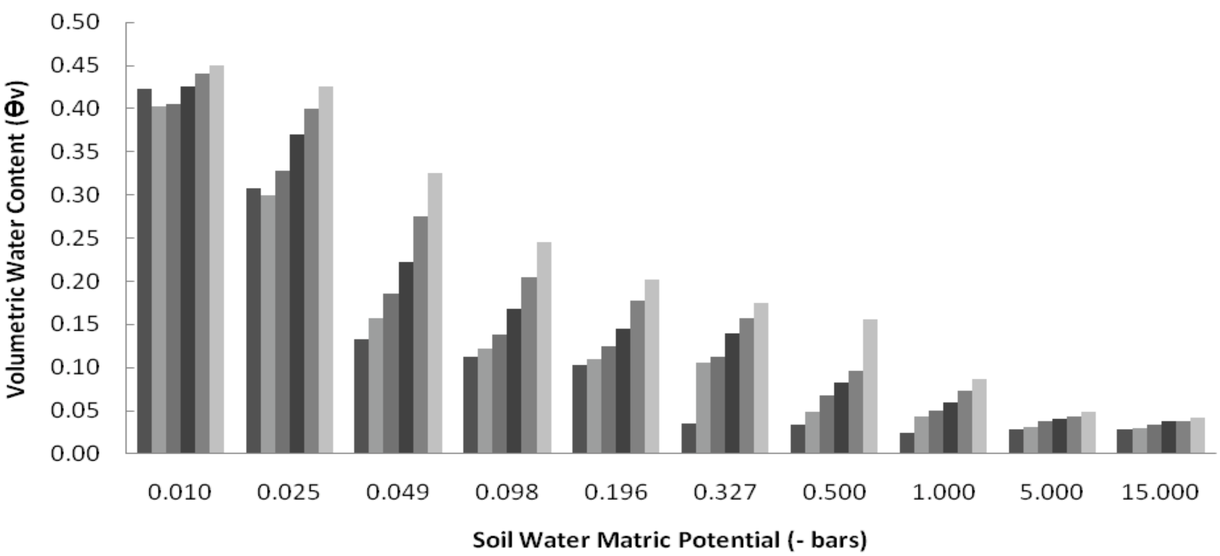

Figure 1. Volumetric water content in relation to the matric potential. At each matric potential level, six treatments were evaluated. Treatments from left to right at each matric potential level: 0% biochar to 25% biochar increasing by 5% biochar increments (v/v). Four replications per treatment were evaluated at matric potentials -0.010, -0.025, -0.049, -0.098, -0.196, and -0.327 bars (n=4). Two replications per treatment were evaluated at -0.5, -1.0, -5.0, and -15.0 bars (n=2).