Biochar-compost mixtures added to simulated golf greens increase creeping bentgrass growth

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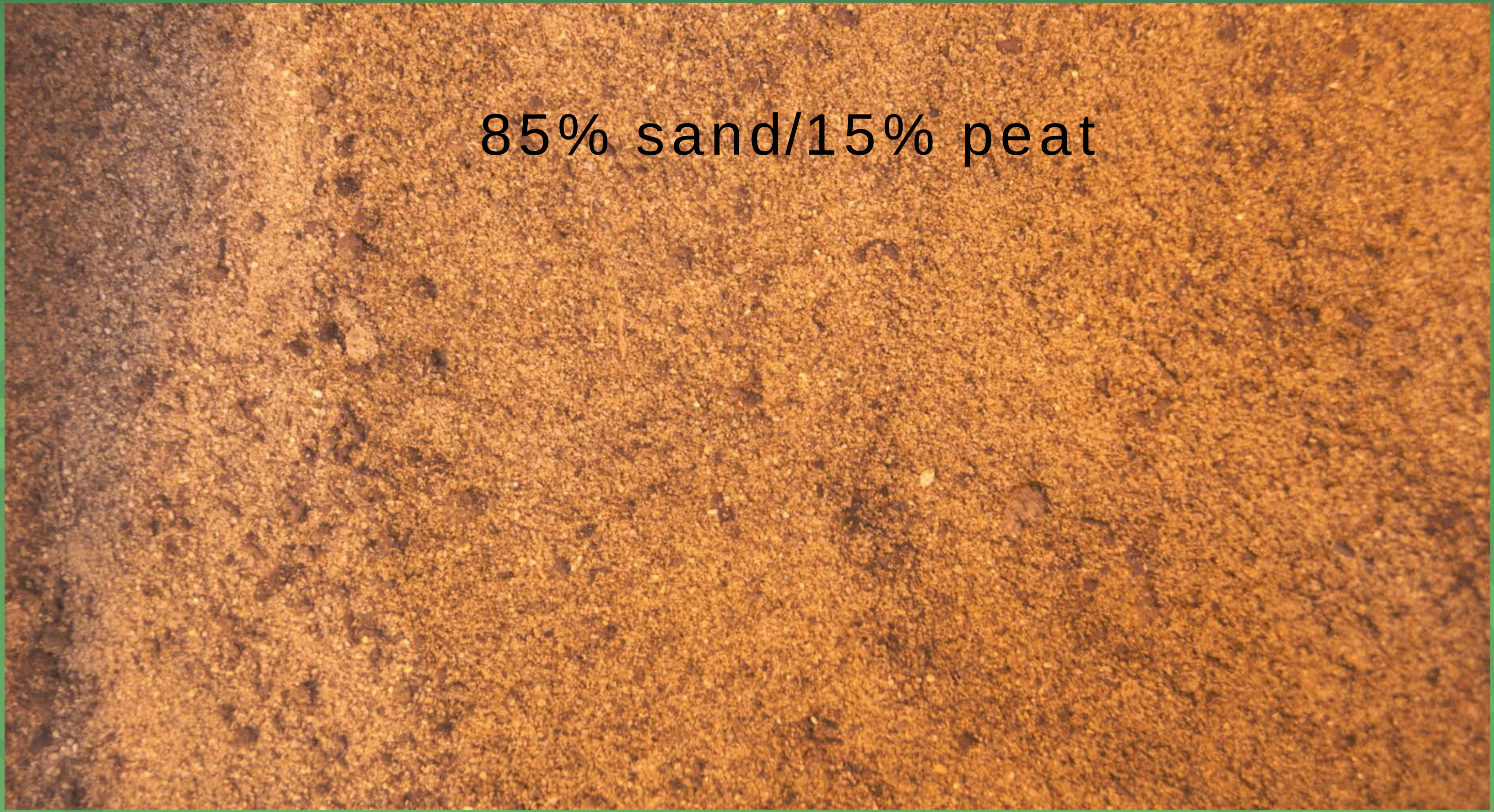
Creeping bentgrass (*Agrostis stolonifera* L.) is the principal cool season grass used for golf greens in the northern United States.

Golf greens must be designed to provide high water infiltration and drainage rates, and prevent compaction.

At the same time they must retain enough water and nutrients to support vigorous growth.

Current USGA recommendations for golf green construction are for a 30-cm sand root zone on top of a 10-cm pea gravel bed.



Organic amendments such as peat increase water and nutrient retention, but peat decomposes over time, which results in lower water and nutrient retention.

In the U.S., peat moss is almost exclusively used in the horticulture industry. Forty thousand acres of sphagnum are currently being harvested in Canada, with 90% of the product destined for the U.S. In the U.K., where peat moss is burned as fuel, nearly 94% of the lowland bogs have been altered or completely destroyed due to harvesting.

Various composts are also used as root zone amendments for new and established golf greens.

Biosolids from the Metropolitan Water Reclamation District of Greater Chicago have also been examined (Tian et al., 2008).

Why use biochar/compost mixtures in new green construction instead of peat?

Unlike peat which degrades relatively quickly, biochar should have a much greater longevity in the root zones while sequestering carbon.

Composts can supply nutrients in lieu of chemical fertilizers, with the biochar helping to retain the nutrients in the root zone and preventing runoff.

Biochars have excellent air porosity which should not be lost as much over time as with peat.

Compost and Charcoal

By JOHN MORLEY, *Greenkeeper*
Youngstown Country Club, Youngstown, O.

DISCUSSION has been rife the past two years, both by experts on soils and experienced greenkeepers regarding the advisability of eliminating the compost pile and produce other methods to create suitable porous soils, especially adapted for topdressing of putting greens.

The preparing and mixing of compost forms one of the most important items in greenkeeping. To meet the requirement of a modern putting green, the dressing and preparing of compost must be carried out in a more scientific manner.

JOHN MORLEY
This veteran's success as a greenkeeper has given him a world-wide reputation

The greatest care must be taken to use only that compost or manure which may be best expected to repay the outlay. There should be a proper place provided for the compost with a hard bottom to prevent the heavy rains from washing the better materials contained in the pile away. If the compost is properly made and allowed sufficient time for the nitrofying bacteria to release the various elements which the organic matter in the compost contains, and the materials used are carefully selected, I find no reason to discontinue building them.

Some of the troubles with the average compost pile, which I have observed during my visits to various courses is that they are not properly built. For an illustration—a number of greenkeepers often, owing to insufficient help cannot afford the time to make compost, especially through the summer season. They are often compelled to wait until late fall. The greenkeeper can get together at that time all the employes available and proceed to erect the compost pile and keep working at it until it is completed.

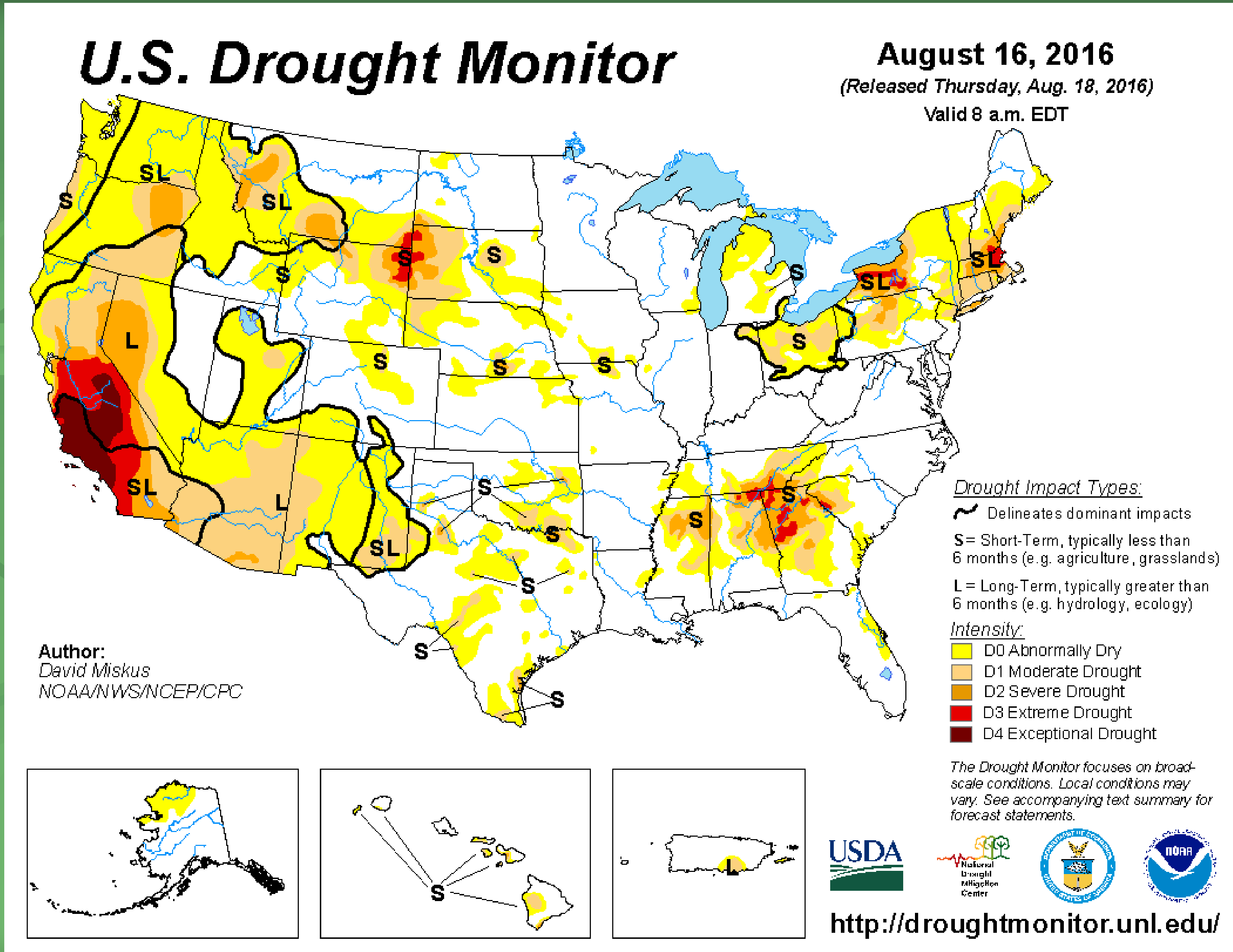
Preceding its erection he has secured a good supply of stable manure. A fair portion (especially horse manure), has begun to heat and has the appearance of a light gray color. This

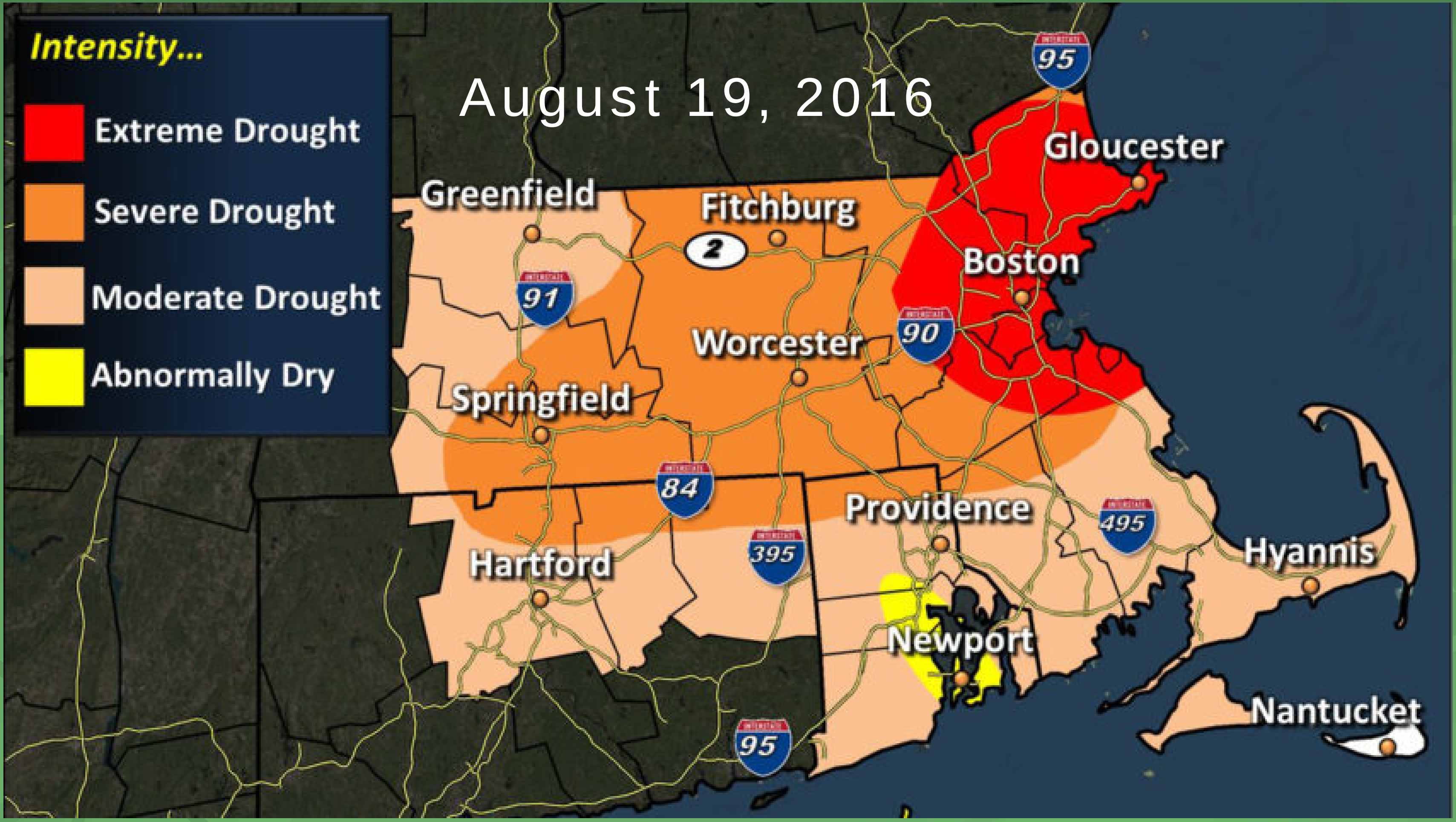
THE 9TH GREEN ON THE FAMOUS OAKMONT CHAMPIONSHIP COURSE
Expert greenkeeping on the part of Emil Loeffler together with the judicious expenditure of money has made this course famous throughout the world

John Morley, the founder and first president of the Golf Course Superintendents Association of America, promoted the use of charcoal to improve the properties of golf greens in 1929!

Unlike many of the other areas where turfgrasses are used, golf courses *must* be watered and fertilized regularly to have actively growing grass which can recover from divots and other wear and tear.

Audubon International estimates that the average American course uses 312,000 gallons of water per day. In a place like Palm Springs, where 57 golf courses challenge the desert, each course eats up a million gallons a day! That is, each course each day in Palm Springs consumes as much water as an American family of four uses in four years.


U.S. Drought Monitor
August 16, 2016
(Released Thursday, Aug. 18, 2016)
Valid 8 a.m. EDT
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
Author:
David Miskus
NOAA/NWS/NCEP/CPC
USDA
National Drought Mitigation Center
http://droughtmonitor.unl.edu/



Even areas of the U.S. with high precipitation levels can experience periods of drought.

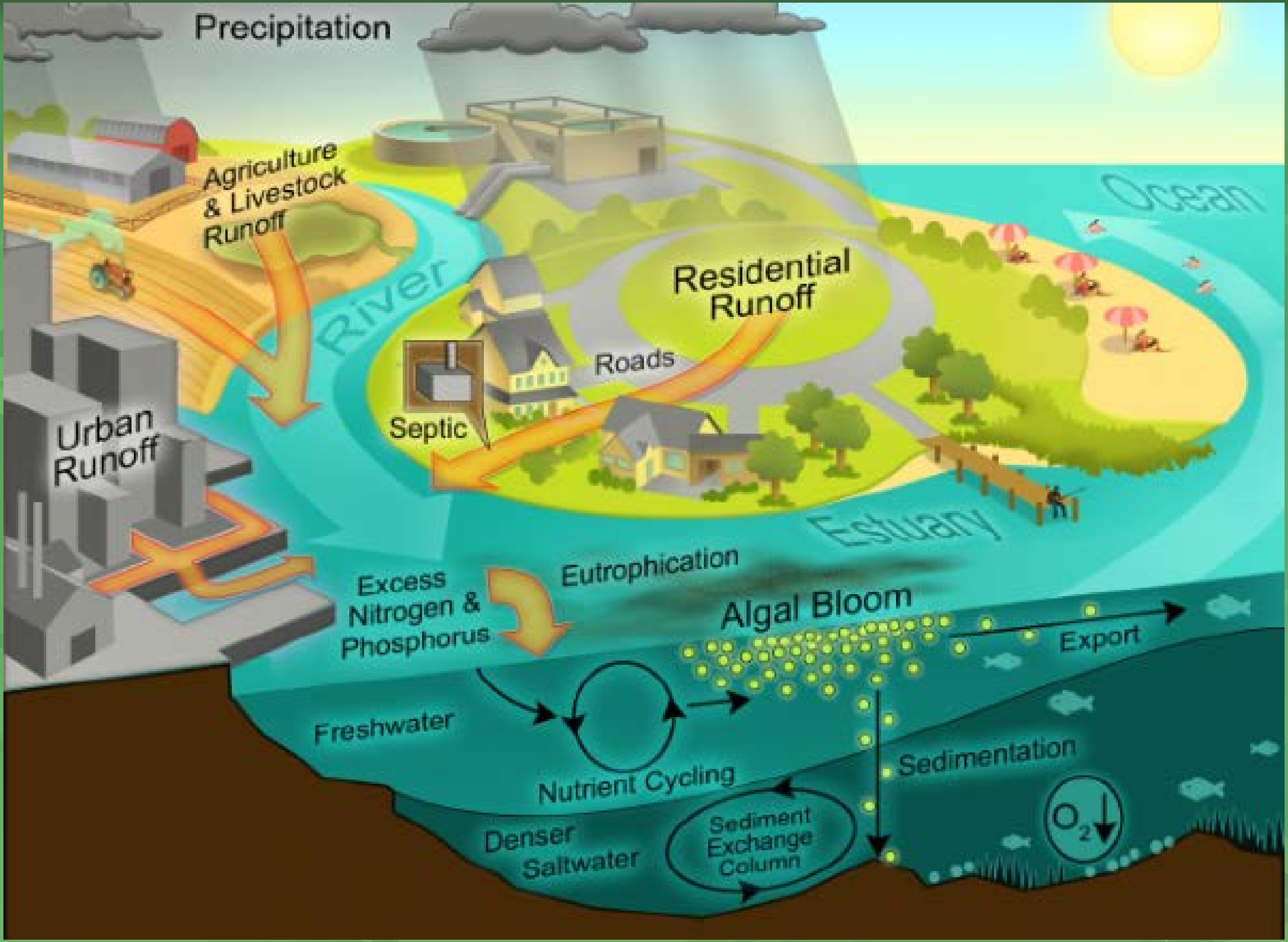
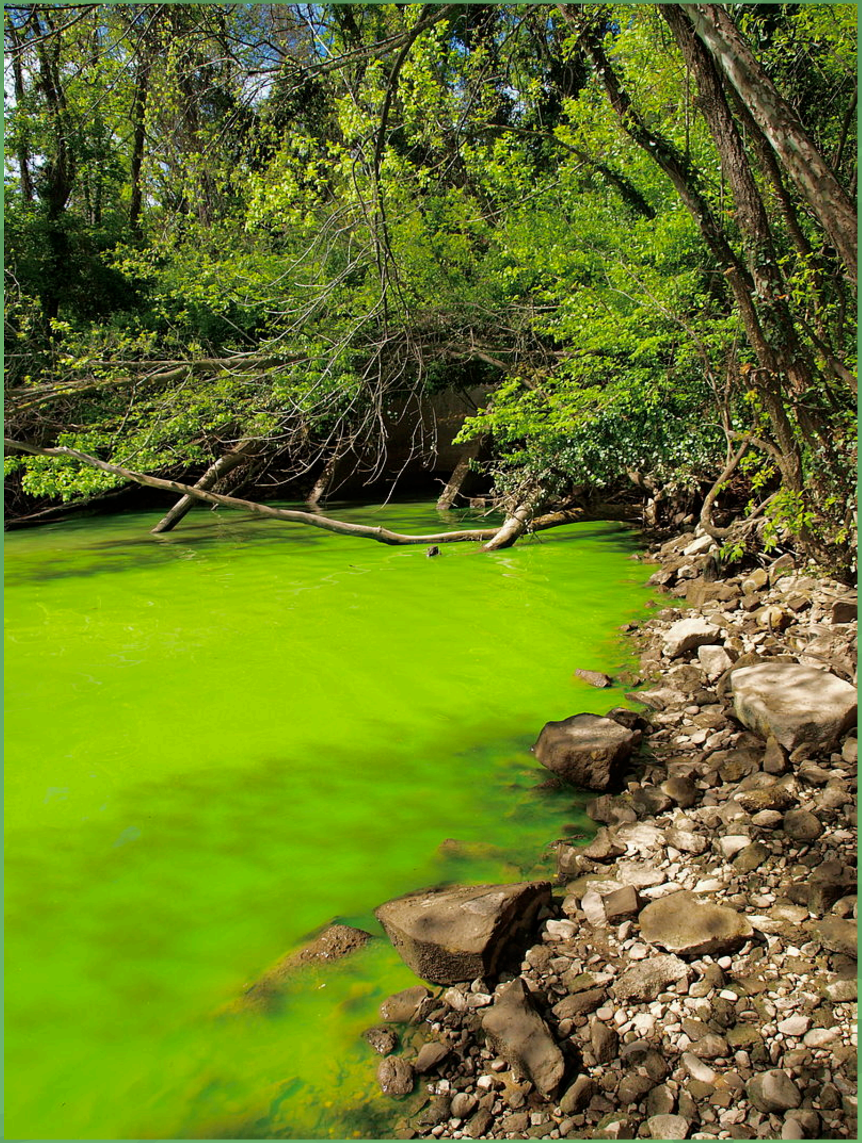


Diagram of processes leading to eutrophication.

Toxic algal blooms in Great Lakes, August 2015

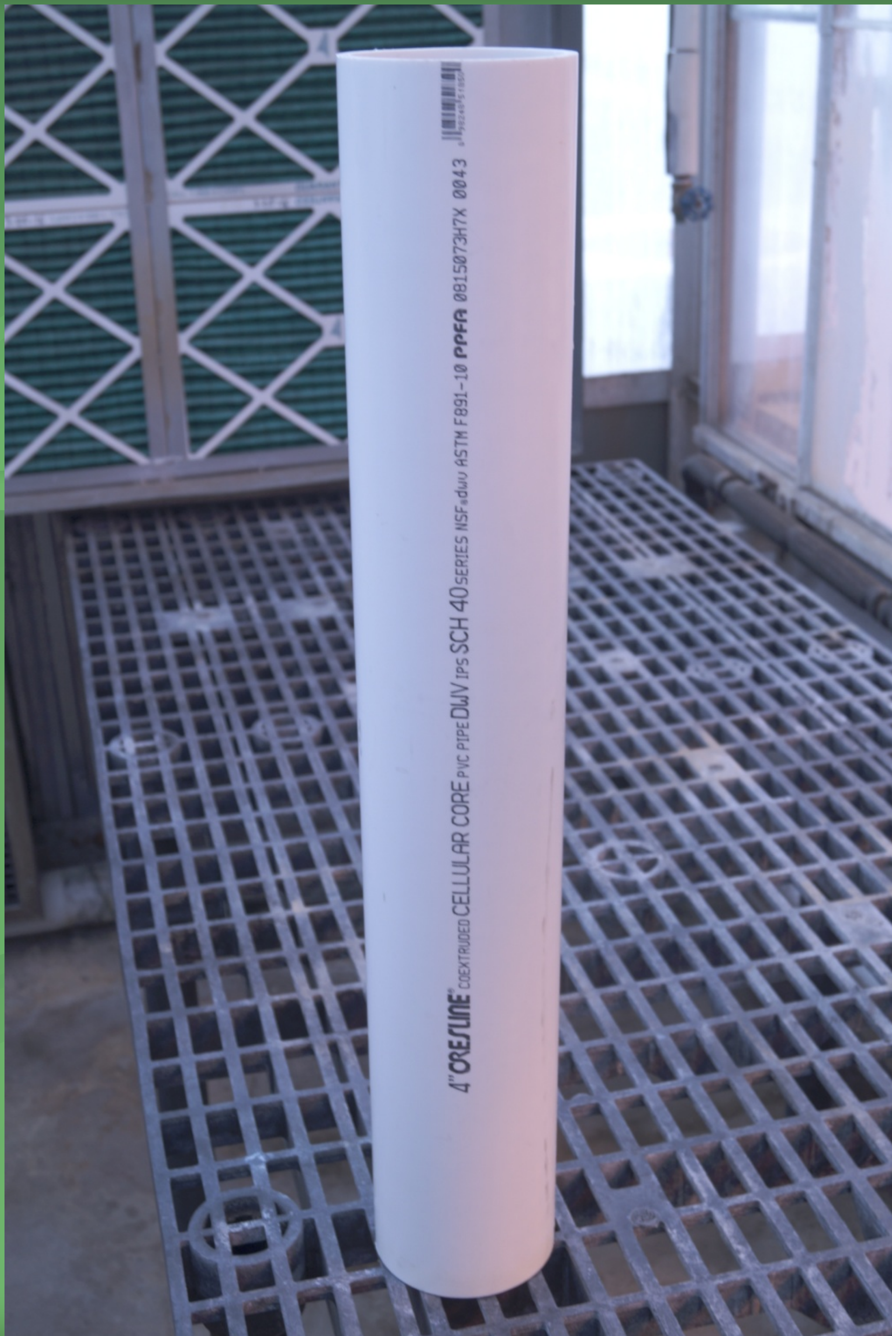
Eutrophication of the Potomac River and Chesapeake Bay led to Maryland’s Lawn Fertilizer Law, which took effect on October 1, 2013, severely reduces phosphorus and nitrogen applications.



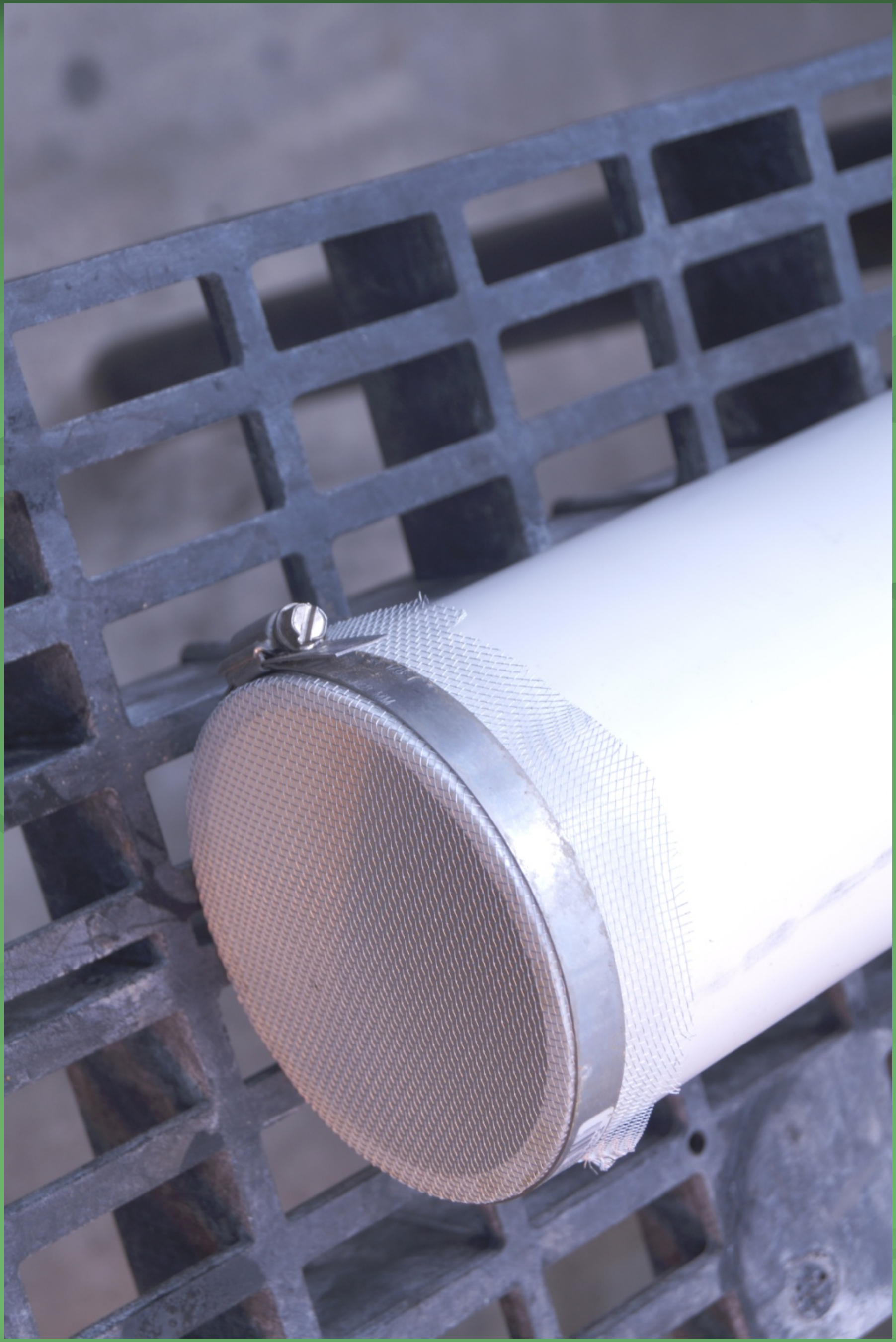
In this study we compared creeping bentgrass growth in 85% sand-based media with 15% mixtures (v/v) of peat, biochar or biochar/organic composts while simultaneously using highly reduced (~10% rec. rate) levels of chemical fertilizer.

Biochar was obtained from Mirimichi Green, LLC. Organics amendments were as follows: (1) 15% peat moss; (2) 15% biochar; (3) 5% biochar/10% peat; (4) 5% biochar/10% anaerobic biosolids; (5) 5% biochar/10% compost + biosolids; (6) 5% biochar/10% vermicompost; (7) 5% biochar/10% Organimix; (8) 5% biochar/10% Humus; (9) 5% biochar/10% worm castings; (10) 15% CarbonizPN-Soil.

Biochars and composts were mixed with sand using a commercial cement mixer.



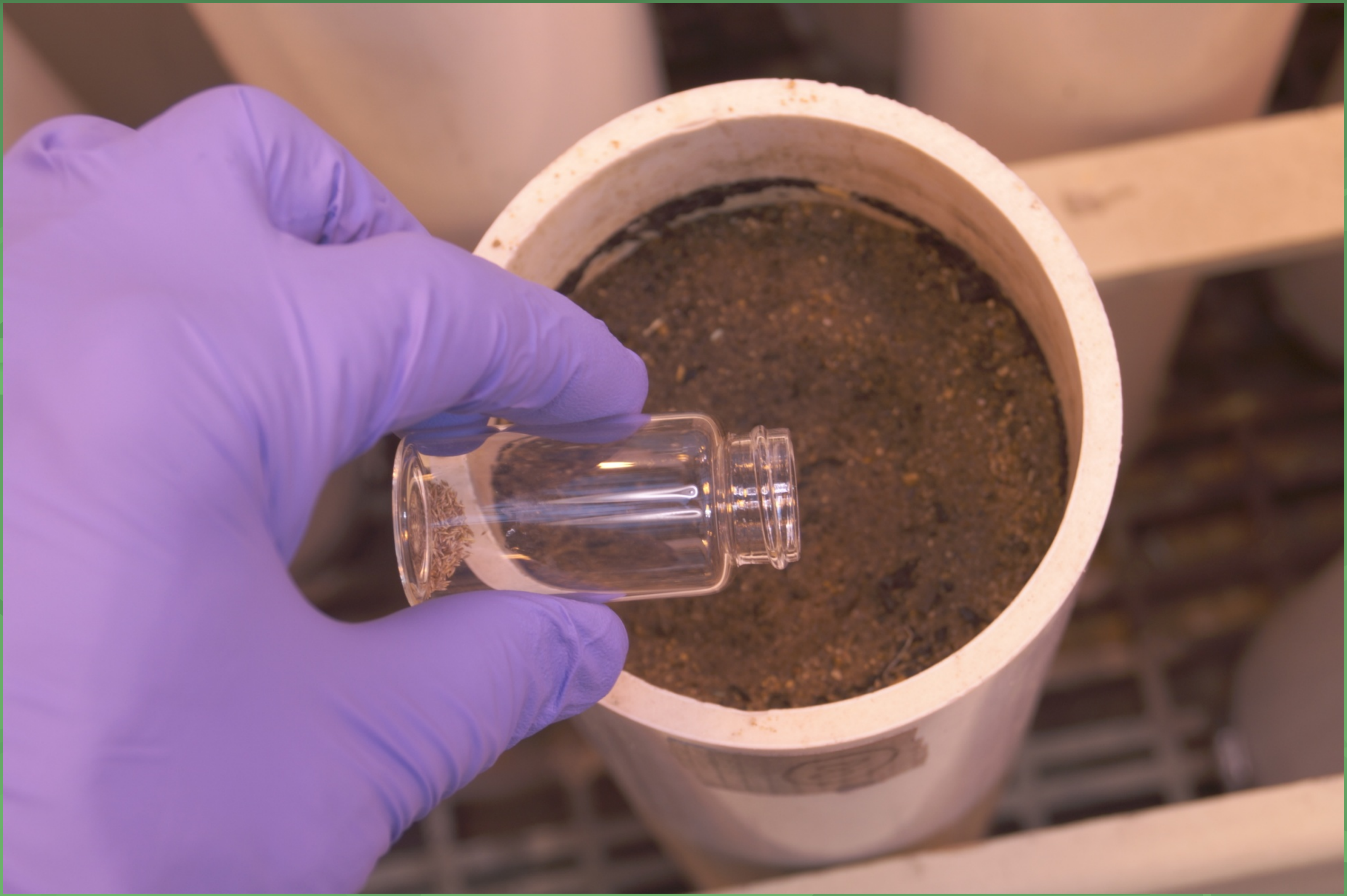
Rooting tubes to mimic a golf green were constructed out of PVC tubes.



The bottom of each tube was fitted with an aluminum door screen held in place by a hose clamp.

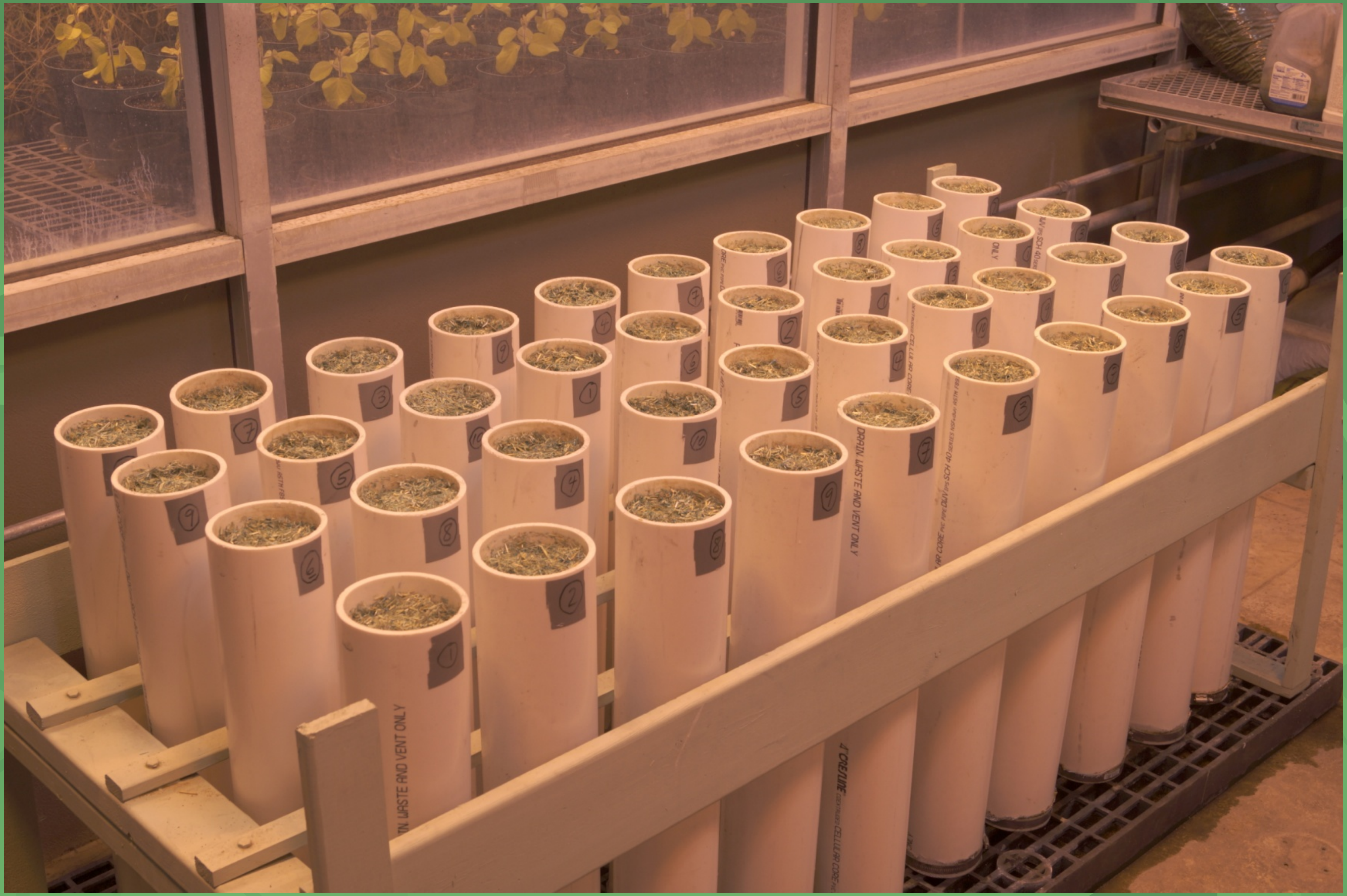
The bottom 30 cm of each tube was filled with pea gravel and the top 30 cm with the sand/peat/biochar/compost mixtures which had been preconditioned for 30 days after mixing.

Seven hundred and fifty mL of DI water containing a complete hydroponic fertilizer were poured into each tube, for a rate of 5.0 g N m^{-2}.

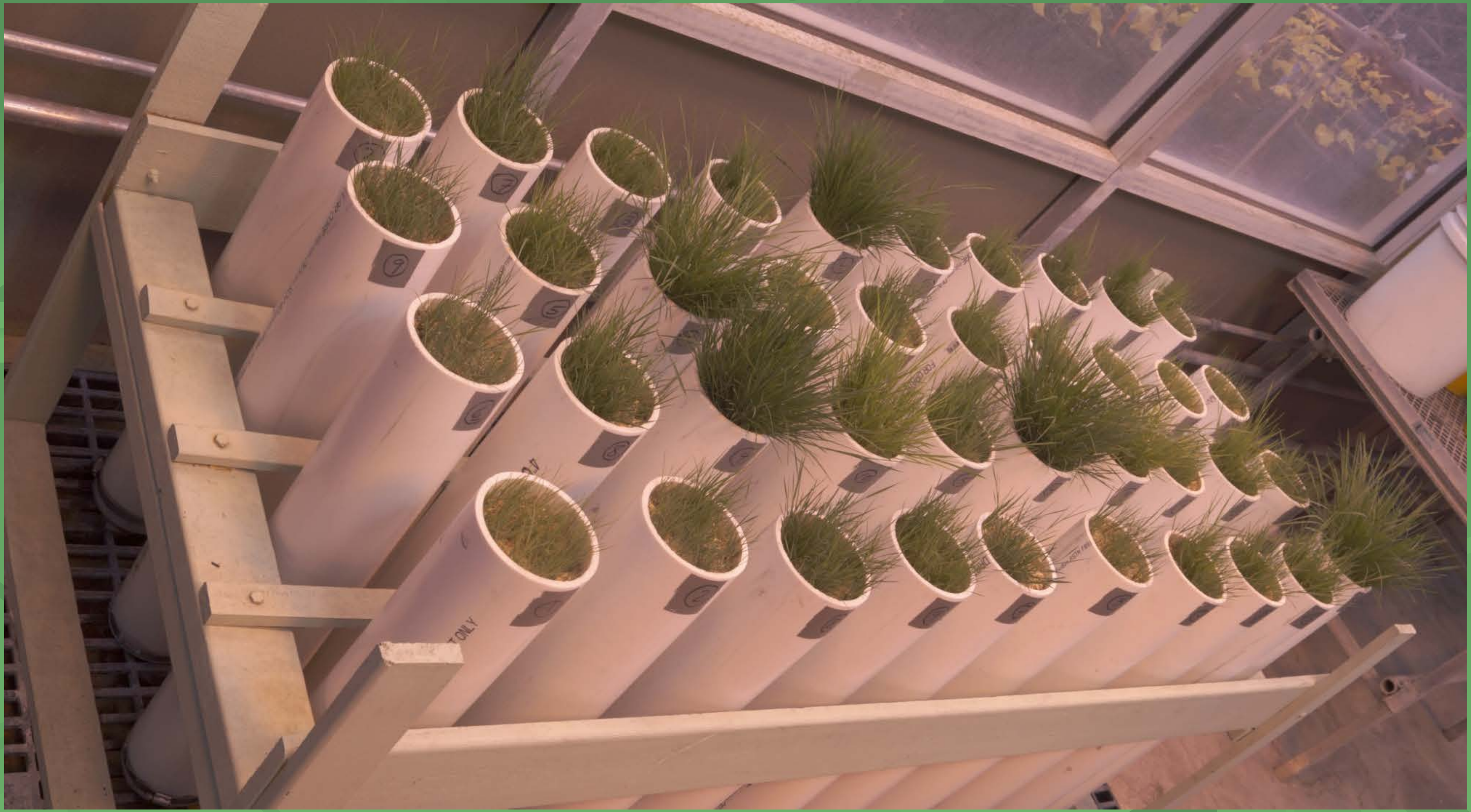


Creeping bentgrass seed (47 mg) was added to each tube.

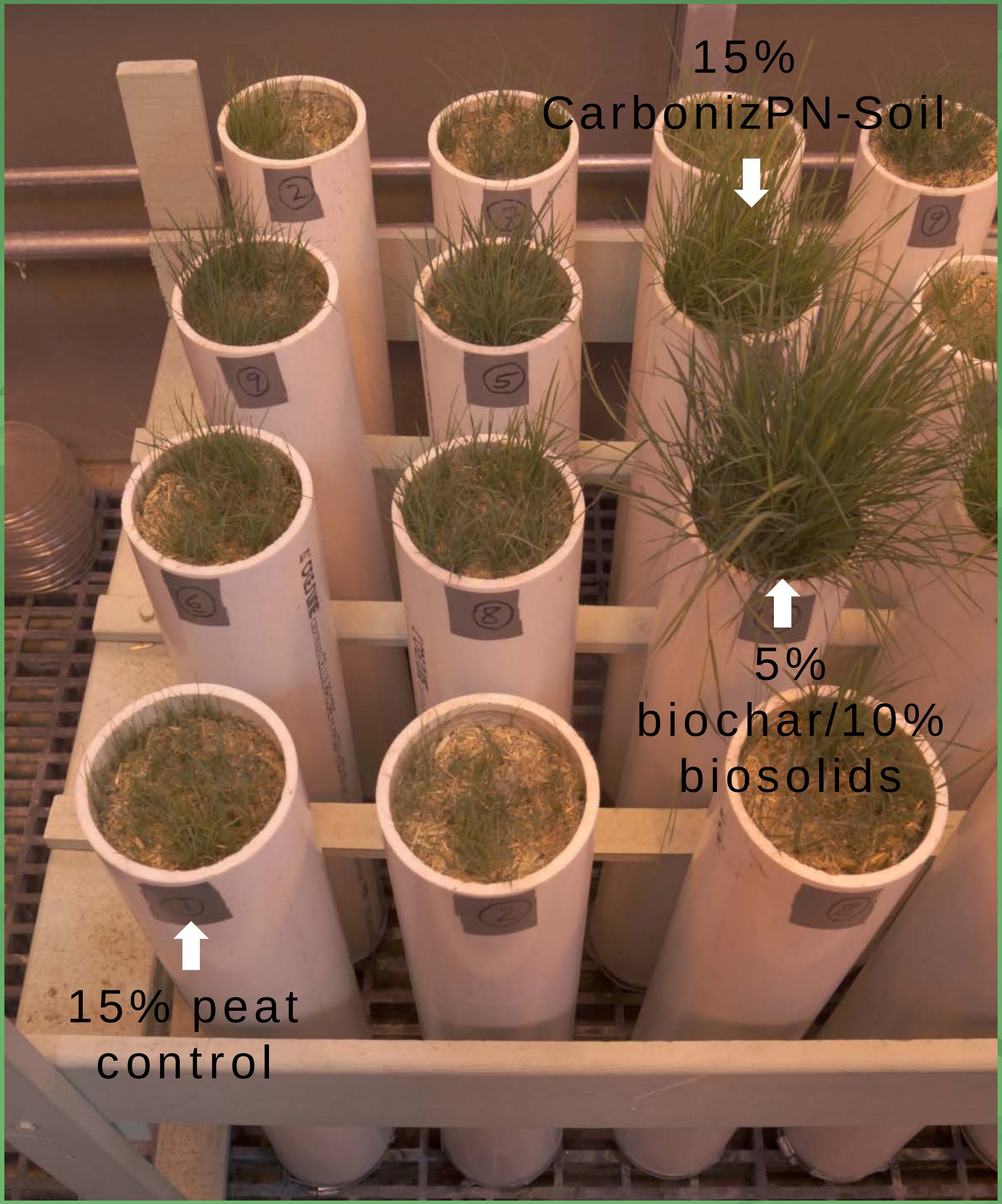
Hydromulch was applied to the soil surface to retain moisture and to keep substrate surface temperatures consistent among substrates.



Finished experimental setup with 4 replicates per treatment in a completely randomized design.



Creeping bentgrass growth 40 days after seeding.



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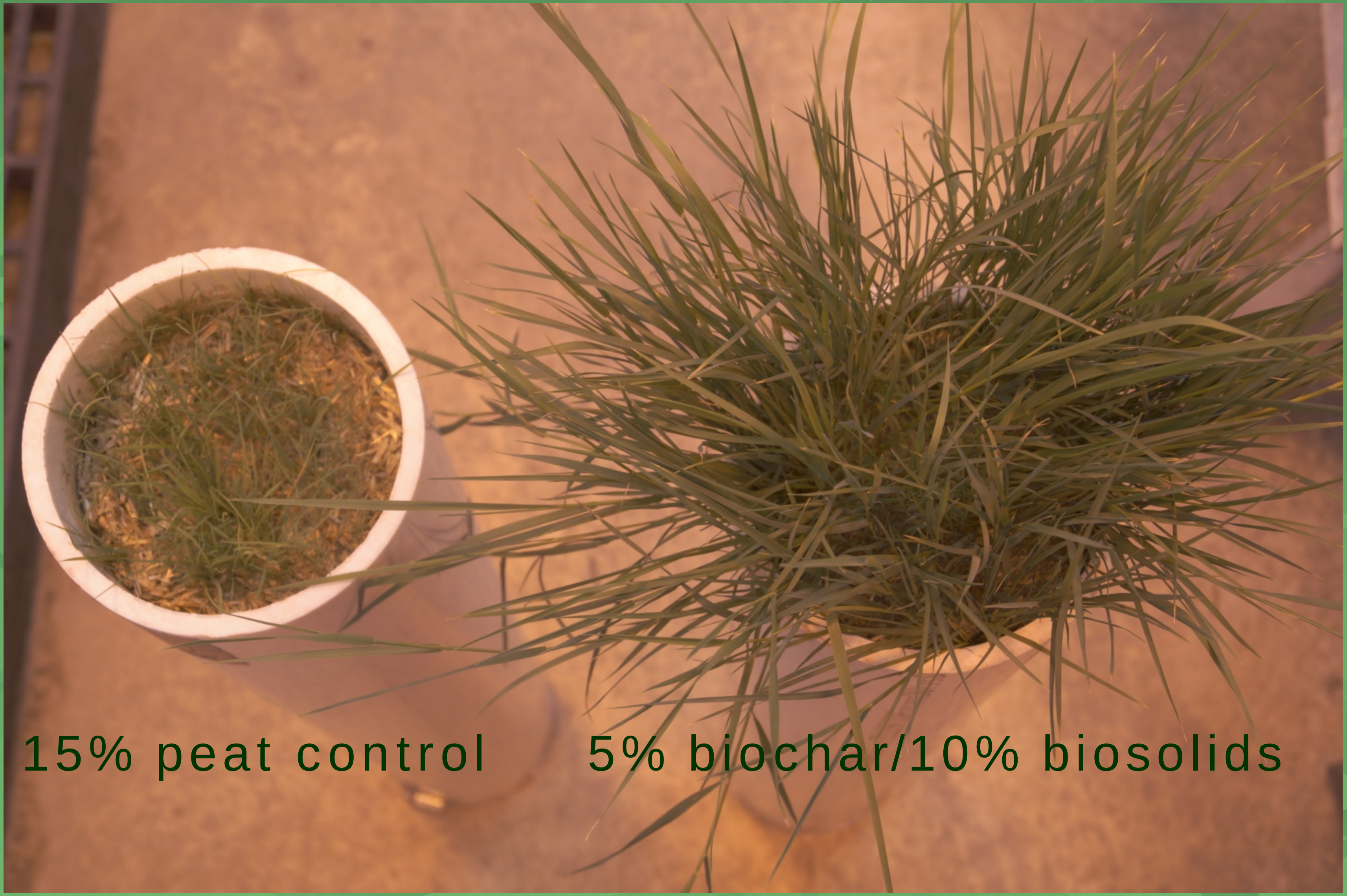
15% peat control
5% biochar/10% biosolids

Conclusions

- ✓ 5% biochar together with 10% MWRD biosolids had the greatest fresh weights, dry weights, shoot heights compared to the 15% peat control.

- ✓ These results and the abundant availability of biosolids nationally indicate that combining biosolids with biochar would likely produce superior results for actual golf course green applications.

Experimental greens at North Shore Country Club, Glenview, IL, 2014

Pea gravel layer applied

Root zone layers applied

North Shore CC experimental greens, April 2015

Questions?