



# How does Designer Biochar Improve Dissolved Phosphorus Sorption?

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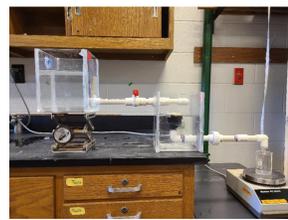
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## Introduction

Subsurface drainage system uses buried perforated conduits to remove excess water from the soil profile to increase crop production and promote soil conservation. However, drainage systems, particularly those with surface inlets, can also deliver large quantities of nutrients, such as phosphorus, from agricultural fields to surface water bodies. This study was conducted to determine whether a designer biochar can filter out phosphorus from water entering a subsurface drainage system through a surface inlet. The effects of biochar size, biochar mixture, and drainage design were investigated with a combination of laboratory and field experiments.

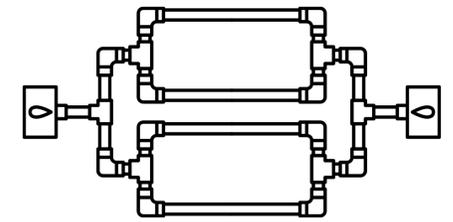
## Method and Materials

- The ability of two designer biochars to absorb phosphorus from water flowing into surface inlets at different flow rates was studied in the laboratory.
- We also evaluated two inlet designs with 100% biochar and 50:50 biochar: sand media in the laboratory.
- In the field a rainfall simulator is being used to evaluate the efficacy of 2mm biochar pellets by themselves or in a 50:50 mixture with sand.



## Future Work

- To design a PVC pipe surface drainage outlet design that mitigates the flowrate decrease and run another set of field test at the ABE Dairy Farm in Urbana, Illinois.



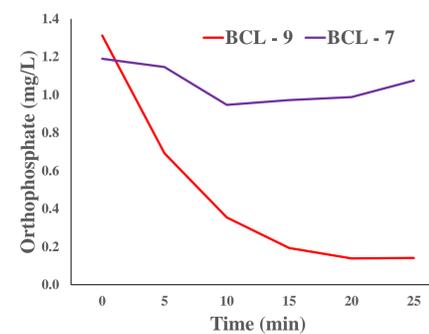
Picture of design

## Objectives

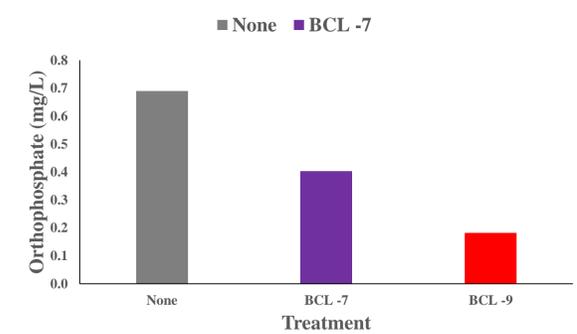
- Find efficient biochar size and media to capture phosphorus being transported from agricultural fields to surface water bodies.
- Achieve optimal surface drainage outlet design.
- Keep phosphorus in the closed agricultural loop.

## Result

- Two designer biochars, BCL-9 and BCL-7, were examined for orthophosphate adsorption. BCL-9 adsorbed 50% dissolved phosphorus within the first 5 minutes of contact time.
- Biochar pellet size was reduced from 25 mm to 2 mm to increase reaction time needed for phosphorus adsorption.
- The orthophosphate sorption results show that the BCL-9 with 2 mm particle size performs better than BCL-7 (2 mm and 25 mm) and BCL-9 (25 mm), suggesting that the small biochar pellet has a high adsorption capacity to dissolved phosphorus.

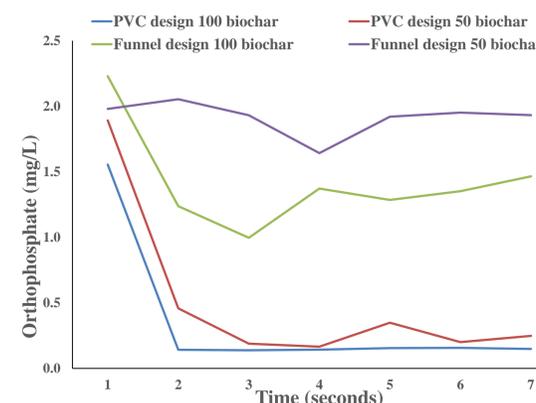


Comparison of two biochar on their sorption capacity

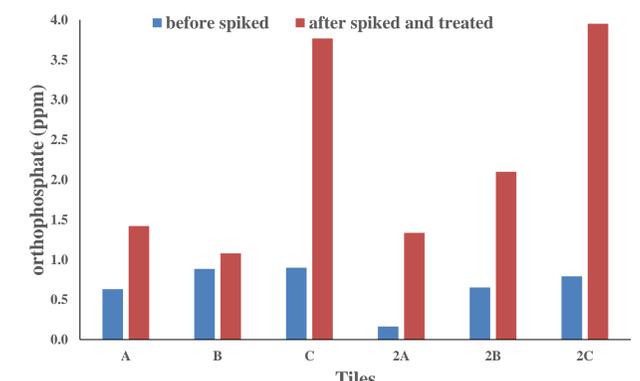


Comparison of two biochar with 2mm pellet size on their sorption capacity

- Approximately 90% of the influent orthophosphate from the pipe design filters with no significant difference in removal through the two media. Less of the influent orthophosphate was removed from the funnel design filters, and there was significant difference in the removal from the two media. There was no difference in the flowrates through the two media for either filter design, but water moved significantly slower through the pipe design filters.

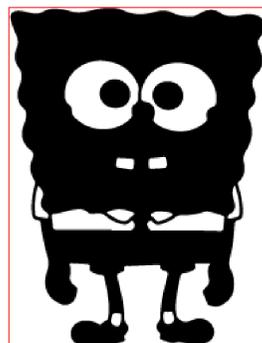


Comparison of two outlet prototypes and their media on dissolved phosphorus sorption capacity

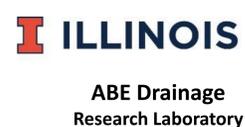


Preliminary field test result on phosphorus sorption capacity of 50:50 biochar to sand mixture with 2mm pellet size

## Acknowledgement:



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