Investigating the Effects of Varying Biochars on Seedling Root Rot in Soybean Plants Inoculated with *Pythium sylvaticum*

Bennett A. Fate, Vijitha K. Silva, Alexandra L. Starkey, Leonor F. Leandro

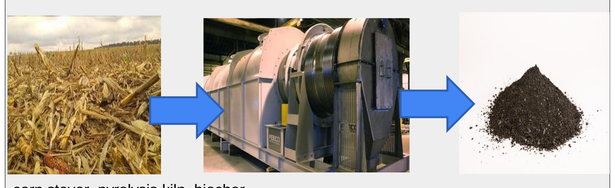
Department of Plant Pathology and Microbiology, Iowa State University

Background

Millet grain, which was inoculated with *P. sylvaticum*

Soybean seedling root rot from *P. sylvaticum*

- *Pythium* is a common soybean pathogen, causing seedling root rot in wet conditions
- Treatment options for managing *Pythium* are limited and there is growing interest in alternatives to fungicide



corn stover, pyrolysis kiln, biochar

- Biochar is made from the pyrolysis of organic materials, often waste products
- Biochar has been demonstrated to change soil moisture structures as well as limit growth of pathogenic fungi on soybeans

Materials and Methods

Soil Preparation

- Pasteurized 2:1 Sand:Soil mix was amended with biochar at a rate of 5%
- Each cup was treated with one of the 4 biochar treatments or left untreated (control)
- Half of the plants were inoculated with 8mL of *P. sylvaticum*. The other half were non-inoculated controls

Soybean Germination and Growth

- Planted two soybean seeds in each cup, later thinning out the weaker seedling
- Plants were watered 1x per day
- Plants were grown for around 3 weeks before they were analyzed to assess root rot severity, root length, and root and shoot dry weight
- Soil moisture sensors were placed in 2 cups per treatment to determine volumetric water content over time

Results

Effects of Biochar on Soybeans

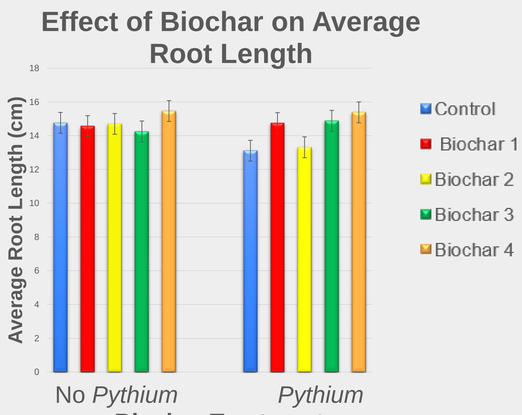


Fig 1. Effect of biochar soil amendments on avg root length in soybeans non-inoculated (left) and inoculated (right) with *Pythium*

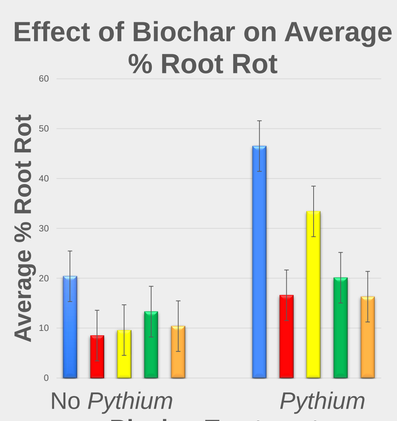


Fig 2. Effect of biochar soil amendments on avg root rot in soybeans non-inoculated (left) and inoculated (right) with *Pythium*

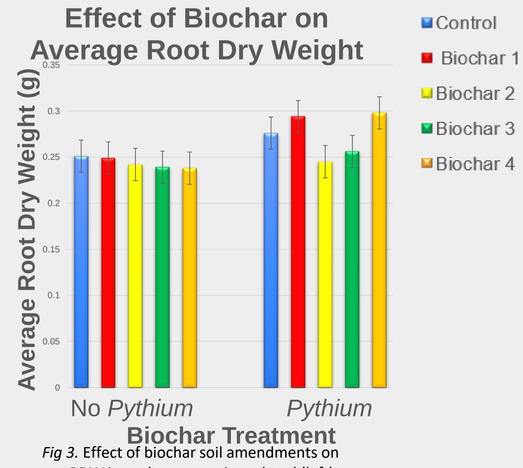


Fig 3. Effect of biochar soil amendments on avg RDW in soybeans non-inoculated (left) and inoculated (right) with *Pythium*

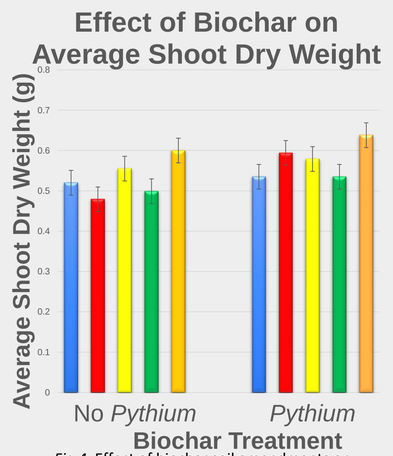


Fig 4. Effect of biochar soil amendments on avg SDW in soybeans non-inoculated (left) and inoculated (right) with *Pythium*

- All four biochars had significantly lower root rot than the control in the presence of *Pythium*
- Biochar did not have a significant effect on Root Length, Root Dry Weight, or Shoot Dry Weight with or without *Pythium*

Effect of Biochar on Volumetric Water Content (VWC)

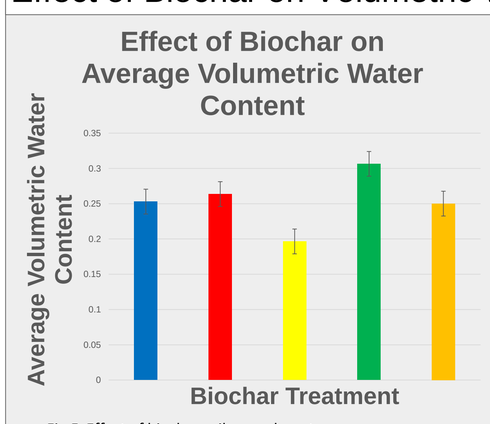
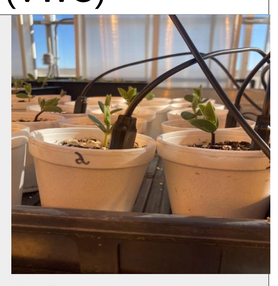


Fig 5. Effect of biochar soil amendments on avg VWC.



- Biochar 2 had the lowest average VWC (0.196)
- Biochar 3 had the highest average VWC (0.306)

Analysis

- All biochars tested had positive effects in reducing root rot in the presence of *Pythium*, without having significant effects on root length, RDW, or SDW.
- Similar reduction in root rot has been observed with another soybean pathogen (Rogovska, 2017).
- Our study provides further evidence for the potential for biochar to reduce soybean root rot.

Significant Root Rot | Minimal Root Rot

Root rot was rated on a 1-100% scale

- We hypothesized that biochar would reduce VWC, thus reducing dispersal of the motile *Pythium* spores and reducing root rot.
- However, in the presence of *Pythium*, Biochar 2 had the worst root rot compared to the other biochars and, also the lowest average VWC.
- This suggest VWC is not correlated with root rot as we hypothesized, and biochar is reducing root rot through another mechanism.

Implications

- Biochar has the potential to be a multifaceted solution to many agricultural issues – possibly addressing fungal pathogens, soil health, and carbon sequestration.
- A current limitation in this research comes from the subjectivity of rating the % rot of soybean roots.
- Future research could further investigate the mechanisms through which biochar can mitigate pathogens on soybeans.

Acknowledgements

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