Does biochar as a soil amendment help the growth of plantings in areas impacted by honeysuckle?

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Introduction

Amur honeysuckle is an invasive species from Asia. The plant has allelopathic effects, meaning it creates a legacy through leaving trace allelochemicals in its soil, which are prevalent even after the plant itself is removed. The net effect of these allelochemicals is dependent on many factors, as shown by various studies (Bauer et al, 2012; McNeish et al, 2016; Taylor, 2020). These effects have been shown to stunt germination rates, increase nutrient turnover, and decrease herbivorous interactions.

Biochar is a substance similar to charcoal in that it is made from the burning of organic material (biomass). As a soil amendment, it has naturally occurred for thousands of years. It is known to have been utilized in indigenous agricultural practices, and has been credited for the health of Amazonian rainforests (Wake Forest University, 2019).

The city of Cincinnati is heavily infested with Amur honeysuckle. Additionally, the city has recently made a $1.1 million dollar investment into creating a biochar production facility. However, studies of both biochar and allelopathy in the Midwest region are lacking.

Accordingly, we decided to investigate the effects of a biochar amendment on soil that has been affected by honeysuckle in order to determine if biochar can have a positive effect in growth of species in soil affected by honeysuckle's allelopathy.

Methods

We collected three soil types from different areas of Mt. Storm: one place where honeysuckle was present, one with no honeysuckle, and one where honeysuckle was removed three years ago. After sieving, 500 mL controls were used for each, then we amended each type as follows:

- biochar amended: 400 ml soil + 100 ml biochar
- compost amended: 400 ml soil + 100 ml compost
- biochar+compost amended: 400 ml soil + 50 ml biochar + 50 ml compost

We used 72 small pots, 6 per each soil + amendment combination. Each pot was planted with 2 radish seeds and watered daily in a 68ºF greenhouse environment. After 28 days the smaller seedling was thinned out. We recorded days until germination and at 14 and 28 days we recorded # of sprouts, height of largest plant, and # of leaves. We tested soil chemistry of soils and biochar using a HACH kit (NPK-1). We mixed 35mL soil in 70mL water & after 2 days of incubation we measured nitrate and phosphate, and tested pH using test strips.

Analysis & Results

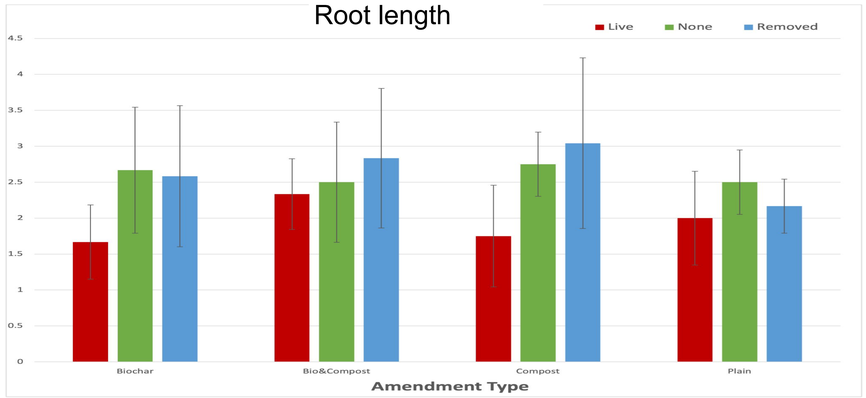

Figure 1. Mean root length of radish after 4 weeks. The live honeysuckle soil had roots that were significantly shorter than the other soil (P=.0021)

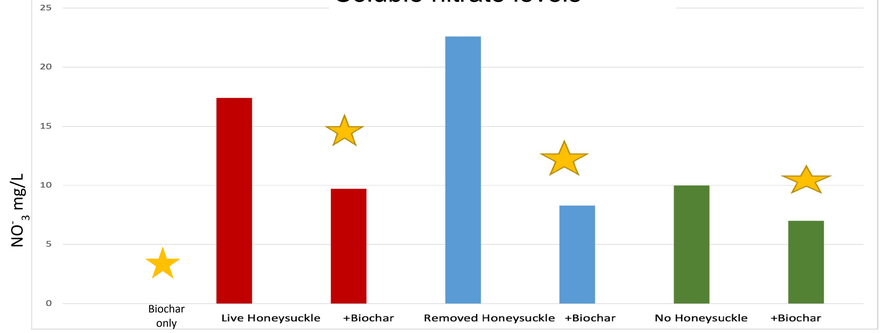

Figure 2. Nitrate levels for biochar alone, each soil type (left), and each type + biochar amendment (starred).

Living honeysuckle	Control: no honeysuckle present	Recently removed honeysuckle
No amendments (#)	No amendments (#)	No amendments (#)
With biochar (B#)	With biochar (B#)	With biochar (B#)
With compost (C#)	With compost (C#)	With compost (C#)
With biochar + compost (BC#)	With biochar + compost (BC#)	With biochar + compost (BC#)

Table 1. Variable combinations tested.

We conducted four, 2-factor ANOVA tests for soil type and experimental amendments. We measured final plant height, days until germination, # of leaves, and root length. The only test found to be significant was root length, and only the soil type was significant. Soil from the area with live honeysuckle had roots that were significantly shorter than the roots from the other types of soil (F = 6.8428; p = 0.0021).

In our study, the samples with biochar did not have any significant effect on the variables tested. Given that there was no significant difference, the biochar did not have a negative or a positive impact on any of the outcomes.

Nitrate was found to have the most significant difference between the soil and the soil amended with biochar. Biochar contained no nitrate. Nitrate levels decreased when biochar was added to the soil.

Conclusions

To our knowledge, this is the first study in the Cincinnati region to examine if the allelopathy of honeysuckle is impacted by biochar. Biochar did not help or hurt the growth of radish plantings in soil. The roots in the live honeysuckle soil were shorter, which could be due to the allelopathic effects of honeysuckle. It could also be a result of honeysuckle decreasing the quality of the soil.

The biochar decreased the nitrate levels which could be due to biochar preventing nutrient leaching. The biochar may have absorbed the nitrate, preventing it from being filtered into the water that we used to run the soil tests.

Given the scope of this study, although no effects were found to be caused by biochar, it should be further examined how biochar amendments in the city of Cincinnati will affect the growth of both native and nonnative species in the area. In particular, this study should be modified to allow for the examination of native species to see how they are affected by honeysuckle allelopathy, both in and without the presence of biochar.

References

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Acknowledgements

We would like to thank Cincinnati Parks, The Common Orchard Project, and Carbon Harvest LLC.