Biochar As A Soil Amendment

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Introduction and Objectives

Biochar can be used as a soil amendment to aid in the growth of plants. It can reduce leaching of nitrogen and nitrous oxide emissions, as well as moderate soil acidity and increase water retention. However, due to its low mass, biochar is easily moved and carried away by wind and water.

The objective of this project was to create a pellet composed of biochar and clay which will aid in keeping the biochar from eroding away. The pellet should be strong enough to not break when handled, but still contain enough biochar to be beneficial as a soil amendment.

Methods

Granulator (Fig. 1 and 2)

- Research on granulation of fertilizer pellets was first conducted
- The granulator was constructed with a one foot diameter, 2 foot length barrel, variable rotation speeds and angles, and spray nozzle
- A feeder was placed at the top end of the barrel to feed in the soil/biochar mixture.

Biochar

- Switchgrass was dried at 105 °C for 24 hours
- The dried switchgrass was ground to a particle size of less than 2mm
- Ground switchgrass was placed in a crucible and covered with a lid, then placed in a furnace set at a temperature of 800 °C for 7 minutes.

Pellets

- Soil/biochar pellets were made using the granulator
- A soil:biochar ratio of 5:1 by weight was used to form pellets
- The mixture was fed into the granuator, and mixed with water from the nozzle
- The barrel of the granulator was hit to keep the mixture from sticking
- Pellets rolled to the end of the barrel and were collected

Pellets Alternate

- An alternate method to from pellets was also used with a 10:1 ratio by weight
- With this method, the soil/biochar mixture was combined with water to form a wet paste
- This mixture was then squeezed from a bag to form soil/biochar drops
- Two types of soil with different clay contents were used in this method

Pellet strength for both methods was tested using Instron. Pellets were dried for 24 hours at 105° C before testing.

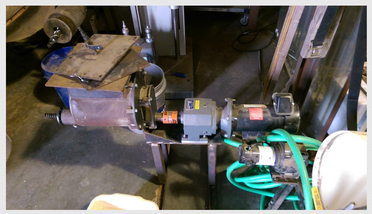

Figure 1: Feeder used to feed soil into granulator barrel

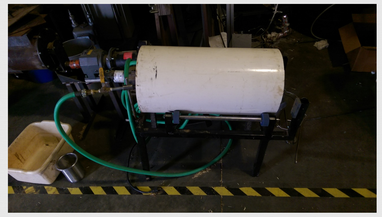

Figure 2: Granulator used to make soil/biochar pellets

Results

Pellets

- Pellets formed using the granulator varied in shape and size
- Pellets formed using the alternate method were more consistent in shape and size

Instron Testing

- Peak load for each pellet sample was tested three times
- The mean peak load was then determined for each sample

Table 1 : Composition for soil

	% Sand	% Silt	% Clay	Used in Sample
Soil 1 *(CB)*	60.0	21.2	18.8	1
Soil 2 *(clay)*	25.0	37.5	37.5	3, 4
Soil 3 *(MS)*	33.8	25.0	41.2	2

Table 2 : Peak load of pellets

	Peak Load (N)			Mean	Std. Dev
	Trial				
	1	2	3		
Pellet 1	3.58	4.60	6.71	4.96	1.60
Pellet 2	17.30	16.21	19.46	17.66	1.66
Pellet 3	23.72	29.66	51.69	35.02	14.74
Pellet 4	4.57	5.35	7.71	5.88	1.64

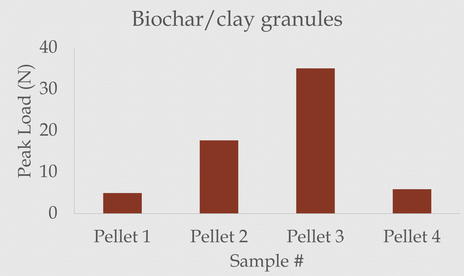

Figure 3: Peak load data obtained from Instron testing of pellets

Figure 4: Pellets sample #1 with soil 1/biohar (10:1 ratio)

Figure 5: Pellets sample #2 with soil 3/biochar (10:1 ratio)

Figure 6: Pellets sample #3 with soil 2 (no biochar)

Figure 7: Granulated soil/biochar pellets 4 (5:1 ratio)

Discussion and Future Work

The data from Instron testing (Table 2 and Fig. 3) showed that the pellets with a higher clay content took more force to break. Even with a low soil to biochar ratio, soil with a higher clay content took more force to break.

Pellet size and shape formed using the granulator was less consistent than pellets formed using the alternate manual method (Fig. 4-7). This is due to the ability to control pellet size and shape during the create of pellets during the alternate manual method, while granulation was not optimized and pellets were freely rolling.

In future studies, the ratio of soil to biochar could be varied to investigate their effect on pellet strength. The pellets will also need to be investigated to evaluate effects on plants, in order to determine application rates and quantities. The biochar to soil ratio for optimum benefit must be determined. The suspension mixture will need additional research and testing.

References

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