A Novel Approach to Use Second Generation Biofuel Crop Plants (*Camelina sativa, Miscanthus giganteus,* and *Panicum virgatum*) to remediate Abandoned Mine Lands in Pennsylvania

Edward A. Gerst[1], Tyler Bowe[2]*, Matthew Robinson[3]*, Alison Shuler[1], and Sairam Rudrabhatla[1]

[1]Penn State Harrisburg, 777 Harrisburg Pike Middletown, PA 17057, [2]Cheyney University of Pennsylvania, 1837 University Circle Cheyney, Pennsylvania 19319.
[3]Tuskegee University of Alabama, 1200 W. Montgomery Rd, Alabama.
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Abstract

The basis of our investigation is to observe the abilities of three biofuel crops' (*Miscanthus giganteus, Camelina sativa, and Panicum virgatum*) to phytoremediate marginal soils affected by coal refuse and/or acid mine drainage. To test this hypothesis we chose soil from three locations upon the land holdings of the Eastern Pennsylvania Coalition for Abandoned Mine Land Reclamation (EPCAMR) in Ashley, PA. We believe that each of these species of biofuel crop will respectively show favorable removal of heavy metal contamination in each of three experimental soil types.

<u>Through this experiment we hoped to answer the following questions:</u>

1. **Which of the three (3) biofuel crops we selected [*Camelina sativa, Miscanthus giganteus, or Panicum virgatum*] has the ability to survive in the marginal soils affected by coal mining operations?**
2. **Do any of the aforementioned species thrive in such conditions?**
3. **Do any of these biofuel crops have the ability to Phytoremediate soils contaminated by heavy metal contaminants?**
4. **Do any of the aforementioned plant species behave as a hyper-accumulator of any of the pollutants studied?**
5. **What is the feasibility of using any of these plant species to phytoremediate contaminated soils and also as a source of energy following phytoextraction?**

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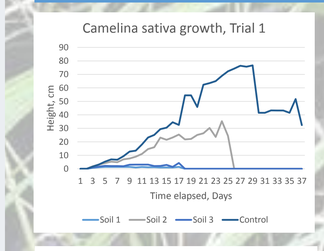
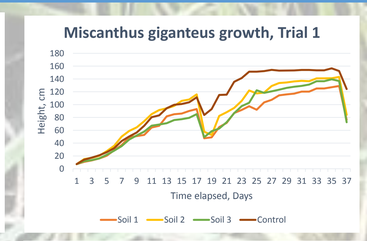
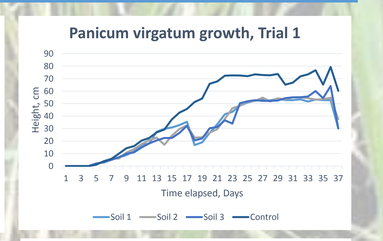
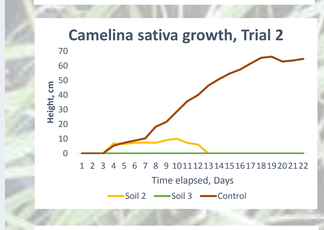
Methods

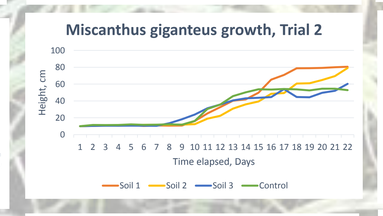
Results

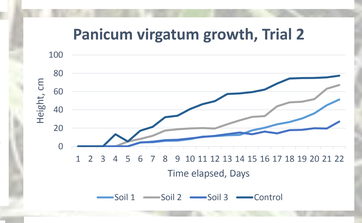


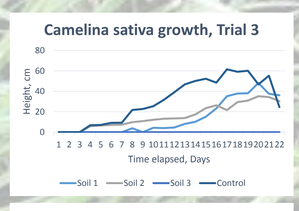


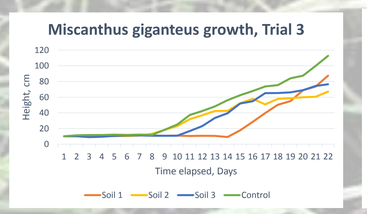


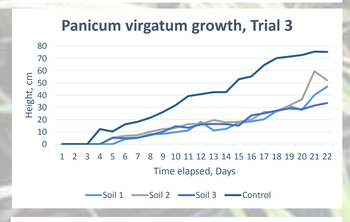


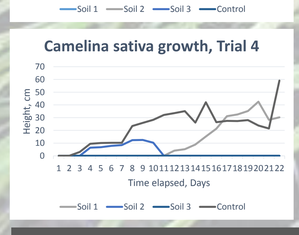


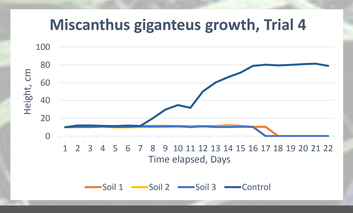


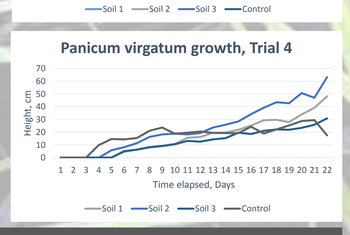












Bibliography

• The full bibliography can be attained upon request. Eag222@psu.edu.
• All photographic images were taken by Edward A. Gerst, 2012 with the exception of the greenhouse external image (http://harrisburg.psu.edu/places/central-pennsylvania-research-and-teaching-laboratory-biofuels) and http://www.lehighvalleyfoundation.org/sites/www.lehighvalleyfoundation.org/files/imagecache/220w/logos/EPCAMR-logo.png for the EPCAMR logo.

Discussion

- **Germination results:**
  - ***Panicum virgatum* specimens were more successful over time.**
  - ***Camelina sativa* specimens started off strong but did not grow well.**
- **Growth Results**
  - ***Miscanthus giganteus* had best overall growth, but had high water demand.**
  - ***Panicum virgatum* had steady growth with lower water demand.**
- **Lab Results**
  - **There were instances where phytoextraction appeared occur for Al, As, Ba, Cr, Pb, Hg, and S in each of the biofuel crops.**
  - **There appeared to be instances of hyper-accumulation.**
- **Mass-Balance Results**
  - **The theoretical mass-balance was sketchy in the instances where the chemical concentrations were not detected.**
  - **The leachate was not considered in the experimental design.**
  - **There were unexpected instances where the outgoing soil concentrations were higher than the input soil concentrations.**
  - **Net zero mass-balance was achieved in a few situations.**

Conclusion

1. ***Miscanthus giganteus* and *Panicum virgatum* appeared to be the most able to adapt to the experimental soils.**
2. ***Miscanthus giganteus* produced the greatest amount of biomass.**
3. **Each of the species displayed instances of phytoextraction.**
4. **There were instances of hyper-accumulation.**
5. **Feasibility for the use of these biofuel crops for phytoextraction must be determined in a case by case basis depending upon results of a cost benefit analysis.**

- **Field application studies could be conducted.**
- **Possibly repeating the experiment including analysis of the leachate and mass measurements.**
- **Continue research with different species and/or varieties of biofuel crops.**
- **Apply transgenic crop experimentation to aid with tolerances to harsh environments.**
- **Combustion tests with stack testing for air quality toxicity determination.**