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An Investigation on the Influence of a Biofilm Fertilizer on Plant Growth and Soil Geophysical Properties

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An Investigation on the Influence of a Biofilm Fertilizer on Plant Growth and Soil Geophysical Properties

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Background & Significance

A biofilm is a grouping of one or more types of microorganisms in which cells stick together. Atmospheric nitrogen (N_2) can be converted into ammonia (NH_3) by organisms in a process called biological nitrogen fixation, becoming more bioavailable for plants to use. ***Anabaena cylindrica*** is a non-toxic nitrogen-fixing cyanobaceria (NFC) that has been proposed use as a biofertlizer.

A biofilm of ***Anabaena cylindrica*** around the base of one of the wheat plants

Hypothesis

We hypothesize that during the dynamic interaction of the NFC biofilm with the soil matrix, the geophysical properties of the soil change. These changes are correlated with the health of the plants from chlorophyll readings and plant height, thus the health of the plants can be monitored through automated geophysical measurements.

Methods

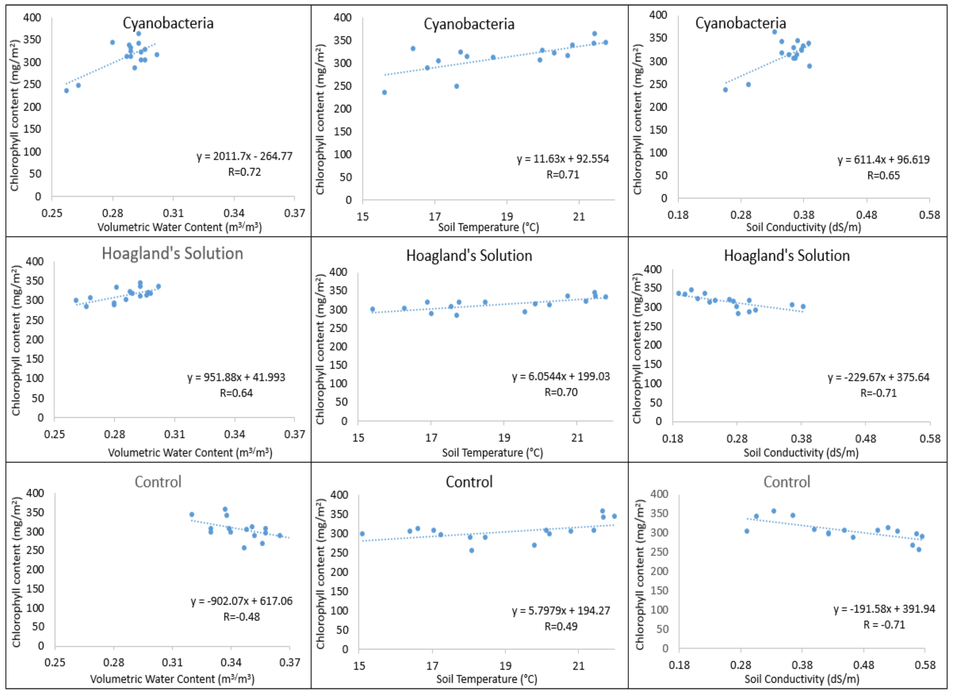
- ***Anabaena cylindrica*** was cultured in the laboratory using distilled water, controlled lighting and appropriate nutrient media BG-11
- Plants were treated with the NFC and grown along side two control groups
- One control group was treated with a hydroponic nutrient solution known as Hoagland's solution while the other was just given water
- Geophysical measurements of soil moisture, temperature and electrical conductivity took place automatically every 15 minutes using Decagon 5TE sensors
- Plants were measured for physical growth and chlorophyll content twice a week with Optisci CCM-300

Decagon 5TE Sensor

Optisci CCM-300 Chlorophyll Content Meter

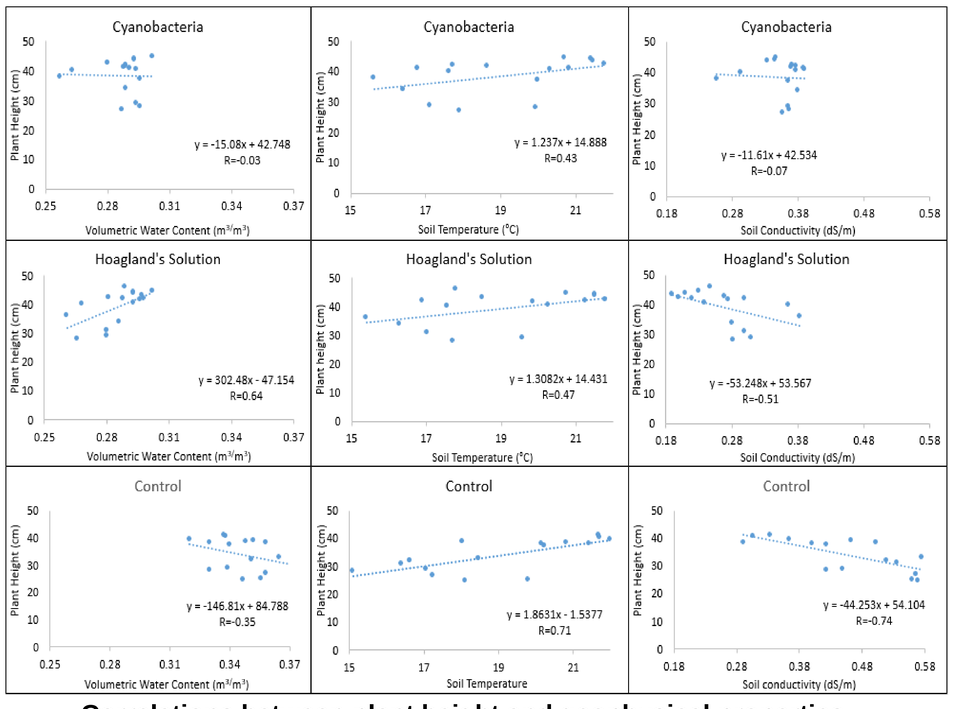
Results

Chlorophyll



Correlations between chlorophyll content and geophysical properties

Plant Height



Correlations between plant height and geophysical properties

Anabaena cylindrica culturing on the left, wheat plants growing in 2 gallon pots on right

Conclusions

During the course of the growth period thus far from May to July, the plants treated with the biofilm have matched the acceleration in growth of the Hoagland's solution as compared to the water only control group. Interestingly, the only plant to bloom so far is one in the biofilm group.

When comparing chlorophyll content to soil conductivity strong correlations were found; however, the plants with biofilms had a positive trend while the control groups had negative trends, meaning a decrease in conductivity as chlorophyll increased. Strong correlations were also found between chlorophyll and moisture content. The biofilm group like the Hoagland's group saw an increase in chlorophyll as moisture content increased. There was also a very strong correlation between temperature and both chlorophyll content and plant height. These correlations allow us to monitor the health of the plant through automated geophysical measurements without time consuming biological measurements.

Future work

- Project will continue throughout August, as plants are currently just beginning to bloom
- Reduce watering frequency to investigate the biofilm's ability to retain water during times of water stress
- Conduct experiment again with stronger concentration of ***Anabaena cylindrica*** for the biofilm

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