What kind of Native Vermont Plant is the most efficient carbon sequestration tool? By: Megan, Caitlyn and Clara

Background/Motivation:

Carbon sequestration is the long term storage of carbon in carbon sinks such as the ocean, plants, and soils (Figure 1). CO2 accumulates in the plants as they continue to grow (Selin). This makes carbon sequestration an important tool in mitigating climate change, and reducing the amount of CO2 in the atmosphere. All plants have a varying amount of efficiency in their ability to store carbon. Trees are the most well-known carbon sequesters, but we want to determine if they are also the most efficient.

Trees store most of the CO2 they accumulate in "woody biomass and leaves", while grasslands store most of their carbon in the soil (Staff). This can become a problem, because when trees are burned, the CO2 will be released back into the atmosphere. Grasslands are found to be more resilient carbon sequesters, because they are less impacted by natural disasters, especially forest fires. When a forest burns through grassland, "the carbon fixed underground tends to stay in the roots and soil" (Staff).

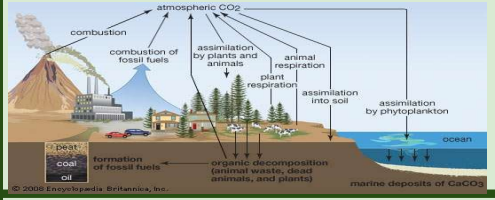


Figure 1. Carbon cycle

Hypothesis:

We hypothesize that there is a relationship between plants and carbon sequestration as well as topsoil regrowth.

Prediction:

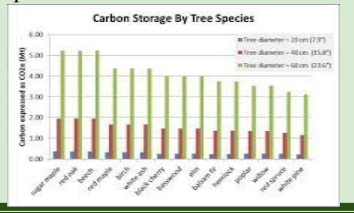
If trees and grass are compared, then grass will be more efficient at sequestering carbon and regenerating topsoil because of its rapid growth and regrowth, and because grasses are better at restoring carbon to topsoil while trees tend to store their carbon within their woody bark.

Study design:

We are conducting a long-term manipulative field experiment in a greenhouse where we are simulating a Vermont environment by using native Vermont plant species. The predictor variable is the type of native vermont plant, and the response variable is the rate of carbon sequestration. The study will span over 10 years. We are comparing 2 native Vermont tree species (Sugar Maple: *Acer saccharum* and Red Oak: *Quercus rubra*) and 2 native Vermont grass species (Cutty Grass: *Carex buchananii* and Blue Sedge: *Carex flacca*) in their ability to sequester carbon from their atmosphere in to the soil (Figures 2 and 3). We will create 3 separate plots for each plant species, all in their own enclosed atmospheres, as well as 3 plots with no plants as our control. We will then will pump a set amount of CO2 into each atmosphere to replicate the average vermont atmosphere based off of the 2012 greenhouse gas inventory for Vermont emissions of 8.27 MMtCO2e (Forest Carbon). Over a ten year period we will continue to replenish the plant atmospheres with equal amounts of CO2 and watch as the plants grow from their seeds while recording how quickly the carbon in the atmosphere diminishes from the air as well as how much carbon is found sequestered in the soil.

Figure 2.
Cutty Grass

Figure 3.



Intended analysis:

In this experiment, the resulting data will show if grass or trees are more efficient in sequestering carbon, as well as the efficiency of each specific species. The predictor variable is considered categorical and the response variable is continuous, so we would use either a t-test or ANOVA to conduct statistical analysis. If we were to compare only grass and trees, we would use a t-test since there are only two categories. For the t-test, the average carbon expressed and the standard deviation would be used to create a p-value comparing the two categories to test statistical significance. If the p-value is less than 0.05, then the data is significant, and there is a difference between the carbon sequestration levels between trees and grasses. But, if we were to compare the different species of trees and grasses we would use ANOVA because there are more than 2 categories. In an ANOVA test, we would compare the F-statistic to test the statistical significance of the individual species.

Citations:

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