Black Gold: The Effect of C3 vs. C4 Feedstock on Carbon Sequestration of Resultant Biochar

Mugundu Pradeep, Swathi (School: Northview High School)
Saran, Chinmaya (School: Northview High School)

Biochar can serve as a long-term carbon sink in terrestrial ecosystems. While there is significant research on the agricultural applications of biochar, the impact of C3 vs C4 feedstock on the carbon capture efficiency of the resultant biochar is largely unexplored. The following research and experimentation indicate how the method of carbon metabolism, C3 or C4, affects the amount of carbon the resultant biological charcoal (biochar) sequesters. It was hypothesized that C3 feedstock would create biochar that sequesters more carbon when compared to C4 feedstock as although C4 plants can fix more carbon than C3 plants in stressful conditions due to their efficient photosynthesis, soil organic carbon (SOC) derived from C4 plants is more labile than its C3 counterpart. As C4-derived soil organic carbon is less stable, it may limit the capacity of biochar produced from C4 biomass to act as a long-term carbon sink, owing to the carbon source's greater volatility. To test this hypothesis, two closely related species in the Poaceae family, bamboo (a C3 plant) and sugarcane (a C4 plant), were separately pyrolyzed to create biochar. Ash and moisture content were experimentally derived through the use of a muffle furnace and hot air oven respectively, while details about mass fraction of volatile matter for bamboo and sugarcane biochar were derived from related literature. Fixed carbon content values were calculated and after using a 95% confidence interval and t-test, it was found that at the slow pyrolysis conditions used in this experiment (600°C), biochar made from the feedstock of C3 plants (bamboo) has a statistically significant greater fixed carbon content than biochar made from the feedstock of C4 (sugarcane) plants.

Awards Won:

Fourth Award of $500