Characterization of Photosynthesis Rates in a Managed Forest Ecosystem to Optimize CO_2 Sequestration Ability

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Introduction

Carbon dioxide levels in the atmosphere are rising, contributing to many global changes associated with rising temperatures. The rate of CO_2 increase may be partially counteracted by managing urban areas to increase carbon sequestration by plants by replacing turf with forest-like communities. Characterization of CO_2 uptake rate by various Michigan native and non-native species found in the a Calvin College woodlot could help to inform this restoration process.

$$6\ CO_2 + 6\ H_20 + \text{light energy} = C_6H_{12}0_6 + 6\ 0_2$$

Objective

•To determine and compare total CO_2 uptake rate by leaves of 8 native and 2 invasive species found in the Calvin Fieldhouse woodlot

•To initiate a long–term restoration and monitoring program in the PE woodlot by removing buckthorn and transplanting several native species

Method

•Photosynthesis rates of plants in the woodlot were measured using a TPS-1 (PP systems) gas exchange sensor.

•Two leaves in the sun and 2 leaves in the shade were measured on each plant.

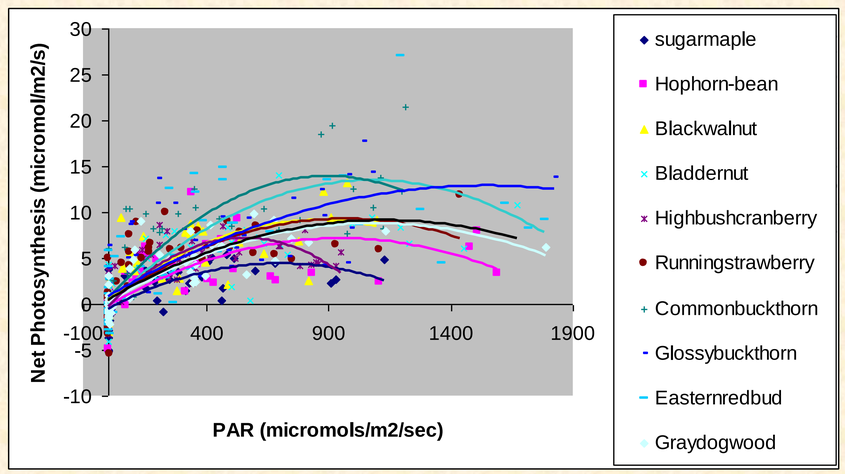
•Buckthorn was removed from parts of forested areas on Calvin's campus, and native species were planted.

Before removal.

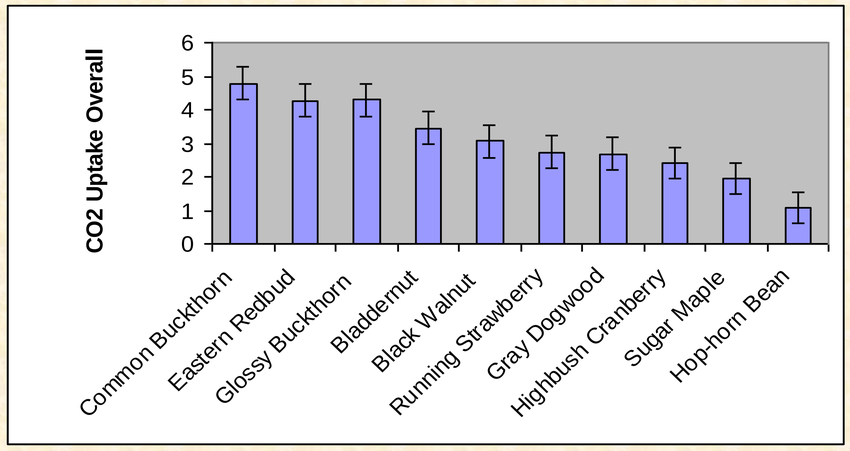
After removal.

Transplanted block.

Results



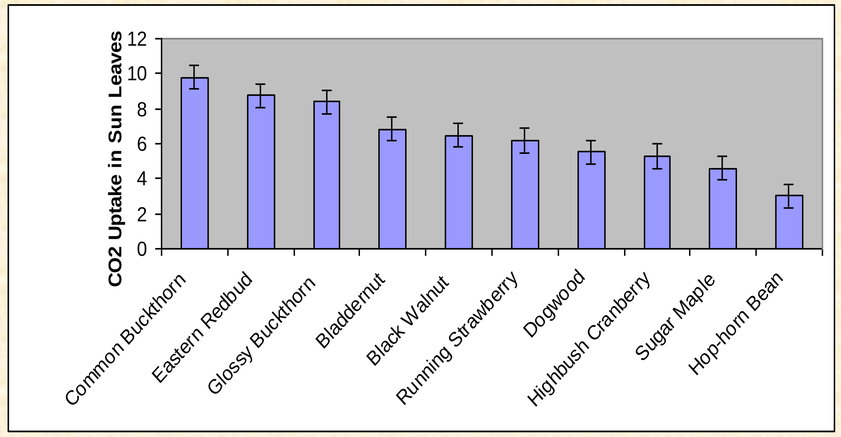
Polynomial relationships describe the rate of carbon fixation as a function of light intensity. R^2 average = 0.62**



Only eastern redbud and bladdernut can compete with either buckthorn species in CO_2 uptake rates.

Light level	Mean WUE	Light level	Mean LUE
Sun	3.8	Sun	0.02
Shade	0.0	Shade	-0.04

Differences in both light use and water use efficiency among the species tested were statistically insignificant.



Eastern redbud was the only species able to compete with buckthorn on CO_2 uptake of sun-exposed leaves. There was no significant difference among species' in CO_2 uptake rate of shaded leaves.

Conclusions

•Only eastern redbud and bladdernut can compete with buckthorn in regards to carbon fixation.

•If desired plants are placed in high light areas, CO_2 uptake will be optimized, since WUE and LUE do not vary between species in the environments tested.

•In varied light environments, such as that found in the woodlot canopy, some species are more competitive in some light environments than others.

•Restored areas will be monitored throughout their development to determine survivorship and growth rates as a consequence of buckthorn treatments.