Background

• Global climate change largely depends on the atmospheric carbon balance, of which soil respiration is a significant component.
• Native perennial prairie vegetation is being tested as an alternative to corn for renewable biofuel production.
• Mixtures of this vegetation are considered ‘carbon negative’ because net CO₂ sequestration exceeds atmospheric release.
• Studies have shown that aboveground biomass and the rate of carbon sequestration are both increased by planting a diverse mixture of species versus a monoculture.

Research Question:
How does the diversity of biofuel vegetation mixtures affect soil respiration, aboveground biomass and belowground biomass?

Methods

- Experimental Design: 4 replicate plots of 4 diversity treatments
  - Treatments:
    • 5 species – switchgrass monoculture
    • 5 species – warm season C4 grasses
    • 16 species – grasses, forbs, and legumes
    • 32 species – grasses, forbs, legumes, and sedges
- Soil respiration was measured 5 times throughout the summer of 2015 using a LI-COR LI-8100A Automated Soil CO₂ Flux System and averaged for each plot
- 1 soil core (7.5 cm W X 15 cm D) was taken from each plot and roots were washed, dried and weighed to find belowground biomass
- Aboveground biomass was collected annually from 2010-2013 and averaged for each plot

Results

Figure 2. Average soil respiration rates (µmol/m²/s) for each treatment separated by sampling round. Sampling round had a significant effect on respiration (p<0.001, below) and there was a marginally significant difference among diversity treatments (p=0.091).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>µmol/m²/s</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>36</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Soil</td>
<td>36</td>
<td>0.011</td>
</tr>
<tr>
<td>Diversity</td>
<td>36</td>
<td>0.091</td>
</tr>
<tr>
<td>Soil x Diversity</td>
<td>36</td>
<td>0.091</td>
</tr>
</tbody>
</table>

Soil Respiration

Figure 3. Bars represent average belowground biomass (g/m²), and black line represents average aboveground biomass (g/m²), which varied significantly across treatments.

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Conclusions

• Soil respiration rates increased with time throughout the growing season across diversity treatments.
• In this preliminary study, diversity did not have a significant effect on soil respiration; however, studies have revealed significant effects of diversity as well as other factors including leaf N, soil temperature and soil moisture.
• Aboveground biomass was significantly different between diversity treatments while belowground biomass was not, which is likely due to differences in sampling intensity.

Ongoing Work

• Analyzing effects of soil type, nutrient availability, temperature and moisture on soil respiration rates
• Measuring root density and growth rates using minirhizotrons
• Investigating the role of litter decomposition on carbon sequestration in the context of biofuel production

Acknowledgements

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Literature Cited