Restoration and Respiration

Introduction

Organic matter and soil respiration provides useful indicators for understanding carbon dynamics and therefore how soil carbon reacts to global change (Trumbore, 2000). Evidence suggests that carbon is held in three primary pools (Figure 2) and that the majority of carbon processed by soil microbes is comparatively older. We tested whether this carbon bias is maintained in a former agricultural field that was restored to tallgrass prairies. We hypothesized that soil microbes process older carbon, as evidenced by an isotopic signature associated with agricultural crops, rather than the newer carbon inputs from the prairie plants. We also measured soil respiration, the process of carbon dioxide release from roots and the decomposition of organic material done microbes. Soil respiration is an important indicator of ecosystem productivity (Lou et al, 2006).

Materials and Methods


Results:

One critical and unresolved component of soil dynamics is the age of processed carbon.

Table 1. Known effects of herbivory and diversity on respiration.

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<thead>
<tr>
<th>Soil Respiration Rate</th>
<th>Herbivory</th>
<th>Diversity</th>
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<td>In response, plants may increase below ground growth→ increased respiration (Holland, 1995)</td>
<td>In response, respiration rates should increase, most likely driven by increased productivity (Zak et al. 2003)</td>
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Figure 3. Oakridge study site. The red outline marks the herbivory enclosures. The light green circles mark the high diversity area (seeded with a seed mix of 58 species), while the remaining area was seeded with 14 species. Plots are 32m x 32m and interior circle has a diameter of 19.2m.

Soil cores (10 cm deep and 2 inches diameter) were taken from all plots in both high and low diversity areas. Samples were stored at -20C. Samples were thawed seven days before testing. Testing was done on a TGA to read respiration rates and carbon isotope emissions. Analysis was done in R using linear models.

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Discussion:

• Contrary to our hypothesis, we found that soil microbes process the much newer carbon inputs from the planted prairie plants, as indicated by the greater proportion of respired C3, rather than the older carbon pools which are more C4 dominant.

• In this system, new carbon inputs constitute a significant or even dominant fraction of the actively-cycling carbon pool.

• There does appear to be a temporal lag in carbon processing. C3 plants make up ~80% of the plant cover, but only ~65% of respired carbon is C3. This suggests that there is still a legacy effect from the previous agricultural regime.

• Overall, microbial respiration rates did not vary by diversity level, suggesting that below ground productivity is similar in both diversity treatments. Herbivory also did not significantly affect microbial respiration rates.

• Above ground, high diversity areas with herbivory are almost exclusively C3, suggesting that herbivory has stronger negative impacts on C4 plants compared with C3. This, however, was not reflected below ground.

Figure 2. The estimated age of each carbon pool and its contribution to the carbon produced by the soil as described in the Century Model (Parton, 1993).

Figure 4. Proportion of C3 plant cover by treatment, diversity and herbivory. C3 cover was significantly greater in high diversity plots (p <0.001) but did not significantly differ between herbivory treatments (p=0.07).

Figure 5. Soil respiration rates across herbivory and diversity treatments did not significantly differ (diversity: p = 0.07; herbivory: p=0.79).

Figure 6. The difference in proportion of respired C3 under different levels of herbivory and diversity. There was a significant difference under different diversity levels (p<0.001).

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