Rhizosphere Priming of Cover Crop Decomposition

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Introduction

•As a large reservoir of organic carbon (C) and nutrients, soil organic matter (SOM) plays an important role in plant growth and ecosystem functioning.
•**Rhizosphere priming** is a process by which plant root labile C stimulates or suppresses SOM decomposition through microbially mediated processes.
•We lack an assessment of the relative importance of priming effects on C and nitrogen (N) cycling in agricultural systems.
•We studied the rhizosphere priming effect of corn on cover crop decomposition in the context of an organic cropping system in Rock Springs, Pennsylvania.

Objective: Determine the effect of corn rhizosphere C allocation on cover crop litter decomposition and plant N uptake.

Materials & Methods

•Clover (low C:N ratio) and rye (high C:N ratio) litterbags were buried within plots with legacies of clover, rye, and no (fallow) cover crops. Corn and no corn treatments were established within each cover crop treatment.
•Plots were destructively sampled at 8 and 10 weeks after corn planting to measure litterbag decomposition and soil C and N pools (Figure 1).
•The ^{13}C natural abundance method enabled the distinction between C derived from corn (C_4) vs. C derived from SOM and litter (C_3).

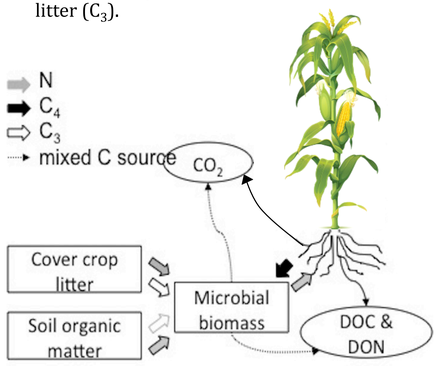

Figure 1. Measured sources and sinks of C and N.

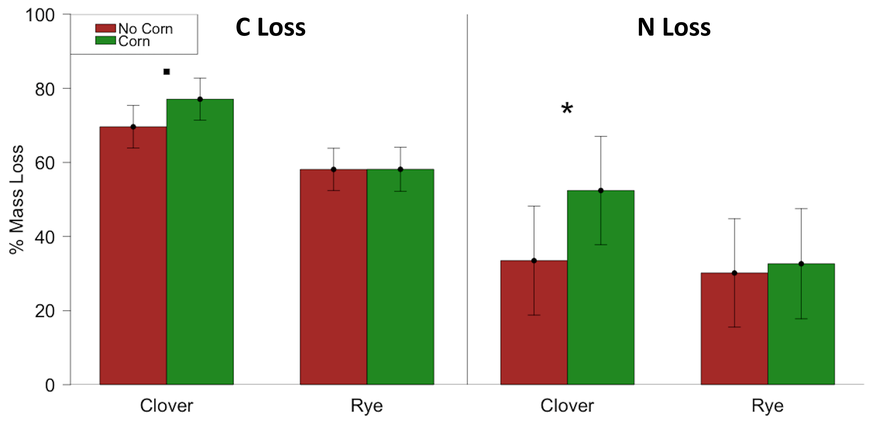

Figure 2. Percent C and N loss from rye and clover litterbags after 10 weeks in plots with and without corn in 2013.

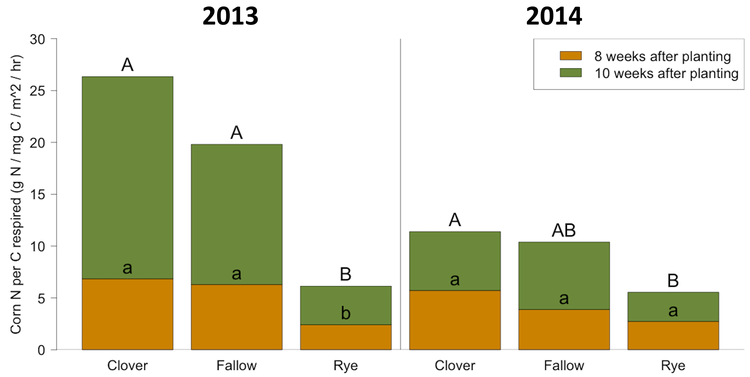

Figure 3. Total N in aboveground corn biomass per unit of corn-derived soil CO_2 respiration in plots following a clover, rye, or no (fallow) cover crop.

Results & Discussion

1) Corn stimulated the decomposition of the N-rich clover litter in 2013, but had no effect on rye decomposition (Figure 2).
- •Priming led to greater N loss than C loss in the N-rich litter (Figure 2), supporting the concept that priming is a microbial N-mining response to raise soil N availability.
- •We did not see a priming effect in 2014 (data not shown) likely due to more soil moisture in no corn plots, suggesting the effect of priming is small compared to environmental drivers of decomposition.

2) Corn was able to access more N in clover and fallow plots per unit respiration than rye plots (Figure 3).
- •There may be a higher C cost for corn to access N from lower quality litter.

3) We did not find an increased contribution of corn-derived C in dissolved organic C or microbial biomass in any of the cover crop plots. Additionally, there were no priming-related trends in C3-derived respiration.

Conclusions & Implications

Priming of clover litter and SOM contributed to greater corn biomass and uptake of N compared to corn grown in plots with legacies of fallow and rye cover crop treatments. Most models of C and N dynamics rely mainly on environmental parameters such as temperature and moisture to predict decomposition patterns. However, the results of this study suggest that rhizosphere priming is a significant process driving C and N dynamics in agricultural systems.

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