Cover Crops and the Fate of Nitrogen

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INTRODUCTION

Cover crops, a sustainable agricultural practice, store nitrogen in plant biomass and prevent leaching during the winter months. After termination, the cover crop is used as mulch ahead of the growing season. The mulch serves to both suppress weeds and release nitrogen back into the soil for that season's cash crop uptake. We do not yet know how soil conditions and soil microbial communities impact the amount of nitrogen available for plant uptake. In this literature review, we sought to understand the fate of nitrogen from cover crop termination and the potential interaction with soil microbes.

METHODS

During the summer of 2020, we conducted a literature review of scientific studies to gather information on what is already known about the fate of nitrogen stored in cover crops and how termination methods may affect it. Google scholar was the primary search engine used to gather information. Keywords included nitrogen, termination, cover crop, microbes, and management.

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1. Mechanical methods, such as disking and roller crimping, are just as efficient at terminating cover crops as chemicals like glyphosate. This may result in a less expensive, long term management tool than annual chemical applications (Ashford et al. 2013).

A tractor terminating a crop with a roller crimper.

2. The timing and mode of cover crop termination affects nitrogen availability, and as such, causes variation in crop yield and microbial populations. With some cover crop species, disking has shown to increase nitrogen mineralization and crop yield more than roller crimping (Liebman et al. 2018).

A disking attachment cutting the earth.

3. The bulk amount of nitrogen derived from decomposing cover crops will be held in the soil while a smaller percentage will be taken up by the growing cash crop. An even smaller percentage is held in soil microbial biomass.

A field without cover crop treatment.

4. The trend of nitrogen primarily ending up in the soil is dependent on variations of soil moisture, climate, texture, and the C:N ratio of the cover crop. For example, species of wheat have a higher C:N ratio than bean plants such as faba or peas, leading to greater nitrogen immobilization in soil pools. A cover crop with a lower C:N ratio can reduce N immobilization (St. Luce et al. 2013).

A field of corn growing with a cover crop of clover.

Next Steps

Isotopic labelling will be a critical technique used in the study's next steps. Elements have different isotopes that exist at varying percentages. As an example, ^{14}N is the most abundant form of nitrogen while ^{15}N is far less common. Since ^{15}N is scarce in nature, we can use it to trace where nitrogen travels in the soil. A plant can be experimentally grown with extra ^{15}N (enriched). When that ^{15}N-enriched plant decomposes and the nitrogen is mineralized, we can measure the concentration of ^{15}N in various soil and plant pools to tell where the nitrogen ended up. See figure 1 for an example of isotope tracing.

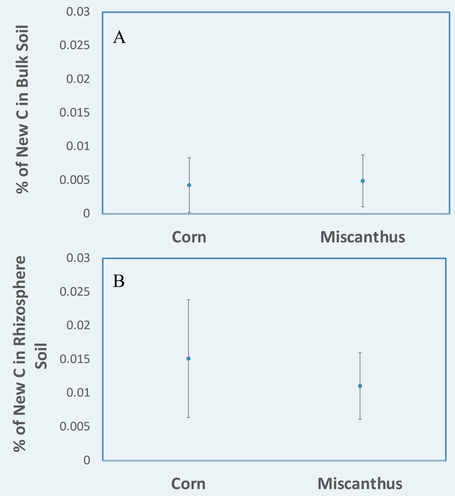

Fig. 1. Example of isotope tracing using ^{13}C. Enrichment of ^{13}C in the bulk soil (A) and rhizosphere soil (B) derived from two crops: corn and miscanthus. These results show an increase in enrichment of ^{13}C in corn and miscanthus soils closer to the roots (rhizosphere soil). Also, ^{13}C enrichment is significantly larger for corn in the rhizosphere indicating a difference in below ground carbon allocation between annual corn and perennial miscanthus. These results demonstrate the utility of stable isotope tracing in agricultural soils. We propose to use ^{15}N to trace nitrogen from cover crop to soil and microbial pools.

The proposed study will be relevant for the climate of the Northeastern United States. In the literature review, multiple studies claimed that their findings were more applicable for the climate they were conducted in. To gain a broader understanding of the fate of nitrogen from cover crops, the study may need to be repeated in multiple climates and soil types.

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