Decomposition of nitrogen containing plant residues and composts is a crucial source of nitrogen in agroecosystems, particularly under organic management. Inherent variability in decomposition rates across soils and ecosystems presents challenges for predicting nutrient supply for crops from these amendments. One factor contributing to this variability is the composition and structure of the microbial community of the soil, particularly bacterial species, understanding the role community structure plays is central in developing our understanding of the biological aspects of decomposition.

Agricultural output of crops with high nutrient demand (e.g., maize) requires soils to be amended with nitrogen fertilizers for economical production. Plants require mineral nitrogen for growth, and cycling nitrogen between organic and mineral forms is a crucial process to understand for efficient agricultural management. Following the green revolution and development of synthetic mineral fertilizers, agricultural output has increased significantly to feed the growth of the human population. This increase in production is paralleled by increased mineral fertilizer usage and agricultural output, with environmental side effects. Not only does the production of these fertilizers contribute to increases in atmospheric greenhouse gases, but soluble mineral fertilizers can leach into our waterways and cause eutrophication and degraded water quality.

Soils under crop production in agricultural ecosystems are currently a significant source of nitrogen pollution in surface and groundwaters, largely due to the use of synthetic fertilizers.

Nitrogen fertilization with organic amendments is an alternative to synthetic fertilizers with a wide range of potential soil health benefits from the additional organic matter. In organic amendments, nitrogen is provided to soils from plant litter, microbial cells, and animal wastes. Compared to synthetic fertilizer, little is known about the soil nitrogen cycle from organic amendments. This is partly due to the variety of amendments…. We do know that amendments are good because…. However, the key to using these amendments to replace commercial fertilizers is a better understanding of how mineral and inorganic N is made available in the soil. Specifically, we need to identify the key microbial players that are involved in nitrogen cycling.

Previous research has revealed that organic matter in soils, particularly N-bearing compounds, must be depolymerized into smaller compounds that can be assimilated by microbes or acted upon by extracellular enzymes before assimilation. Depolymerization regulates N cycling and controls N entering the microbial pool where it can then be mineralized into plant available forms. Balancing the rate of depolymerization and mineralization of nitrogen from soil organic matter to closely match the needs of the growing plant will provide a more efficient supply of nutrients to plants while minimizing losses to the environment. This biologically mediated process has been associated with litter/amendment C: N ratios below 25:1. When C: N ratios of more than 25:1 are observed in litters and amendments, immobilization has been observed, which is the utilization of nitrogen compounds for microbial growth at the expense of plant available mineral nitrogen. Thus C: N ratios are a critical factor affecting the impact of organic fertilizers on levels of plant available nitrogen in the soil.

In this study, we aimed to understand specifically the soil microbial response to organic amendments. Improving our understanding of the biological players involved in nutrient release could help improve agricultural production while still maximizing environmental benefits from complex amendments. We hypothesize that distinct microbial communities respond to varying organic amendments. In this study, we study the impacts of amendments of both alfalfa and compost, provided at 3 equal rates of total nitrogen, to a soil but with differing C: N ratios ….let’s work on this paragraph together!.... immobilization (compost) or mineralization (alfalfa). We characterize both the chemical and microbial response to these amendments and hypothesize that specific microbial communities will respond to initial nitrogen and carbon availability and that this membership will be specific to varying amendments. We expect that these distinct early microbial responders will dominate soil microbial communities in response to organic amendments and will decrease in abundance through time. Our objective was to characterize these early responding microbial communities for various organic amendments and to identify potential microbial membership within organic amendments that may be involved in plant nutrient availability.