Management affects the weed suppression potential of soil microorganisms and green manures

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Introduction and Methods

Agricultural soils are home to thousands of species of microorganisms with the potential to provide biocontrol of undesirable weed populations. Unlocking this microbial potential requires a mechanistic understanding of how farm management practices affect microbial functions and how these management-microbial interactions can be leveraged for desirable outcomes. The use of cover crops as green manures can suppress the emergence of early season weeds, and green manures may also stimulate microbial activity in ways that enhance weed suppression (increased plant pathogen populations) or diminish it (degradation of allelochemicals). Do soil microorganisms increase or decrease the weed suppression potential of green manures? Do these interactions vary across different management regimes, and do they depend upon microbial community composition? We conducted weed seed germination assays using live and sterilized soils from a variety of farm systems. We then partitioned the total weed suppression in these treatments into components representing the unique contribution of soil microorganisms, the unique contribution of green manures, and their interaction. We used high-throughput DNA sequencing to understand how microbial suppression and the microbe-green manure interaction depend on soil microbial community composition.

Results and Conclusions

We found that green manures have a high, but temporary, suppressive effect on weed seed germination. Live soil microbial communities also have an inherent capacity to suppress weed germination. This microbial suppression was more stable over time than what was provided by green manures, but the magnitude of microbial suppression depended on microbial community composition. Microbial weed suppression was highest in organic systems and lowest in no-till systems, which suggests that different management techniques can be used to foster weed suppressive microbial communities. In general, we found live microbial communities diminished the effectiveness of green manures, leading to a negative interaction between green manures and microbes. However, the strength of this negative interaction varied along with temporal and system-based differences in microbial community composition. We conclude that understanding this microbial variation, in the context of management decisions that directly affect soil microbial communities and their activities, can help farmers optimize cover cropping and green manure strategies for maximal weed suppression.

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