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Cover crops enhance carbon and nitrogen storage in soil microaggregates

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Winter cover crops growing in a cotton–corn rotation system at the R. R. Foil Plant Science Research Center in Starkville, MS. Photo courtesy of Wei Dai, postdoctoral research

associate and first author on the study.

Aggregation of soil particles plays a crucial role in maintaining soil health, nutrient cycling, and carbon sequestration in agricultural systems, particularly in dryland farming. Soil organic matter is essential for aggregate development. However, improper farm management practices deplete organic matter. Therefore, it is significant to explore soil management practices that build organic matter to recover and promote soil functions. Adopting winter cover crops may help rebuild soil organic matter, but uncertaintities remain regarding how different cover crop species influence soil aggregate dynamics and the roles of various aggregate size fractions in regulating carbon and nitrogen storage.

A three-year study in the R. R. Foil Plant Science Research Center of Mississippi State University evaluated five cover crop treatments including rye, radish, peas, and their mixtures on soil aggregation and nutrient stocks within a no-till cotton–corn rotation system. Results indicated that aggregate stability remained similar across treatments with microaggregates (< 0.25 mm) serving as primary reservoirs for carbon and nitrogen. Peas and diverse cover crop mixtures, however, resulted in the highest soil carbon and nitrogen stocks, suggesting that species with different rooting patterns and residue quality might work together to improve soil productivity.

These findings suggest that diversified cover crop strategies involving legumes can effectively boost organic matter and enhance nutrient accumulation in aggregates, which offers a promising pathway to improve long-term soil health and sustain agroecosystem productivity in dryland agriculture.

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Dai, W., Feng, G., Adeli, A., Brooks, J. P., Jenkins, J. N., & Zhang, X. (2025). Effects of cover crops on soil aggregate-associated organic carbon and nitrogen characteristics in a cotton–corn rotation system. *Soil Science Society of America Journal*, *89*, e70137.

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