Linking intra-aggregate pore size distribution with organic matter composition, evidence from FTIR and X-ray tomography

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Background:

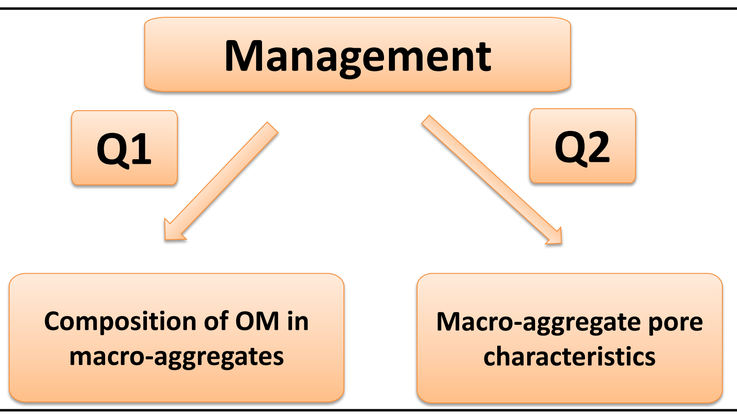
- Macro-aggregates contribute to maintaining soil functions e.g. protection of *soil OM.*
- Land management is a key controlling factor in macro-aggregate turnover. Thus, abundance and stability of macro-aggregates are used as early indicators of management intensity.
- Within-aggregate pore characteristic is a less-seen aspects of macro-aggregates. Pores indirectly regulate

Turnover of macro-aggregates e.g. through diffusion of gases and solutes and accordingly, microbial activity and community inside the aggregate.

Research Questions:

1-Does long-term management affect composition of OM in macro-aggregates?

2-Is there a relationship between OM properties of macro-aggregates and their pore characteristics?



Martials and Methods

- Study site: Long-Term Ecological Research (LTER) Site at Kellogg Biological Station, MI.
- Management history: 23 years

Management	Vegetation
Conventional	Corn-Soybean-Wheat
Cover Crop	Corn (rye)-Soybean-Wheat (clover)
Natural Succession	Mixed annual and perennial herbaceous

Study 1:

We combined **FTIR**, **^{13}C-NMR** and **δ^{15}N** techniques to assess composition of OM in macro-aggregates under contrasting management systems. We used FTIR and ^{13}C-NMR indices that reflect OM decomposition status in comparative studies.

Results:

Table1 . Organic matter properties of macroaggregates as affected by management

Management	C/N	δ^{15}N	^{13}C-NMR		FTIR			
			Alkyl C/ O-Alkyl C	Arom-C/ O-alkyl	Index1	Index2	Index3	Index4
Conventional	9.6[a]	4.64[b]	1.06	1.09	1.37[a]	1.3[a]	1.04[a]	1.28[a]
Cover Crop	9.6 [a]	3.76[a]	0.94	0.85	1.17[b]	1.23[b]	0.94[b]	1.17[b]
Natural Succession	10.9 [b]	3.18[a]	0.88	0.79	1.20[b]	1.17[c]	0.95[b]	1.20[b]

Results suggest that long-term adoption of less intensive management systems has resulted in shift in OM properties of macro-aggregates towards abundance of less decomposed compounds

Study2:

We determined pore size and distribution of 4 intact macro-aggregate from the natural Succession system using **X-ray tomography** technique. To find possible relationships between pore characteristics and OM composition, we cut the macro-aggregates into sections (totally 27) and assessed OM properties of each section using **FTIR** and **δ^{15}N.**

Results:

Table 2. Results of multiple regression analysis between OM properties derived from FTIR indices and δ^{15}N and proportions of intra-aggregate large and small pores.

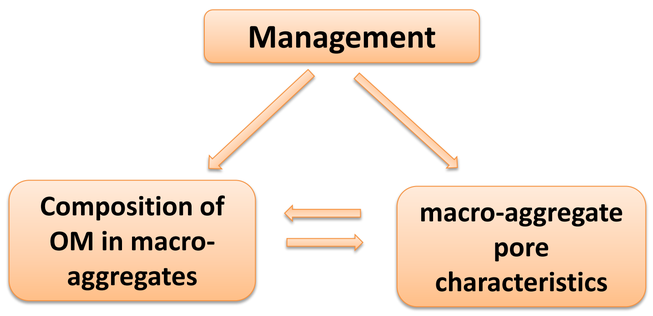
Response variable	Regression slopes		Multiple regression coefficient (R^2)	Number of observa-tions
	Large pores (>115 um)	Small pores (13-30 um)		
δ^{15}N	-65.5	-12.5	0.24	22
Index 1	-16.5	-6.9	0.75	12
Index 2	-17.3	-1.08	0.51	12
Index 3	-14.9	-1.5	0.41	12
Index 4	-12.9	-4.5	0.74	12

All values are significant at α=0.1 level. Bold indicates significance at α=0.05. δ^{15}N and all indices increase with increasing decomposition status of OM

Highlights:

1- Macro-aggregates under less intensive systems showed properties associated with less decomposed OM.

2- In macro-aggregates under the Natural Succession system, abundance of small and large pores was positively related to lower OM decomposition status.



Future research is needed to validate the importance of the findings of the study under a wider environmental and soil conditions.

This research is supported by the United Soybean Board, Award No. 1420-732-7230, and is part of a regional collaborative project supported by the USDA-NIFA, Award No. 2011-68002-30190 "Cropping Systems Coordinated Agricultural Project (CAP): Climate Change, Mitigation, and Adaptation in Corn-based Cropping Systems" sustainablecorn.org