INNOVATION GRANT FINAL REPORT

PROJECT TITLE: What is it about manure?
REPORTING PERIOD: Final Report and Invoice due by Oct 29, 2021
FARMER INNOVATOR:
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1.) PROJECT ACTIVITIES COMPLETED DURING THE REPORTING PERIOD. (*Describe project progress specific to goals, objectives, and deliverables identified in your project proposal.*)

Final analyses of potentially mineralizable carbon (PMC, Objective 4) particulate organic matter (POM, Objective 3), and permanganate oxidizable carbon (POXC, Objective 1), were completed.

2.) IDENTIFY ANY SIGNIFICANT FINDINGS AND RESULTS OF THE PROJECT. (*This could include photo documentation of the project at various stages if you haven't already provided these as well as final relevant images of the project at completion. Any data analysis (especially Level 3 Grants), graphics or record of observations throughout the growing season or during the field day event are also anticipated.)*

We were able to separate POM from manure only with great difficulty, and low recovery of manure suggest that the results should be interpreted with caution. Normal recovery is 95-105%, and we recovered a maximum of 85% of the material. As expected, solid and semi-solid manure had greater POM than liquid. There may still be some value in investigating particle size distribution of organic matter in manure, but different dispersal agents and sieve sizes would need to be used. Total quantity of POM was lower than anticipated and similar to soil, suggesting that enteric digestion breaks down most of the larger particles of organic material.

Table 1:

Manure types	POM (g)	% mass recovered
Liquid Separated	2.01 (0.28)	84.8 (0.73)
Solid	3.86 (0.10)	79.9 (3.79)
Semisolid	3.10 (0.34)	79.6 (5.18)

With regards to POXC, an assay reliant on plate-reading technology, high total C required substantial dilution of the manure in order to read samples within the recommended range of the instrument. Specifically, total C in the manure ranged from 22-30%, an order of magnitude greater than most agricultural soils. We reduced the manure used from 2.5 g to 0.1 g, and increased the permanganate solution (from 2 mL to 6 mL) to make sure there was sufficient permanganate to react with the most of the manure C. Results were, as expected, still very high, ranging from 24,904-79,636 g POXC/kg soil. A recent review of many soil types found that using lower soil mass for analysis slightly increased POXC values, so our results should only be compared within this study, as most studies do not use less than 0.25 g of soil (Margenot et al. 2021). However, this study also found that while POXC increased with total SOC (g/kg soil), POXC represented <3% of all high-SOC soils (samples with SOC>40 g/kg soil). In manure, POXC made up about 20% of the total C.

Table 2:

Type of Manure	mg/kg POXC	POXC (% of total C)
Liquid	38927 (8632.2)	17.4
Semisolid	61055 (9639.1)	20.5
Solid	61642 (4079.9)	22.9

Low POM and high POXC is likely beneficial for conversion of manure C to protected soil C. C sequestration occurs when microbes incorporate C into their bodies, and microbial necromass is associated with mineral particles in the soil. POM needs to be decomposed by larger organisms prior to this microbial assimilation. POXC, on the other hand, is expected to be readily mineralized and assimilated by microbes. What remains to be seen is whether soil combined with manure types with high POXC retains that C over time, which would point to POXC as an excellent indicator of manure potential to spur SOC sequestration.

3.) CHALLENGES ENCOUNTERED. (*Describe any challenges that you encountered related to project progress specific to goals, objectives, and deliverables identified in the project proposal.*)

Continued method adaptations slowed lab work, but we are satisfied with the results we are able to present here.

4.) EDUCATION AND OUTREACH ACTIVITIES. *(Describe any opportunities to engage with farmers, influencers or the media about your project.)*

None in this period, but all PIs will incorporate these results into their winter Extension programming. In addition, further experiments may test hypotheses generated from this research.

5.) HOW CAN WE HELP? *(Please let us know how we can improve the experience for the next generation of projects.)*