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Research Brief

Digested Dairy Manure Solids Improve Productivity of Eroded Soils

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No amendment (eroded soil)

Digested manure solids added

Topsoil added

Soil and digested manure solids added

Key Findings:

- One-time application of 18 tons/ac digested dairy manure solids to severely-eroded soil improved crop yields by an average of 15-22%.
- Yield increases were similar with addition of digested manure and replacement of 6-8 inches of eroded topsoil 6 years earlier.
- Digested manure did not change soil organic matter, but greatly increased soil P. Soil addition increased soil organic matter, N, and K.
- In corn, combined manure and topsoil addition improved yield compared to manure alone.

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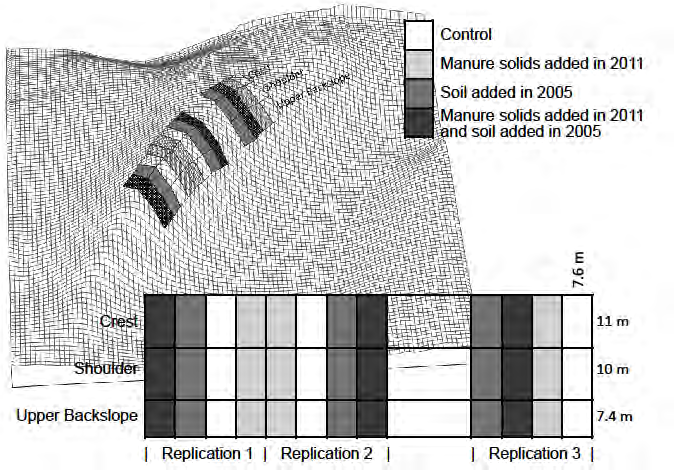
Background

- The use of anaerobic digesters is increasing to produce energy, and digested manure can be used as a soil amendment.
- There are large differences in the properties of digested manure amendments, and the conditions of soil application vary widely.
- This study addressed land application of an anaerobically digested manure product to improve crop production in low-yielding, severely eroded soil.

Objective

Evaluate crop response and soil properties in highly-eroded land with

- No amendment
- 6-8 inches of soil added once in fall 2005
- 18 tons/acre of manure solids added once in fall 2011
- Both soil (2005) and manure solids (2011) added

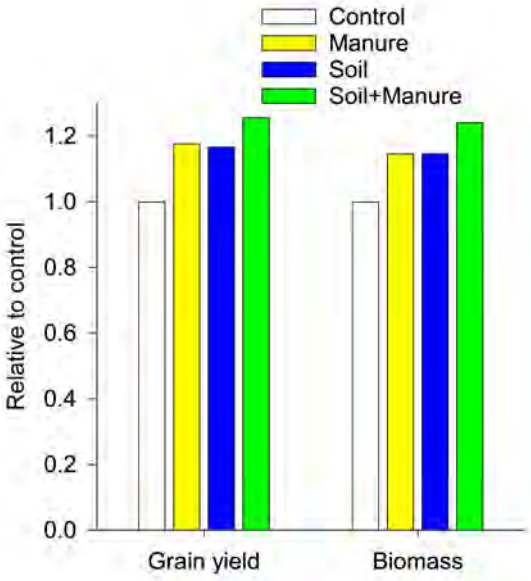


Methods

Fresh dairy manure was treated by anaerobic digestion. Digestate was passed through a solids separator, followed by a dewatering system, then applied to the field and incorporated by chisel plow.

Crop and soil response was measured for the following 5 growing seasons.

Results

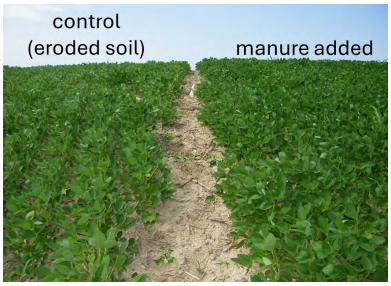


Plant Response

Manure addition and soil addition (6 years prior) increased crop biomass and yields by the same amount.

Yield increases in the combined soil+manure plots were less than the independent effects of manure and soil addition.

Soil addition improved corn test weight and protein; manure did not (data not shown).



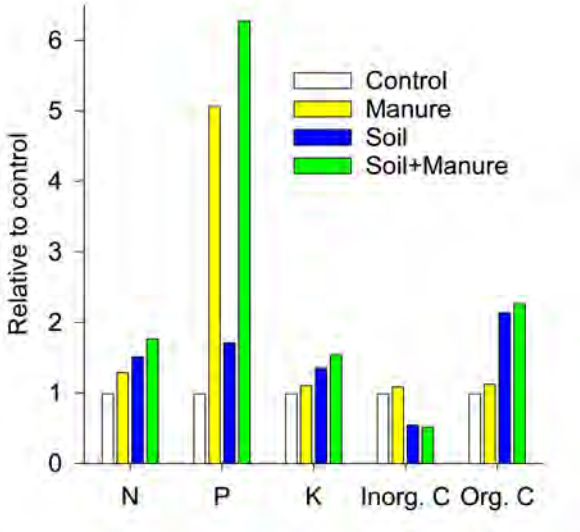
Soil Nutrients

Manure addition did not change organic matter concentrations because digestion removes easily biodegradable organic material.

Manure addition greatly increased soil P.

Soil addition increased soil organic matter, N, and K.

Increases in nutrients in the combined soil+manure plots were the sum of the manure and soil effects.



Conclusions

- Under the favorable weather conditions of this study, anaerobically-digested dairy manure solids were a viable soil amendment to improve crop productivity.
- One-time application of 18 tons/ac digested manure solids was effective in increasing crop yields for the next five years.
- We expect that digested would be most effective in improving crop yields in soils with root restrictions from dense subsoil (brought near the surface by severe erosion) and poor water availability (a combination of reduced water holding capacity and ineffective rooting).

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Next Steps

More research is required to determine the effectiveness of anaerobically-digested manure solids over a broader range of weather and soil conditions, and to evaluate the environmental risks of this practice.

We are collaborating with other scientists to evaluate approaches to build soil organic matter and improve soil productivity to sustain farm profitability and rural economies.

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Questions or comments?
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About NCARL

The North Central Agricultural Research Laboratory (NCARL) is a USDA-Agricultural Research Service laboratory located in Brookings, SD. The goal of NCARL is to develop, document, and promote soil, crop, and pest management practices that are ecologically sustainable while maintaining producer profitability.