Swine manure and cedar woodchip applications improve soil ecological indicators and improve moisture retention

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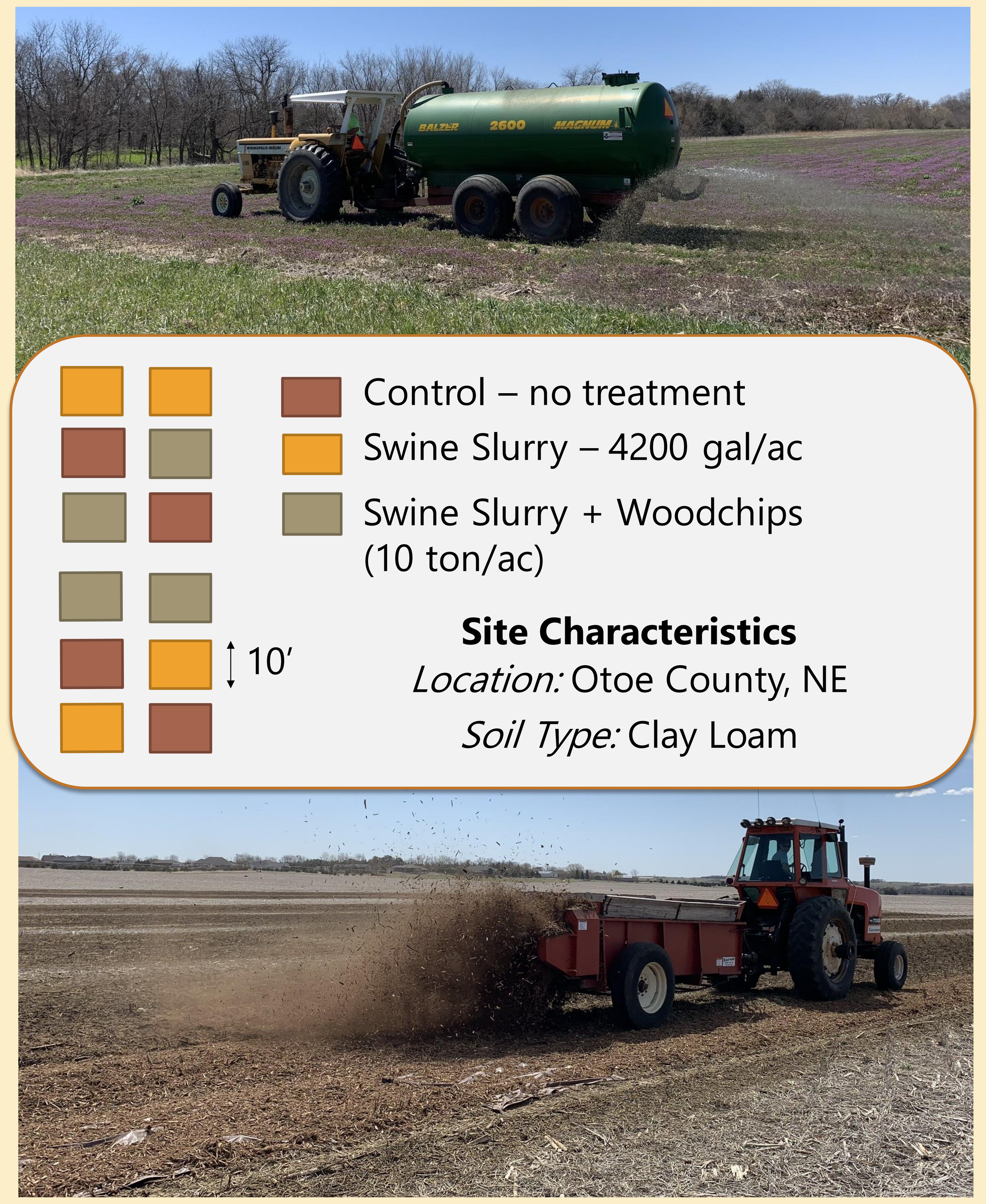
BACKGROUND

Manure application has long been used as a soil amendment to supply nutrients for crop growth. However, the effects of manure on many other aspects of soil health have been less fully explored, especially in on-farm research settings. The health of soil biological communities has been shown to be positively correlated with the addition of organic materials and soil moisture. This study looked to confirm these observations in an on-farm setting using two types of organic treatments: swine manure and cedar woodchips and their impact on arthropod abundance and soil biological quality (QBS), measured through arthropod adaptations to deep soil living conditions (ecomorphological index).

OBJECTIVE

Evaluate soil biological quality (QBS) through arthropod adaptations to deep soil living conditions (ecomorphological index) where manure and woodchips have been applied.

STUDY DESIGN



METHODS

1)Collect. At establishment (Day 0) and at 5 other days during the growing season (25, 54, 81, 99 and 128) roughly 1-gal of soil was collected from each plot by randomly sampling using a 2-in diameter sampler to a depth of 8-in.

2) Dry. Samples were transferred to Berlese-Tullgren funnels for extraction of arthropods. A 70% ethanol solution was used to preserve the organisms for later analysis. Additionally, a ~50-g subsample of the material was used to determine the moisture content of the soil.

3) Examine. Preserved arthropod specimens were identified and quantified to the order or family level using light microscopy.

EMI scoring range by arthropod group

Group	EMI Score
Protura	20
Diplura	20
Collembola	1-20
Microcryphia	10
Zyngentomata	10
Dermaptera	1
Orthoptera	1-20
Embioptera	10
Blattaria	5
Psocoptera	1
Hemiptera	1-10
Thysanoptera	1
Coleoptera	1-20
Hymenoptera	1-5
Larvae	10
Other (adult)	1
Acari	20
Araneae	1-5
Opiliones	10
Palpigradi	20
Pseudoscorpiones	20
Isopoda	10
Chilopoda	10-20
Diplopoda	10-20
Pauropoda	20
Symphyla	20

4) QBS. The QBS method assigns an eco-morphological index (EMI) score based on soil adaptability level of each arthropod order or family. For some groups, such as Coleoptera, characteristics of edaphic adaptation were used to assign individual EMI scores for each arthropod. Each sample was then assigned a total QBS score, which is the sum of the EMI values for each category of arthropod found in the sample.

RESULTS

We observed that on days when soil moisture content was high, QBS differed significantly among treatments, while no differences were observed during periods of low soil moisture content. This indicates that soil moisture is the most important soil factor for soil arthropods collected from the top 8 in of soil. Likely this is because soil arthropods tend to migrate away from heat and drying to more favorable conditions (cooler and wetter environment). Thus, it was only when soil moisture was higher overall that arthropod populations in the soil were high enough to show a difference between treatments. For example, on day 54, a more variable moisture content of the soil was observed, with SSW, SS and CON having moisture contents of 4.16, 3.92, and 3.75%, respectively (Table 1). On this same day, QBS was also significantly greater for SSW (QBS=135) compared to SS (110) and CON (97). Similarly, on day 99 the mean moisture content for the SSW treatment (5.54%) was greater than for SS (4.38%) and CON (4.77%; $p<0.05$) (Table 2).

Table 1. Mean soil moisture content by treatment and time since treatment application

Treatment	Moisture %					
	Day 0	Day 25	Day 54	Day 81	Day 99	Day 128
CON	4.65	3.43	3.75^{a}	3.95	4.77^{ab}	4.31
SS	4.63	3.42	3.92^{ab}	3.71	4.38^{a}	4.10
SSW	4.68	3.72	4.16^{b}	4.27	5.54^{b}	4.63

CON=control, SS=swine slurry, SSW=swine slurry and woodchips; values within columns having the same superscript are not significantly different ($p>0.05$)

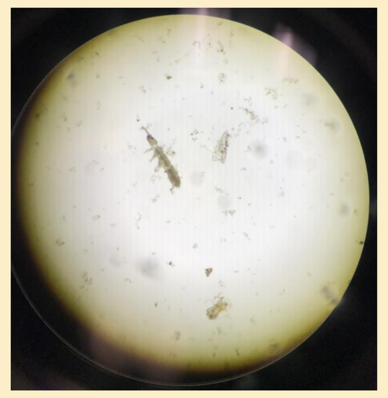
Table 2. QBS index by treatment and sampling day

Treatment	Mean QBS						
	Day 0	Day 25	Day 54	Day 81	Day 99	Day 128	Overall
CON	156	115	97^{a}	140	105^{a}	150	127.17^{a}
SS	125	106	110^{ab}	135	135^{b}	140	125.00^{ab}
SSW	140	105	135^{b}	160	141^{b}	160	137.00^{b}

QBS values having the same superscript within each sampling day are not significantly different. Absence of subscript represent no significant difference between treatments on that day ($p \geq 0.05$).

CONCLUSIONS

- The application of red cedar woodchips to provided a good habitat for soil arthropods, which in the future may increase microbial activity and soil aggregation through decomposition of organic matter and aggregate building binding.
- Swine slurry + Woodchips application also increased soil moisture content on days when any significant differences in moisture content were observed.
- Further analysis will be conducted to parse the arthropod classifications and their role on nutrient cycling more closely.
- Future research should also seek to confirm these observations in different climates and seasons of the year to observe the efficiency of the treatments, especially woodchips, to preserve soil characteristics that are favorable to microbes and arthropods.



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