Impact of Tillage and Carbon on Soil Aggregate Hydration Acoustics and Water-Stability. M. Quintanilla Tornel,[1]*, A.J.M Smucker[2], S. Gage[1], G. Bird, [1] and E.J. Park[3] [1]Department of Entomology, Michigan State University, [2]Department of Crop and Soil Sciences, Michigan State University [3]Department of Environmental Policy Gyeonggi Research Institute Gyeonggi-Do Kore

Soil is the fundamental basis of organic agriculture, and proper soil management is imperative for long-term success of the system. The objective of this research was to determine if sound (acoustical signatures) can be used to discriminate among soils and alternate soil management systems. Air-dried soil aggregates were immersed in water, $CaSO_4$, or NaHMP solutions. Sounds from each aggregate hydration were digitally recorded using a hydrophone. The acoustics were analyzed using Matlab software to produce spectrograms and bar charts of acoustical frequency distributions. Soil aggregates were obtained from a native ecosystem at Kellogg Biological Station (Michigan); forest, tilled and non-tilled agricultural sites at the Wooster, Ohio Agricultural Experiment Station and tilled and non-tilled agricultural sites in Hoytville (Ohio). Sounds recorded from tilled soil aggregates had significantly greater Power Spectral Density (PSD) and variability than non-managed ecosystems. We concluded that tilled soils contain a mixture of stable and less stable aggregates. Soil aggregates from tilled soils are generally less stable and contain less carbon than no-till and non-managed soils. Air released during wetting and slaking appears to cause greater sound in tilled soil than either the native soils or no-tilled soils. Either slow absorption of water or slow release of air resulted in lower PSD in aggregates from no-till and native, compared with the tilled soils. This is probably caused partly by organic matter that reduces the rate of entry of water into soil aggregates and reduces pressure buildup inside aggregates. This results in less breaking and bubbling, therefore less noise. Use of sound to record and quantify soil characteristics can be a useful way to evaluate relative soil aggregate water-stability associated with soils from a diversity of alternative management practices, including organic systems.

2009 Cover Crop Demonstration Report. Dan Hudson, MSUE Agronomy Extension Educator, Ingham County.

With synthetic fertilizer prices at near record levels, farmers are more interested than ever in understanding whether cover crops can improve their sustainability. In response to this interest, demonstration plots were established at two locations in Ingham County.

On or before August 1, 2009, after wheat harvest, 15' X 300' strip plots were planted into wheat stubble using a John Deere 750 no-till drill. Eighteen species/combinations were planted at each location. Individual species included: oats, spring peas (field peas), Austrian winter peas, sorghum X sudangrass, chickling vetch, forage radish, sunn hemp, cereal rye, sunflower, and annual ryegrass. By mid-September, many of the cover crops and combinations showed significant potential, both for nitrogen production/scavenging and for forage. In mid-October, yield was estimated in the most promising plots by harvesting a 0.25 m^2 area that represented a full stand within each plot.

A field that had been frost-seeded with red clover (6 lb/acre) in Spring 2008 served as a check for yield, nitrogen production, and forage quality.

Samples were taken on	Oats	Oats + Sp.	Oats +	Sp.	W.	Grass	Red	Units

October 17, 2008		Peas	W. Peas	Peas	Peas	Pea	Clover	
Total above ground N	41.9	148.7	81.8	90.4	133.7	83.8	120.6	Lbs/acre
Tons/acre dry-matter	1.66	2.80	2.18	1.16	1.45	0.97	2.10	% DM
Crude Protein	7.9	16.6	11.7	24.4	28.8	26.9	18.0	% DM
TDN	65.9	63.8	64.9	67.8	74.2	66.7	61.3	%DM
Net Energy Lactation	0.68	0.66	0.67	0.7	0.78	0.69	.63	Mcal/lb
Net Energy Maintenance	0.68	0.65	0.67	0.71	0.8	0.69	.62	Mcal/lb
Net Energy Gain	0.41	0.39	0.40	0.44	0.52	0.42	.35	Mcal/lb
Acid Detergent Fiber	29.1	31.9	29.6	28.9	19.3	27.9	34.9	% DM
Neutral Detergent Fiber	48.8	44.9	45.4	34.7	26.7	34.9	48.1	% DM
NDF 30 hr Digestibility	70.3	69.1	70.1	42.4	59.3	43.1	N/A	% NDF
Crude Fat	2.5	3.2	3.2	3.2	4.3	3.6	1.1	% DM
Starch	4.8	3.2	4.7	4.3	4.7	1.8	N/A	% DM
Sugar	21.6	15.7	17.8	18.3	19.4	11.2	N/A	% DM
NFC	34.3	26.5	30.8	32.5	33	26.8	N/A	% DM
Calcium	0.26	0.48	0.37	0.67	0.48	0.60	1.14	% DM
Phosphorus	0.2	0.41	0.38	0.37	0.42	0.36	.27	% DM
Magnesium	0.12	0.15	0.14	0.18	0.17	0.23	.29	% DM
Potassium	2.99	4.21	4.18	2.37	3.49	3.93	2.19	% DM
Sulfur	0.14	0.24	0.18	0.22	0.24	0.24	N/A	% DM

In a corn-soybeans-wheat system, red clover represents an excellent low-cost option for enhancing soil health. In a year or situation when red clover is not seeded or otherwise fails, any of the other cover crops in the table above could be an excellent alternative. More research is needed in order to adequately describe the nutrient cycling dynamics of these cover crops in different soils and systems in Michigan.

This research has resulted in a higher level of adoption of red clover on Ingham County Farms and an increase in awareness about other potential synergies between cover crops and livestock operations.

Notes that may be useful to others looking at these cover crops in the future:

- Winter peas and grass pea seem to have nodules at greater soil depths than spring peas.
- The spring pea + oat combination reaches peak biomass more quickly than the other combinations.
- Spring peas reached full-bloom in by early October; grass peas were very late-blooming; and winter peas did not bloom. In mid-November, nodule color and temperatures suggest that winter peas and grass peas can be actively fixing more nitrogen much later in the season than spring peas planted at the same time.
- Spring peas compete well with oats; if oats are planted with *winter* peas, the oat seeding rate should be very low (less than one bushel/acre) to prevent excessive light competition with the pea plants.
- This site had excellent soil structure and the winter- and grass- pea nodules seemed to form deeper in the soil profile near sites where air exchange occurs with less resistance, such as in the seed slot, between peds, and near worm holes.

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