

Our Farms, Our Future Conference St. Louis, April 3-5, 2018

SARE PROJECT FNC14-963

Mike McDonald; Partners—Paul Ackley and Russel Moss

The Analysis of Cover Crops, Soil Health, the Role of Livestock and Impact on Moisture

Introduction and Objectives

+45" in 2015 and 37" in 2016 vs. 14" in 2012. ~27" is typical BUT when and HOW does it come? A neighbor's gift of soil vs. aerial CC steps.



Participants: Paul Ackley, Bedford, IA (southwest IA); Russel Moss, Burr, NE; Mike McDonald, Palmyra, NE (southeast NE)

Basic Setup:

- Rotations of corn, soybeans and wheat; min. of 4 acre plots; grazed vs. non-grazed cover crops (CCs) after the harvest of the cash crop.

Objectives:

- Soil properties testing including water infiltration, soil density and soil organic matter levels were completed for two producers.
- Determined water usage (*note this was not informative because of the excessive rain and subsequent impact on CC growth, cash crop water usage and weight gain in cattle).
- Completed the Haney Healthy Soil Test, Basic Soil Test, PLFA (phospholipid fatty acids) tests and assess biomass were completed on the majority of fields.
- Completed an economic analysis (partially completed because of the delays in planting and excessive rains; anecdotal findings were determined).
- Determined the weight gain of cattle in CC v. grazing in cash crop stubble (general results as based upon harvest dates and CC seeding).
- Apply statistics to analyze the interplay between water usage, CC, livestock gains and cash crop yields (this was not possible nor reliable because of the aforementioned).

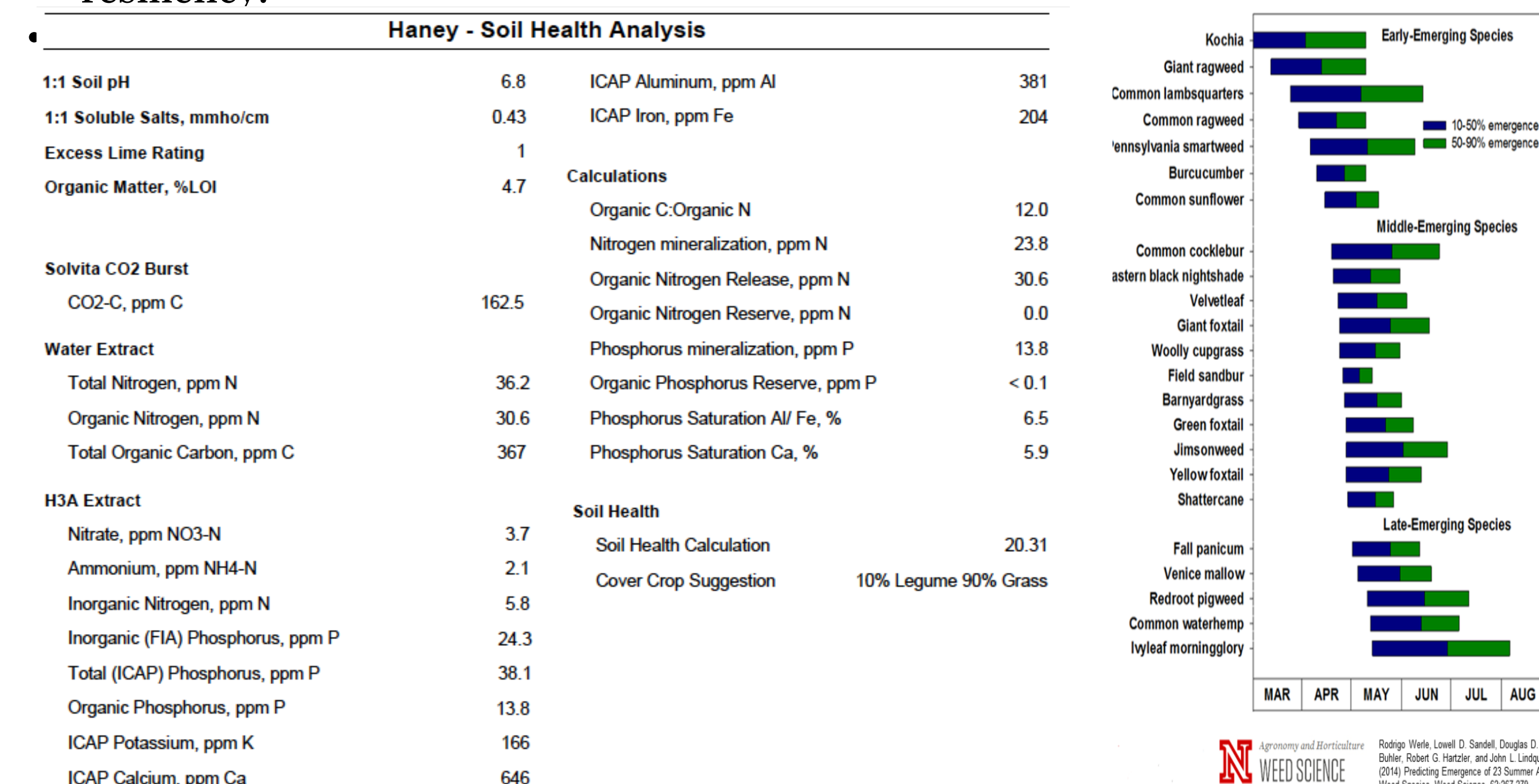
Outcomes and Impacts:

- The excessive rain impacted various outcomes and methods.
- Positive findings (not at the statistically significant level) included: increased weight gains tied to specific CCs (~.80 lbs. more/day); an increase in the

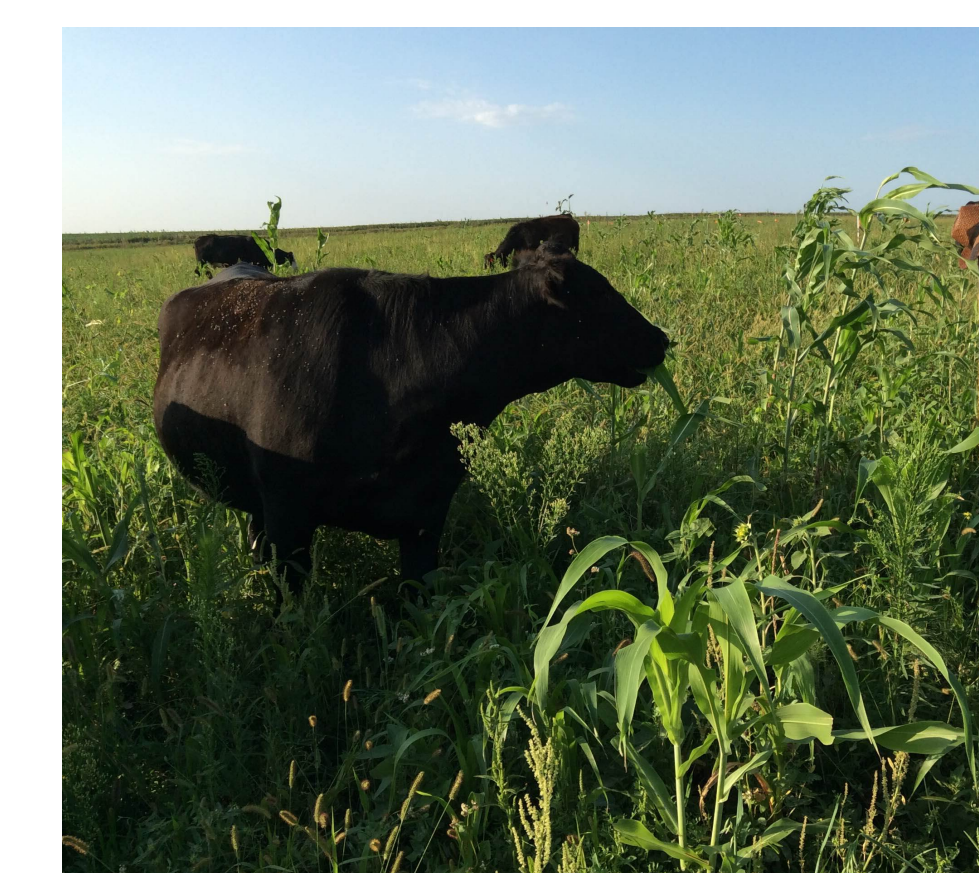
Outcomes and Impacts

Outcomes and Impacts continued:

- Haney Soil Health Score (at Ackley's and McDonald's sites) and soil loss was mitigated through a stable base of CCs during intense rains. The organic and inorganic levels for N-P-K and CC mixtures were gauged and demonstrated improvement (see below).
- The PLFA (phospholipid fatty acids) was completed for one site and the improvement was positive (see below).
- The project was inconclusive on cash crop yield gains when comparing wheat, corn and soybeans.
- The excessive rains made it difficult to determine the interplay of moisture, CC usage and increased infiltration. Anecdotal results and water sensors appear to indicate that the "tougher ground" was improving its aggregation and soil resiliency.



- The weather and impact on herbicides impacted CCs and spraying "windows" which in turn impacted which CCs could be used. Specifically, herbicide residuals are much reduced. This helps brassicas but the weed pressure is too much and impacted fall options (i.e., drilling vs. interseeding).
- The soil testing influenced the fertilizer rates and CC mixtures. In addition, Paul Ackley was asked by the Practical Farmers of IA to be a field leader. and he set up training with his local, NRCS to discuss soil health and his work.



PLFA Soil Microbial Community Analysis		
Functional Group Biomass & Diversity		
Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g		2321.76
Functional Group Diversity Index		1.491
Total Biomass	Diversity	Rating
< 500	< 1.0	Very Poor
500+ - 1000	1.0+ - 1.1	Poor
1000+ - 1500	1.1+ - 1.2	Slightly Below Average
1500+ - 2500	1.2+ - 1.3	Average
2500+ - 3000	1.3+ - 1.4	Slightly Above Average
3000+ - 3500	1.4+ - 1.5	Good
3500+ - 4000	1.5+ - 1.6	Very Good
> 4000	> 1.6	Excellent
Functional Group	Biomass, PLFA ng/g	% of Total Biomass
Total Bacteria	1275.00	54.92
Gram (+)	854.49	36.80
Actinomycetes	235.43	10.14
Gram (-)	420.51	18.11
Rhizobia	16.04	0.69
Total Fungi	227.40	9.79
Arbuscular Mycorrhizal	73.52	3.17
Saprophytes	153.89	6.63
Protozoa	20.79	0.90
Undifferentiated	798.58	34.40

Future Recommendations:

- First, narrow the focus to soil organic matter (SOM), specific CCs vs. a wide-array of CCs and one cash crop. Excessive variables resulted in general interpretations vs. specific findings in all areas. Concentrating on specific cover crops such as legumes optimizes the focus and intensifies the ability to differentiate CCs' impact.
- McDonald focused on these aspects in a separate 18 acres beyond the core study field. Anecdotal evidence appears to indicate that legume CCs (ladino-, medium red- and balansa clover) are increasing SOM and grazing forage beyond the previous plots. Because of the high-moisture, Ackley, was able to drill legumes, brassicas and grazing grasses into his wheat stubble. This step helped prevent weeds and enhanced grazing into stubble that is typically followed with a herbicide pass.
- We should repeat the same plots for at least two years. "Less is more" is a good mantra. By repeating the CCs, we enhanced herbicides, residuals and the long-term CCs particularly legumes.
- Specific herbicides should be identified so that their mode of action and site of action can be studied. Because of the rain, our weed control was poor.
- Fourth, the carbon of specific cover crops should be investigated in terms of "below-ground" exudates and relationship to intentional mixtures and CC diversity. The "above-ground" biomass is important but to truly impact water infiltration and build SOM, one has to replicate the prairie environment as close as possible if substantial gains in SOM are feasible.
- Last, the maturities of the cash crops (i.e., 109 vs. 114 day corn or 2.9 vs. 3.6 soybean) have a direct relationship with CC choices. This was not well-thought out and it ties to the environmental conditions. In order to grow substantial, CC roots/ carbon, we need to allow as much growing time as possible prior to freezing conditions. It is a balancing act with economics and soil health.