
Soil Health
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Soil Scientist

Today's Soil Health Topics

- What is Soil Health
- The Haney Test

What is Soil Health?

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Visually, this Soil Looks Healthy

Visually, this Soil Looks Un-Healthy

How Do We Put Numbers to the Visual Difference?

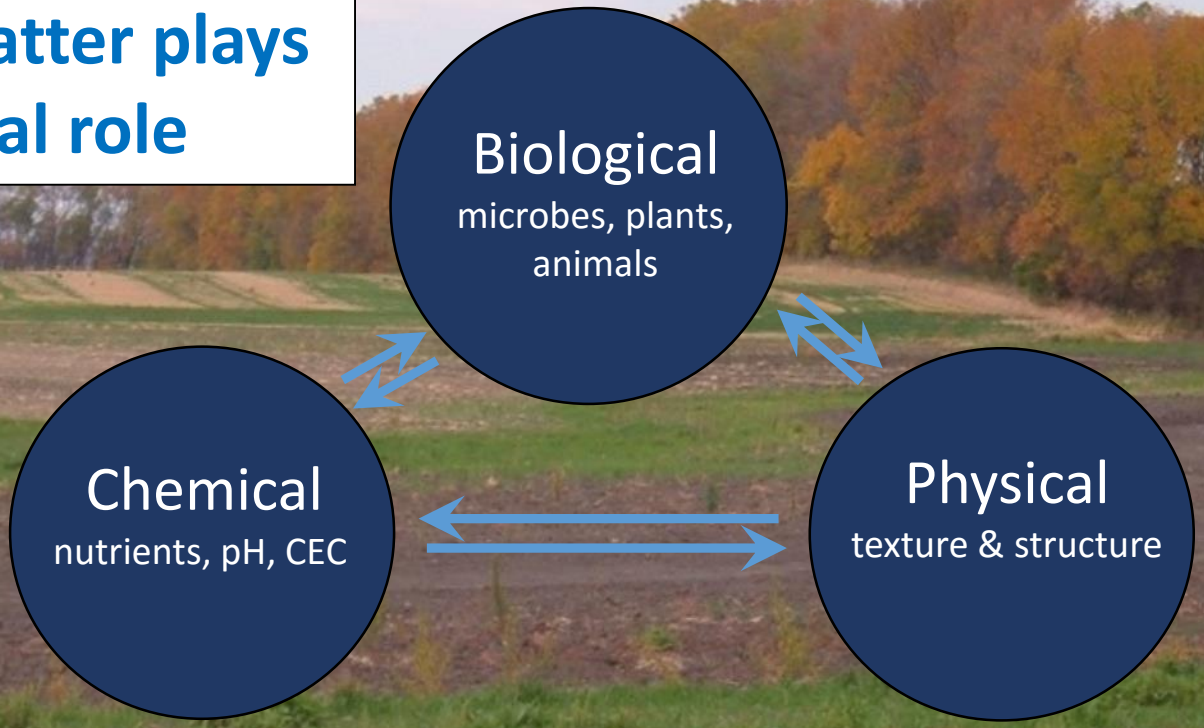
Soil Health vs. Soil Quality

- Farmers and others like the term **Soil Health**
  - Conveys whether soil is a robust or is sick/ailing resource
  - Describes Soil as a *living dynamic entity* that functions in a *holistic* way.
- Scientists like the term **Soil Quality**
  - Defined by the interactions of a particular soil's measurable chemical, physical, and micro-biological properties
  - Some of these properties can be *managed* by grower practices

Components of Soil Health

All components interact

Organic matter plays a critical role



Physical Properties

- Bulk Density
- Infiltration
- Soil Structure
- Water Holding Capacity
- Aggregate Stability

Biological Properties

- Earthworm numbers
- Microbial biomass C and N
- Particulate organic matter
- Potentially mineralizable N
- Soil enzymes
- Soil respiration level
- Total organic carbon

Chemical Properties

- Electrical conductivity (salts)
- Reactive carbon
- Soil nitrate
- Soil pH
- Extractable phosphorus and potassium

Organic matter is Key to Soil Health

- Nutrient Cycling/Reserves
  - Builds nutrient pools
  - Feeds organisms that release nutrients
- Water dynamics
  - Improves infiltration
  - Decreases evaporation
  - Increases water holding capacity
  - Improves drought resistance

NRCS - Soil Quality Factors

(Natural Resource Conservation Service)

- ***Physical:***
  - Aggregate stability
  - Available water capacity
  - Bulk density
  - Infiltration
- ***Chemical:***
  - Reactive carbon (Organic Matter)
  - Electrical conductivity (salts)
  - Nitrate (other nutrients)
  - pH

NRCS - Incentive for Soil Health Testing

- Conservation Security Program (CSP)
  - Haney Test is an “enhancement” *(SQL-15) (growers are paid to for this new enhancement)
    - Haney Test Requirements:
    - Soil Health Score (CO_2 burst test and C and N testing)
    - Haney H3A extractant for other nutrients

NRCS Soil Health Testing (The Haney Tests)

- Soil Health Score
  - (CO_2 burst test and C and N testing)
- Haney H3A extractable nutrients
  - (new soil extract – no regional research)

Haney Test Components

- **Soil Health Score**
  - Testing water extractable soil carbon and nitrogen
  - Testing Biological activity
    - 24 hour CO_2 Burst Test (Solvita)

- **H3A - Alternative nutrient extractant**
  - A new soil extractant
  - Elements P, K, Ca, Mg, Zn, and Al.

CO_2 Burst/Solvita Test

Test measures the amount of CO_2 that microbial activity gives off in 24 hours.

40 grams dried and ground soil is placed in cup.
Soil was wetted from the bottom. (wetting method changed last year).

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AGVISE Soil Health Report

Submitted For:		Submitted By: LE0002	
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Box 316		698 EVERGREEN DR.	
123			
Northwood, nd	58267	GRAND FORKS, ND	58201

Field ID = 12 Sherbys		Sample ID = East 1/2	
County = Ward		Township = Lund	
Section = 17		Quarter = SW	
Date Received = 10/ 2/15		AGVISE Lab No =	1
Date Reported = 12/27/16		AGVISE Ref No =	1
Date Sampled = 10/12/15			

1:1 Soil pH	6.6	
24 Hour CO2 Burst	87.6	ppm C
Water Extractable Total Nitrogen	42.2	ppm
Water Extractable Ammonical Nitrogen	2.0	ppm
Water Extractable Nitrate Nitrogen	13.5	ppm
Water Extractable Organic Nitrogen(WEON)	26.7	ppm
Water Extractable Organic Carbon(WEOC)	222	ppm
H3A Extractable Total Phosphorus	16.5	ppm
H3A Extractable Inorganic Phosphorus	10.6	ppm
H3A Water Extractable Organic Phosphorus	5.9	ppm
H3A Extractable Potassium	122	ppm
H3A Extractable Calcium	690	ppm
H3A Extractable Magnesium	192	ppm
H3A Extractable Sodium	29.8	ppm
H3A Extractable Iron	59.6	ppm
H3A Extractable Zinc	0.6	ppm
H3A Extractable Aluminum	112	ppm

Calculated Values **

Soil Health Score	13.7	
Organic Carbon:Organic Nitrogen Ratio	8.3	
Mineralizable Nitrogen	0.0	ppm
Microbial Active Carbon (MAC)	39.5	%
Organic Nitrogen Release	26.7	ppm
Organic Nitrogen Reserve	0.0	ppm
Organic Phosphorus Release	5.9	ppm
Organic Phosphorus Reserve	0.0	ppm
Phosphorus Saturation	9.6	%
H3A Calcium / (Aluminum + Iron)	4.02	

** Calculated values are based on formulas supplied by the NRCS.

Values used to Calculate Soil Health

1:1 Soil pH	6.6		
24 Hour CO2 Burst	87.6	ppm	C
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Calculated Values **

Soil Health Score	13.7
Organic Carbon:Organic Nitrogen Ratio	8.3

Soil Health Score

CO_2 Burst (Solvita) = 87.6 ppm C

Water extractable organic carbon = 222 ppm

Water extractable organic Nitrogen = 26.7 ppm

Solvita (CO_2 Burst)/10 + WEOC/100 + WEON/10 = Soil Health Score

87.6 ppm c/10 + 222 ppm/100 + 26.7 ppm/10 = Soil Health Score

8.76 + 2.22 + 2.67 = **13.7** (Soil Health Scores are from 0 to >50)

Soil Health Score

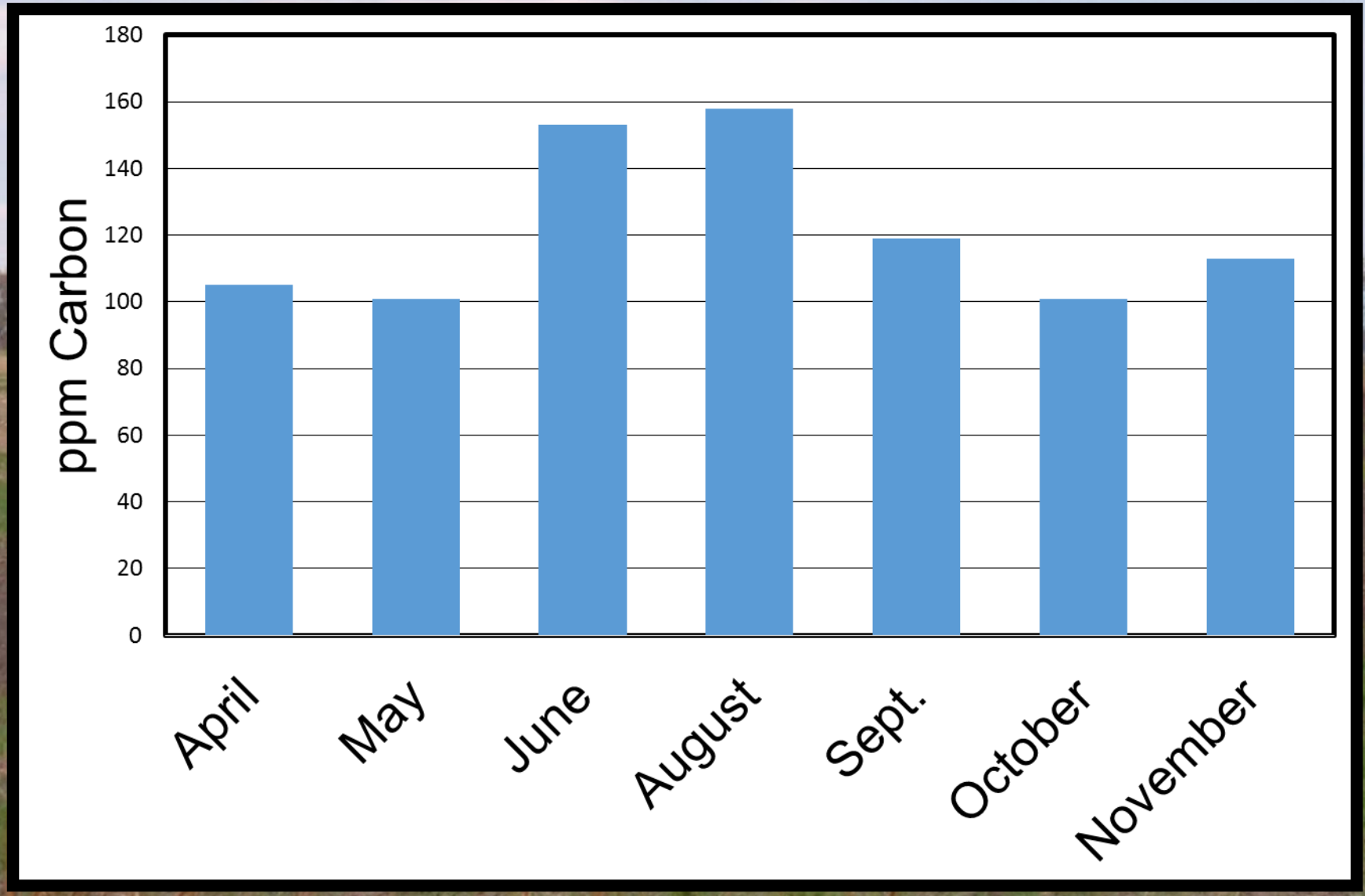
CO_2 Burst (Solvita) is largest part of soil health score

8.76 + 2.22 + 2.67 = 13.65 (Soil Health Scores are from 0 to >50)

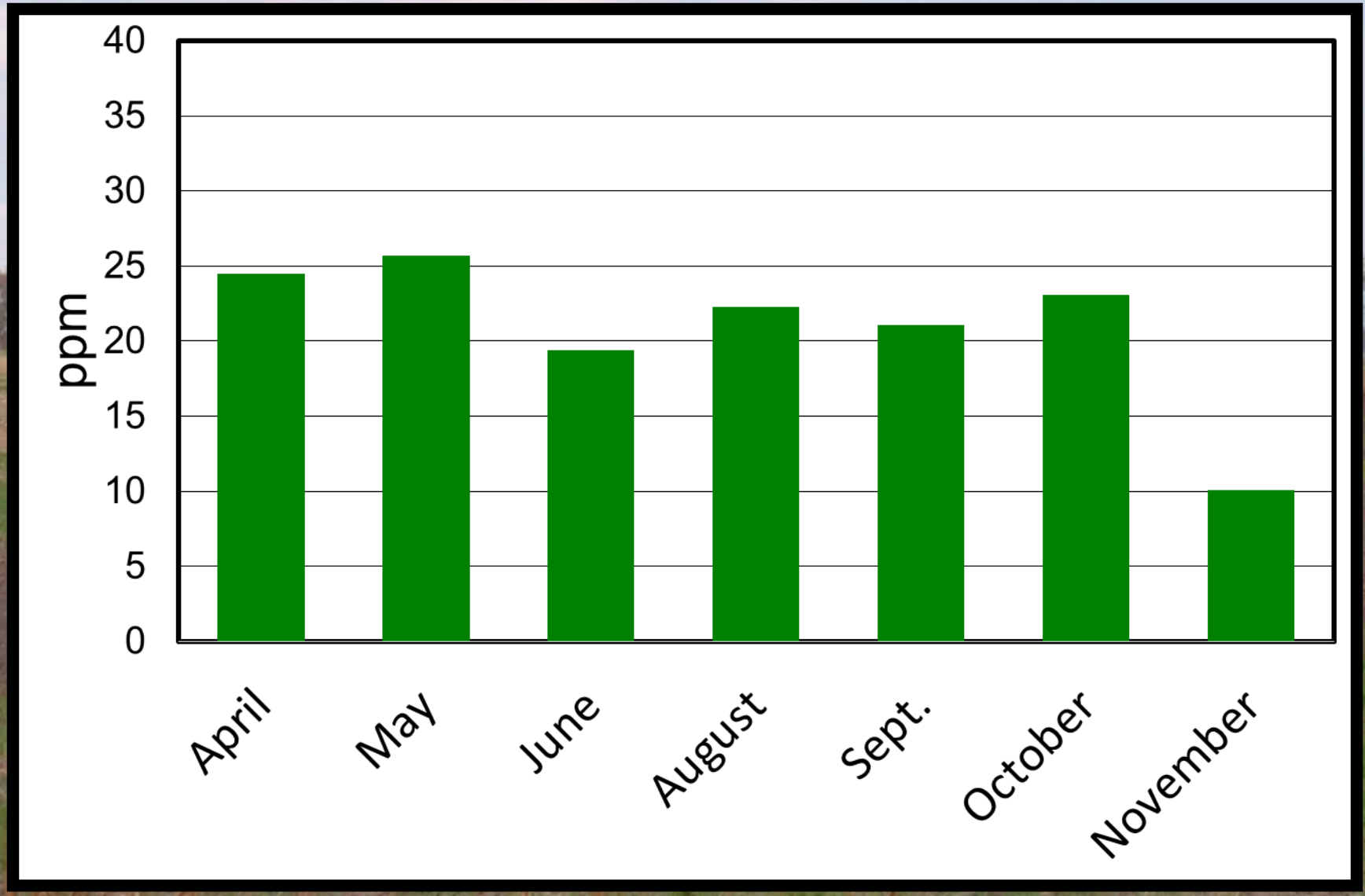
Soil Health Score should be greater than 7

Soil Health Score should increase over time with less tillage, better crop rotation and cover crops (Dr. Haney cam up with this soil health score!!!)

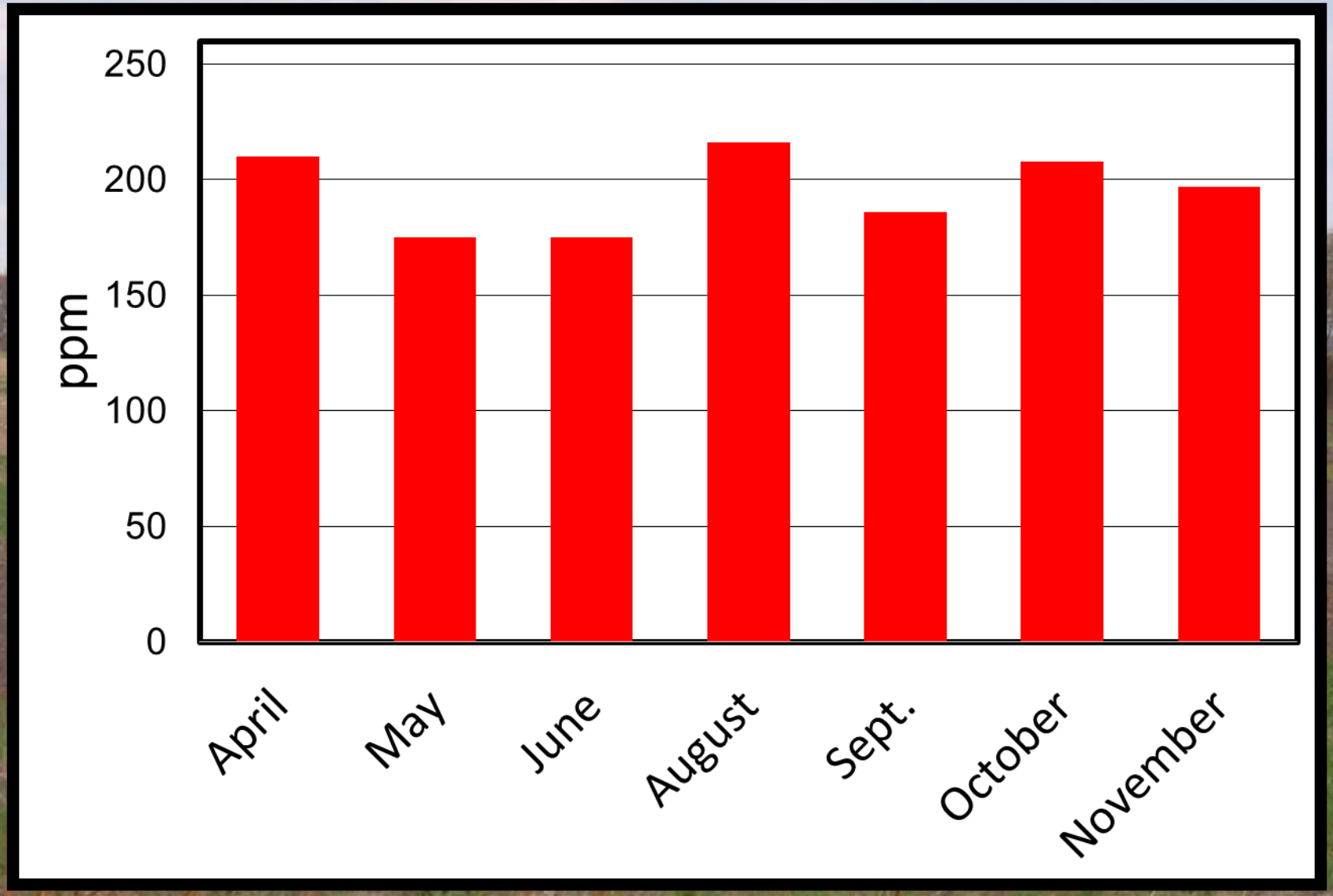
CO_2 Burst Test (Solvita)



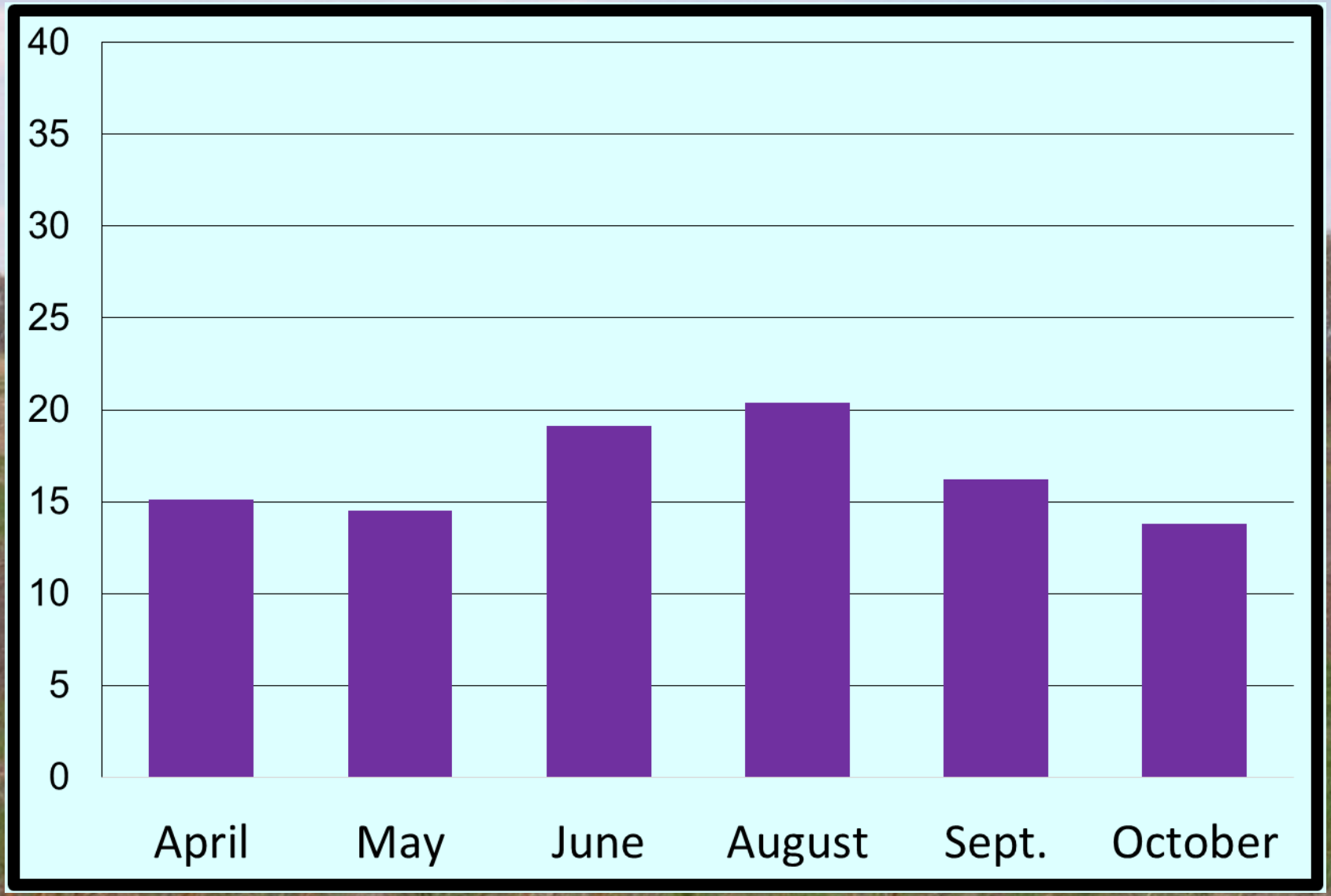
Water Extractable Organic N



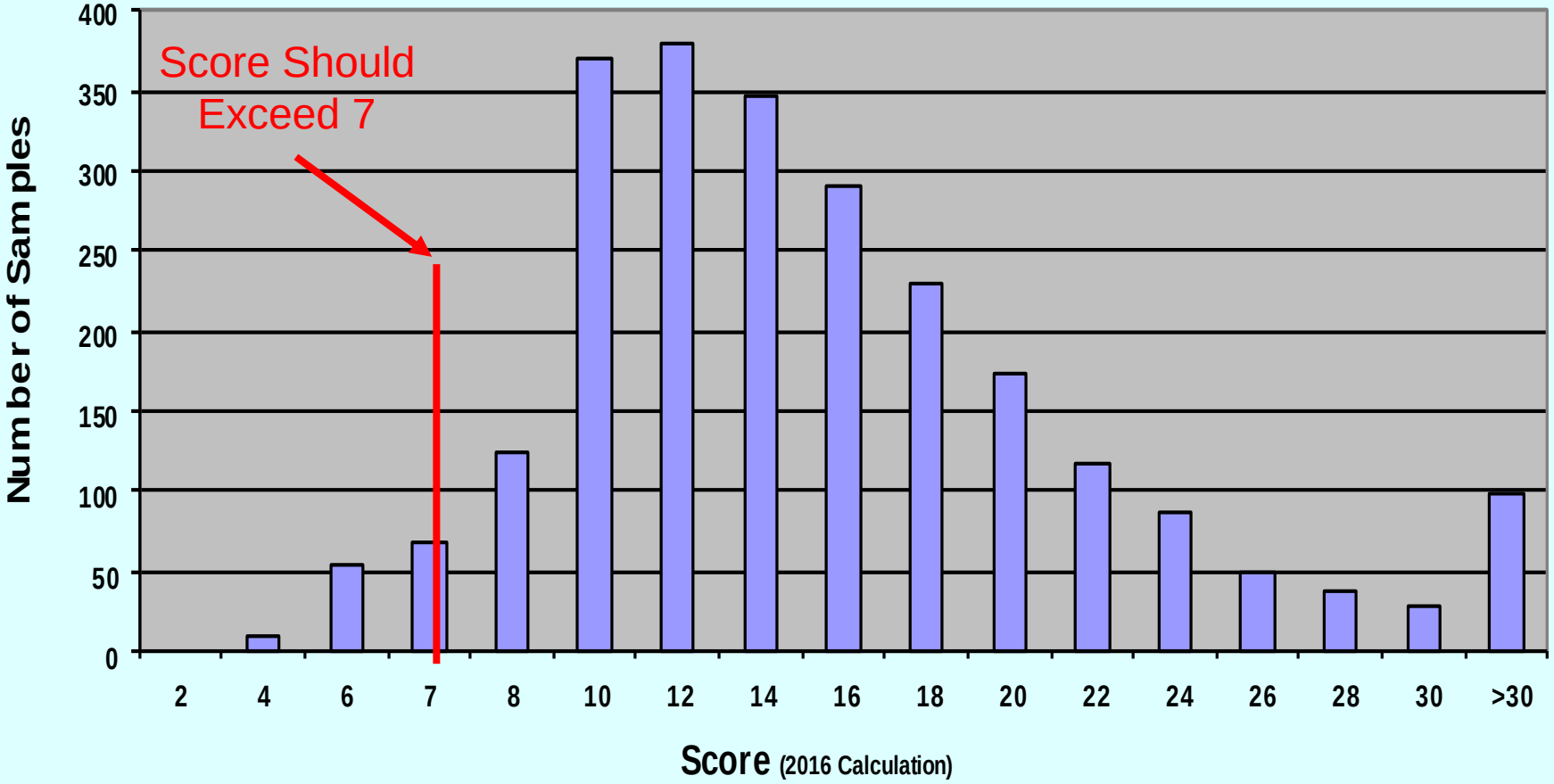
Water Extractable Organic C



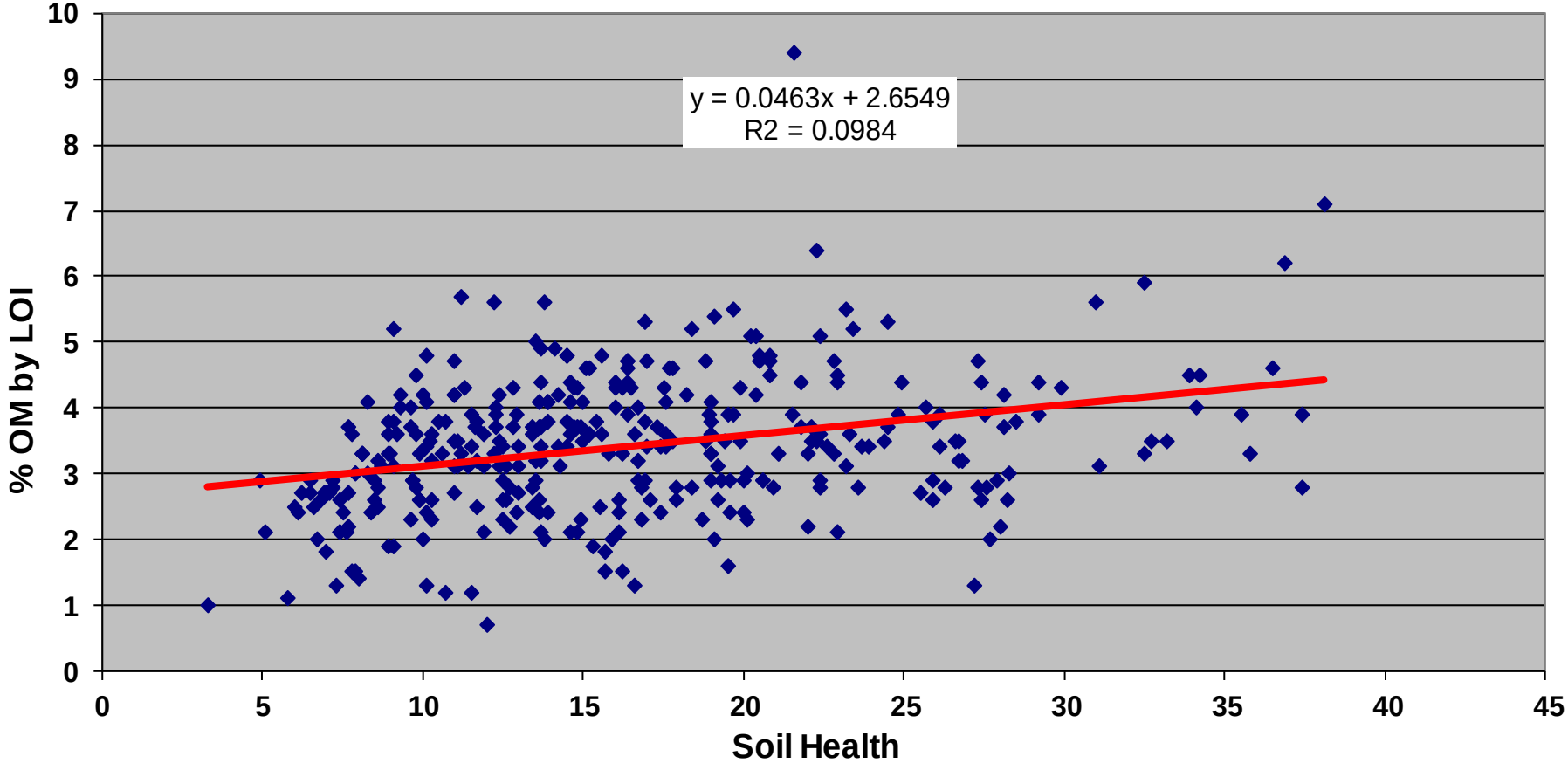
Soil Health Score



AGVISE Soil Health Scores



Soil Health Score vs Organic Matter



How our Region Compares

Test	AGVISE	USA
Carbon Burst/Solvita	112	52
Organic Carbon	199	225
Total Phosphorus	26	48
Inorganic P	21	37
Organic P	5	11
H3A Potassium	84	70
Soil Health	14.8	9.3
Total Nitrogen	32	39
Inorganic N (NO3 +NH4)	15	19
Organic N	17	20

Issues with Soil Health Score

- Lab procedure for CO_2 Burst/Solvita
  - Test Method undergoing standardization (NAPT getting very different results on same samples)
  - Wetting process affects test results (200% or more)
  - Measuring CO_2 after 24 hours
    - Reading color of sensor paddles (Woods End Lab)
    - Instrument reading vs. sensor paddles

Haney Test = "N Fertilizer Savings"?

- Estimated N savings using the Haney test are not considered reliable
- Potential N fertilizer savings are directly related to the highly variable CO_2 Burst/Solvita test.
- No research in this region has confirmed these potential savings in N fertilizer
- NDSU received a $5,000,000 grant to research soil health (research in this region will be great!)

Improving Soil Health/Quality

- Reduced tillage or No-till
  - Less erosion (more/better aggregates)
  - Better water infiltration
  - Store more water
- Good Crop rotations
  - Grasses and legumes (more than 2 crops)
- Cover Crops
  - Increase biological activity
  - Store N to reduce losses (areas to the south)

Are Cover Crops Profitable?

Best Answer by Dr. Ray Massey

Ag Economist-- Unv of Missouri

"I cannot give an answer of whether or not growing cover crops are a good economic decision!"

Future of Soil Health Testing

The General Agreement is Soil Health tests need to be 'robust'.

- Have a sound basis in science and understanding of what is being measured and why.
- Have methods that are consistent, relatively cheap, and require modest equipment.
- Have clear guidelines for interpretation.
- The soil health tests need to be able to measure subtle changes in soil properties when management is changed (i.e. reduced tillage, better rotations, more cover crop).


Questions?