

Soil Health



AGVISE 2017 Winter Seminars
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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?



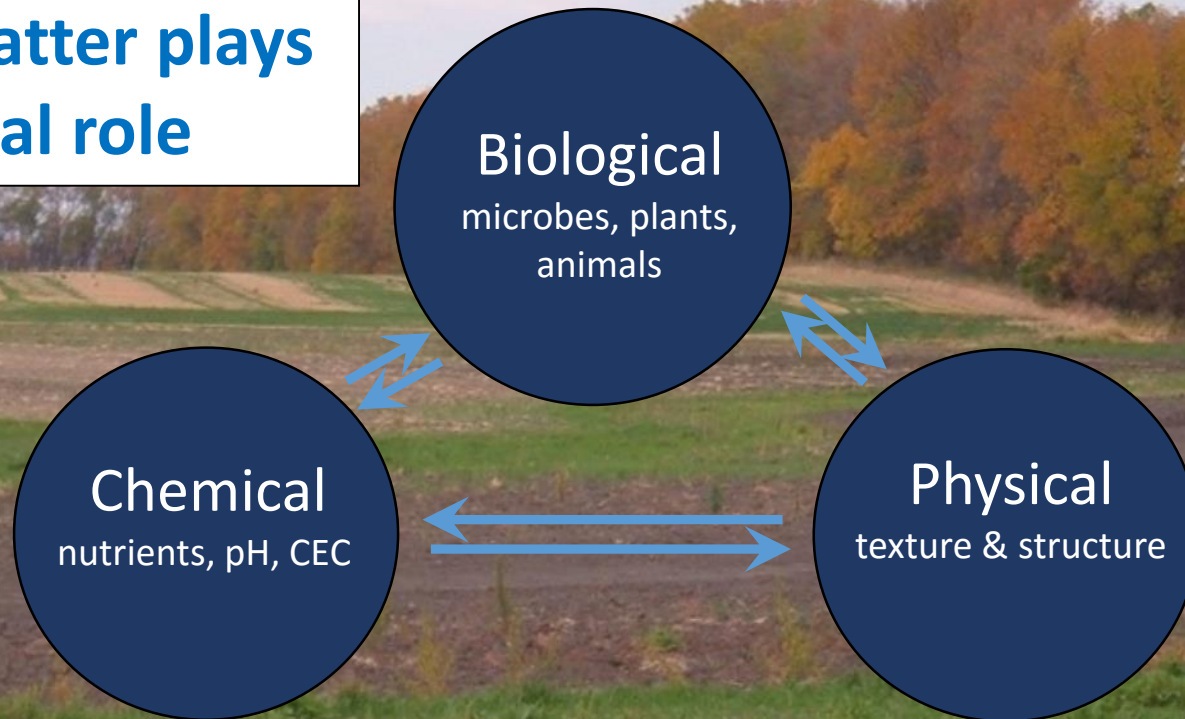
Soil Health vs. Soil Quality

- 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
 - These properties can be managed and by grower practices

Components of Soil Health

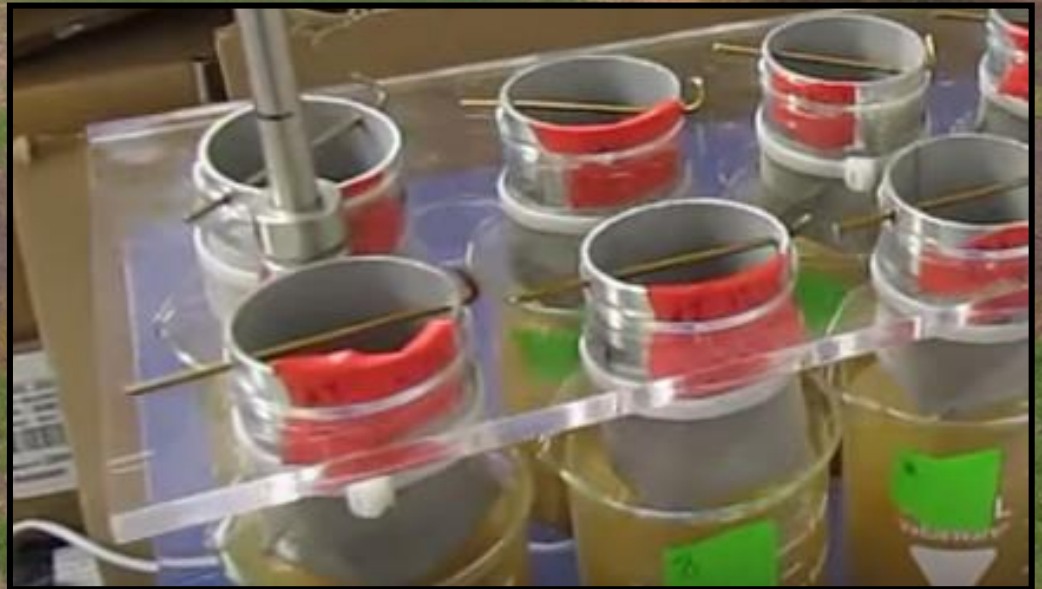
**All components
interact**

**Organic matter plays
a critical role**



Physical

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



Biological

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

Chemical

- electrical conductivity
- 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

- **Physical:**

- aggregate stability
- available water capacity
- bulk density
- infiltration

- **Chemical:**

- reactive carbon (Organic Matter)
- soil electrical conductivity (salts)
- soil nitrate (other nutrients)
- soil pH

NRCS - Incentive for Soil Health Testing

- Conservation Security Program (CSP)
 - Haney Test is an “enhancement” *(SQL-15) in some states (growers are paid to for this new enhancement)
 - Haney Test Requirements:
 - Soil Health Score (CO₂ burst test and C and N testing)
 - Haney H3A extractant for other nutrients

NRCS Soil Health Testing (The Haney Tests)

- Soil Health Score
 - (CO₂ burst test and C and N testing)
- Haney H3A extractable nutrients

Haney Test Requirements

- **Soil Health Score**

- Testing soil carbon and nitrogen
- Testing Biological activity
 - 24 hour CO₂ Burst Test (Solvita)

- **H3A - Alternative extractant**

- A new soil extractant
- Elements P, K, Ca, Mg, Zn, and Al.

CO₂ Burst/Solvita Test

Test measures the amount of CO₂ that microbial activity gives off in 24 hours.

40 grams dried and ground soil is placed in cup. Soil is wetted from the bottom. This wetting method is changing!!!



AGVISE Soil Health Report

Submitted For:

MR FARMER

Box 316

123

Northwood, nd

58267

Submitted By: LE0002

JOHN LEE

698 EVERGREEN DR.

GRAND FORKS, ND

58201

Field ID = 12 Sherbys

County = Ward

Section = 17

Date Received = 10/ 2/15

Date Reported = 12/27/16

Date Sampled = 10/12/15

Sample ID = East 1/2

Township = Lund

Quarter = SW

AGVISE Lab No = 1

AGVISE Ref No = 1

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(WBON)	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	←
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	←
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H3A Extractable Aluminum	112 ppm	

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

$\text{Solvita (CO}_2 \text{ Burst)}/10 + \text{WEOC}/100 + \text{WEON}/10 = \text{Soil Health Score}$

$87.6 \text{ ppm c}/10 + 222 \text{ ppm}/100 + 26.7 \text{ ppm}/10 = \text{Soil Health Score}$

$8.76 + 2.22 + 2.67 = \mathbf{13.7}$ (Soil Health Scores are from 0 to >50)

Soil Health Score

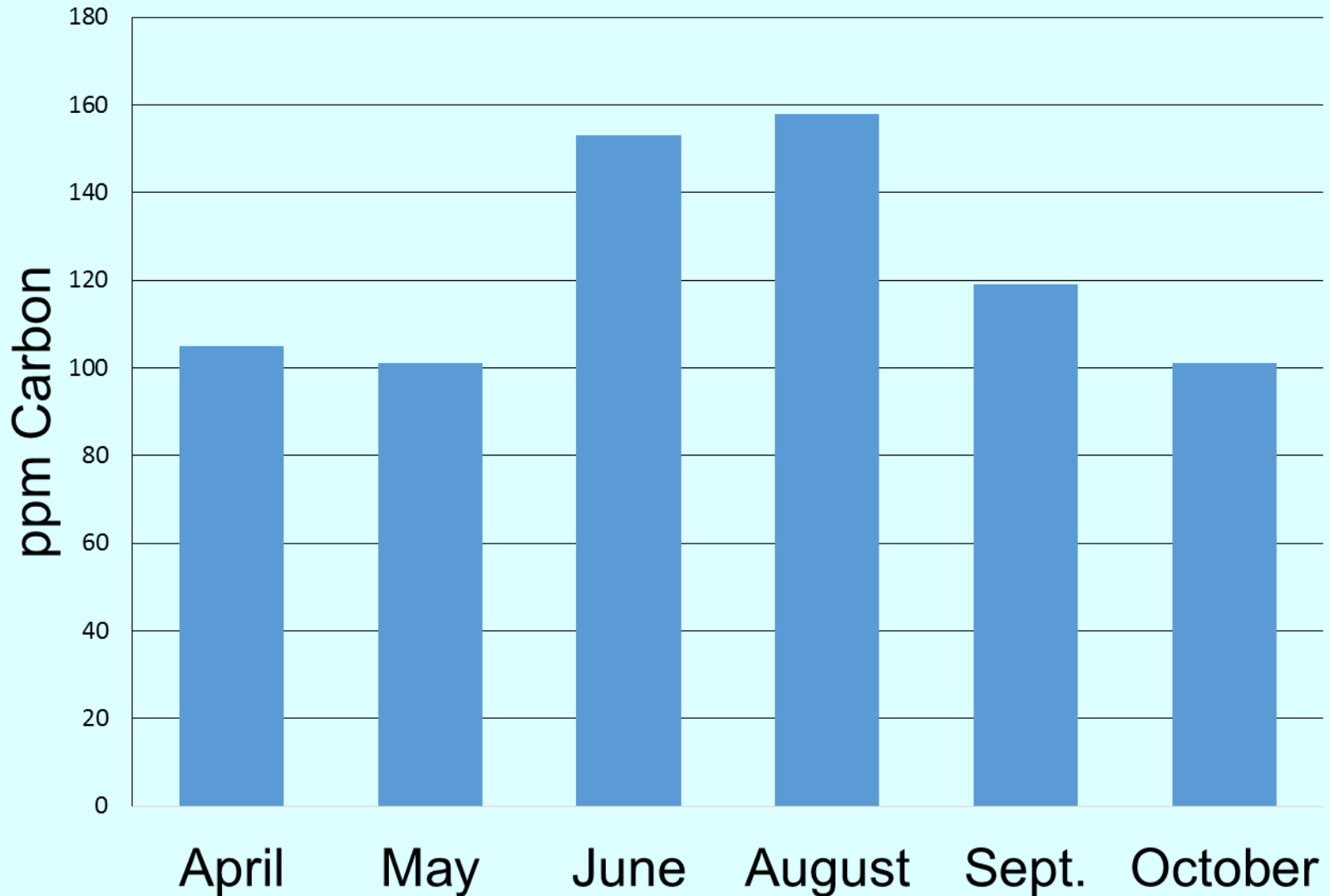
Solvita (CO₂ Burst) is large part of soil health score

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

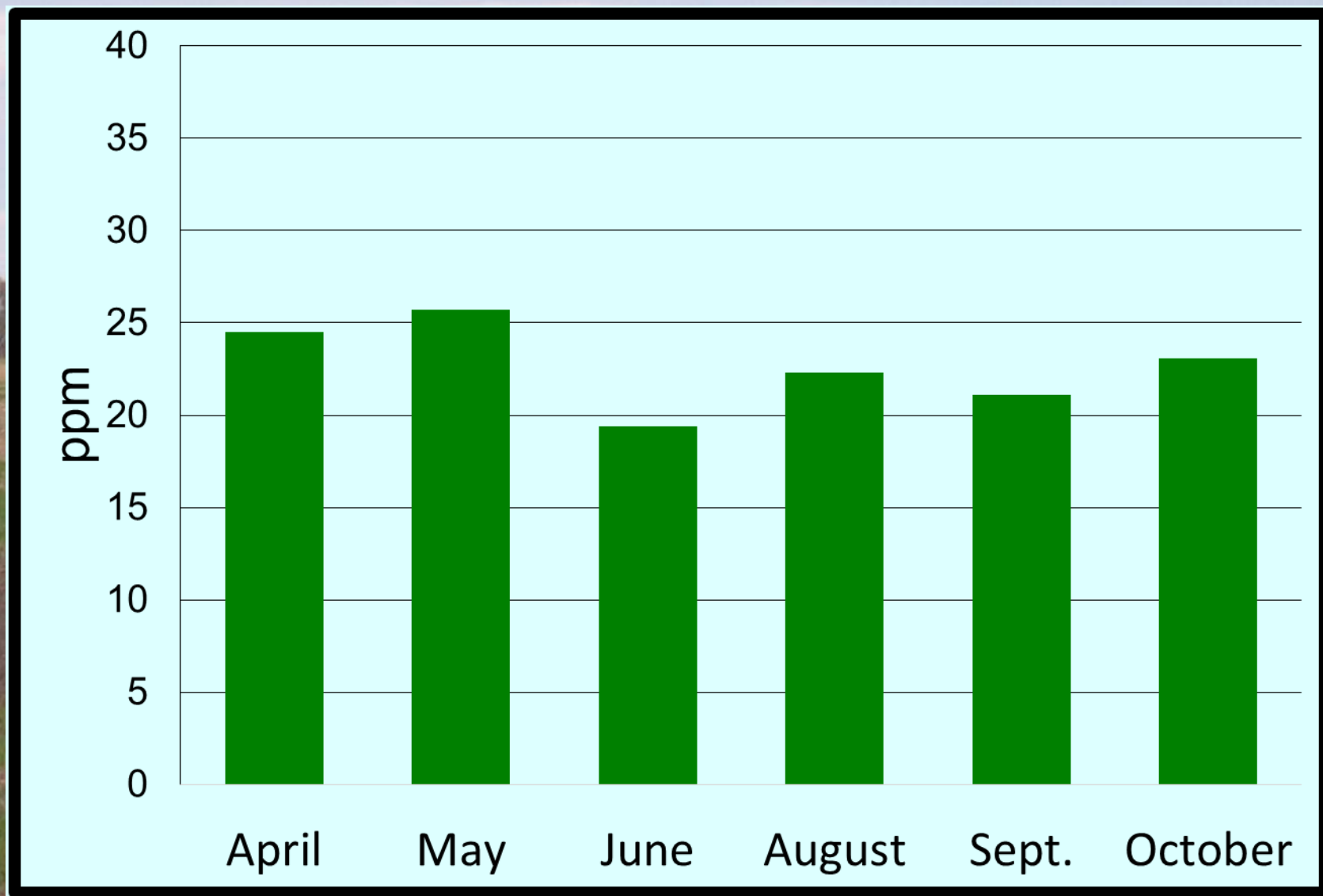
Soil Health Score should be greater than 7

Soil Health Score should increase over time with less tillage, better crop rotation and cover crops

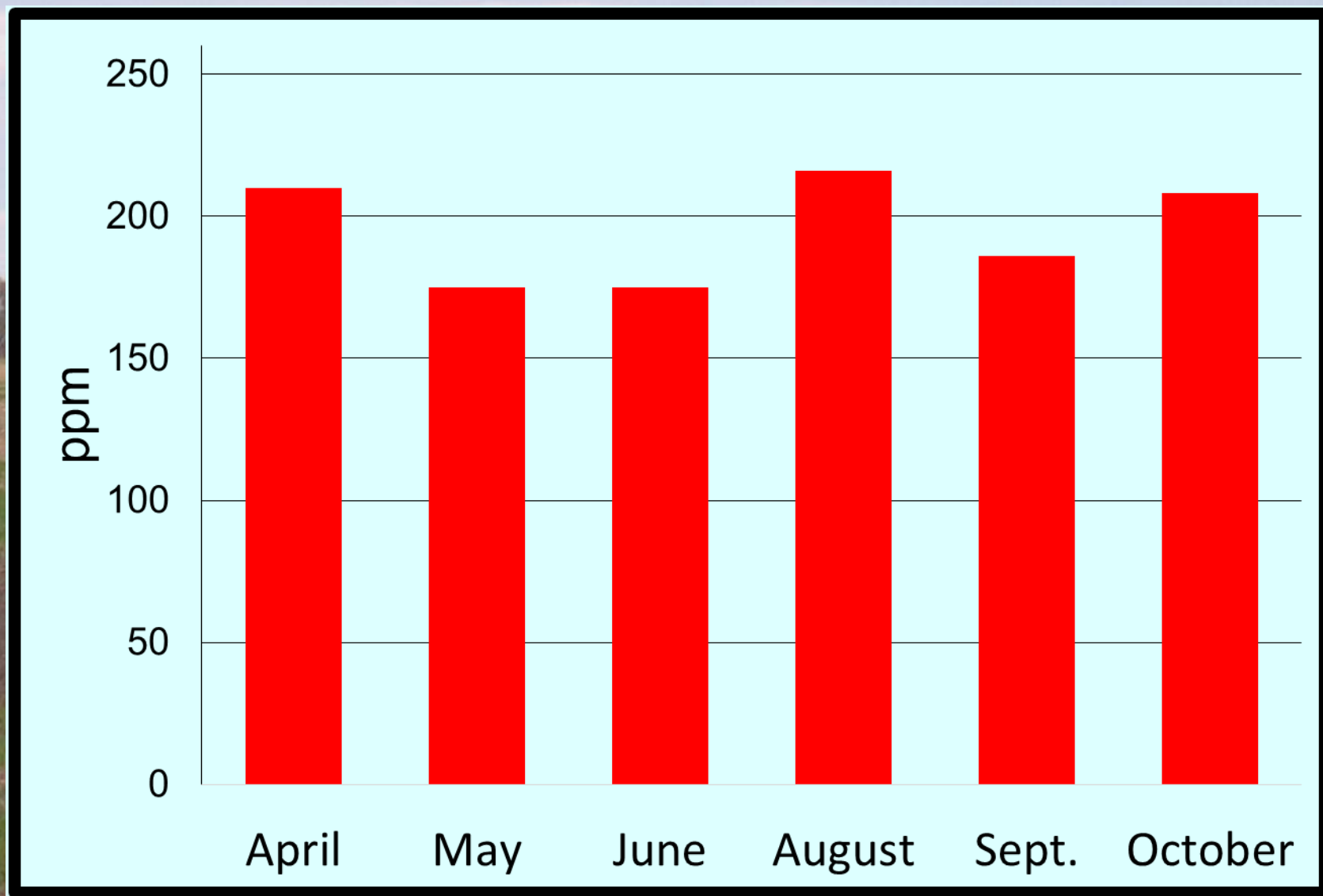
CO₂ Burst Test



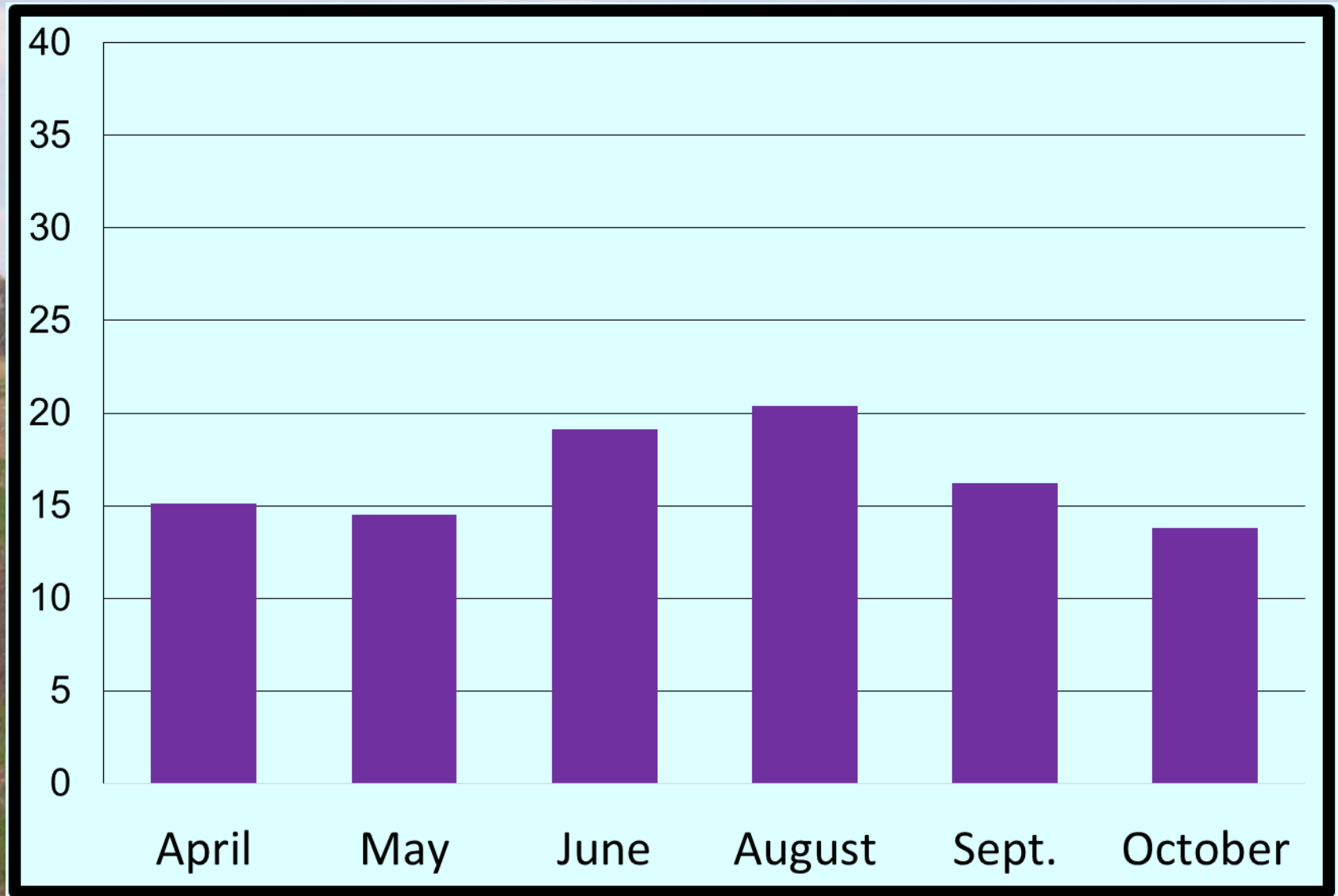
Water Extractable Organic N



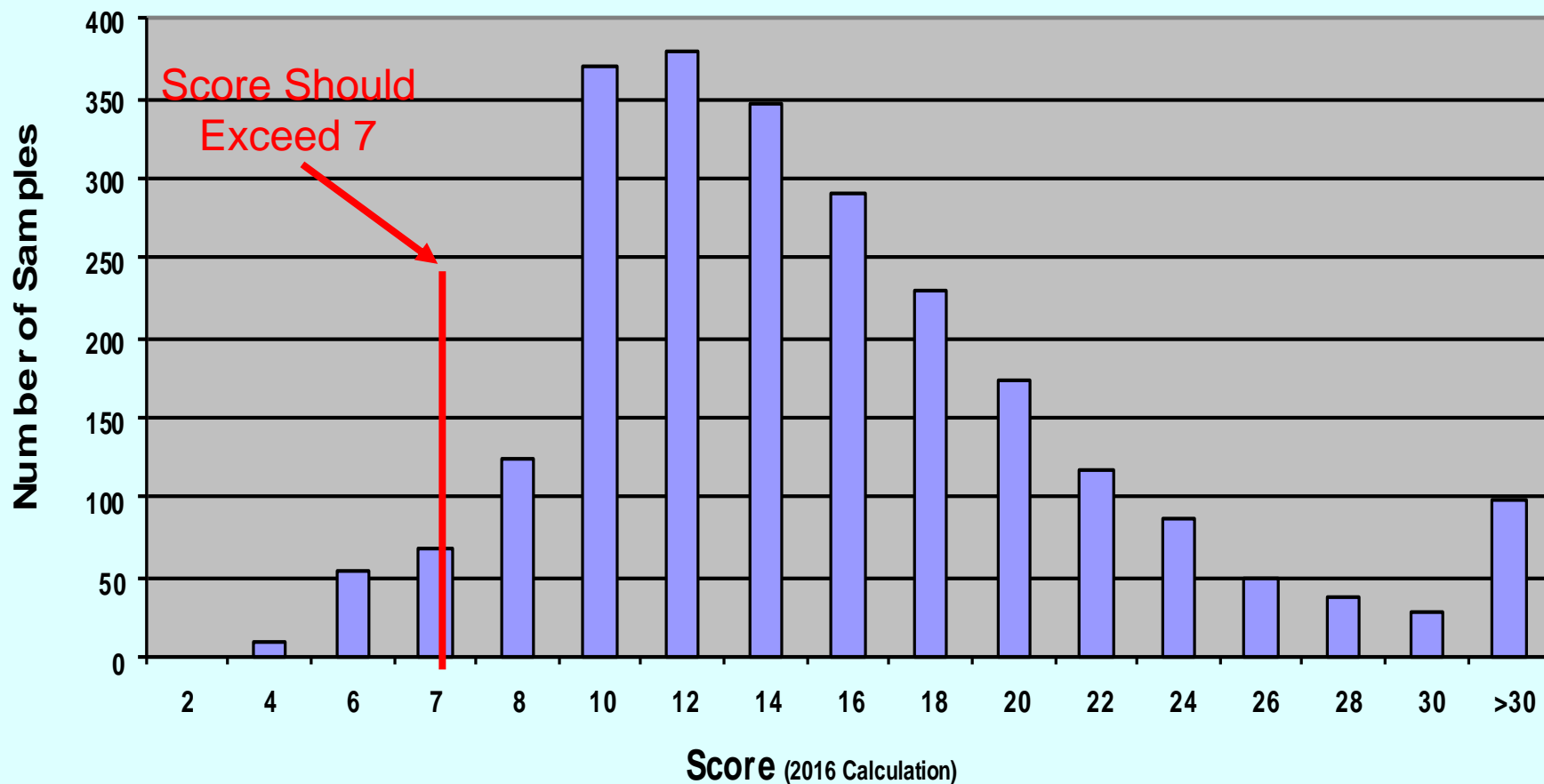
Water Extractable Organic C



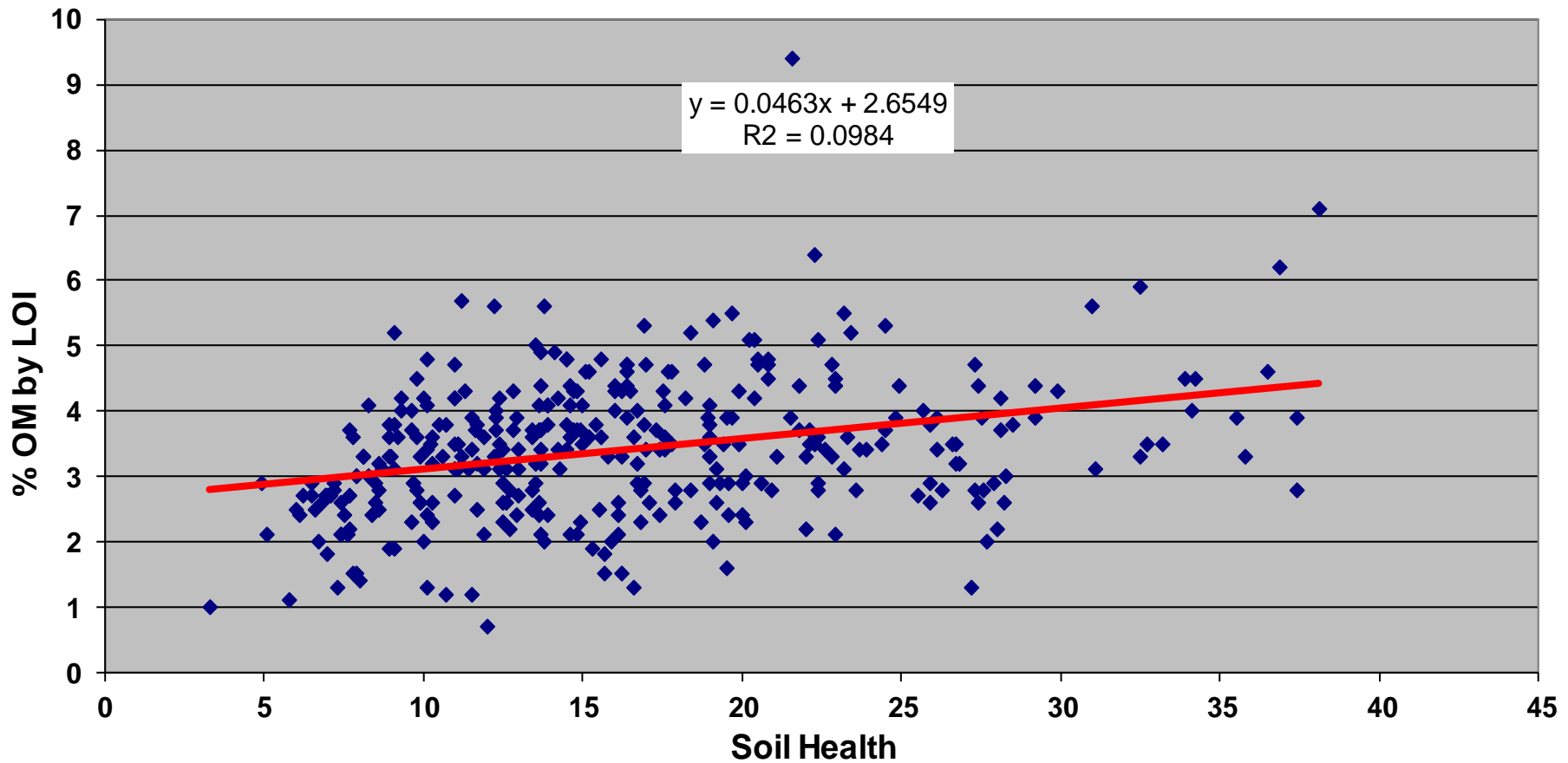
Soil Health Score



AGVISE Soil Health Scores



Soil Health Score vs Organic Matter



How Our Numbers Compare

Test	AGVISE	National
Carbon Burst	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 CO₂ Burst/Solvita
 - Test Method undergoing standardization (ALP program – labs getting very different results)
 - Wetting process affects test results (200% or more)
- Measuring CO₂ 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 CO₂ 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 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-- Univ 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.
- Have methods that are consistently, relatively cheap, and require modest equipment.
- Have clear guidelines for interpretation.
- The tests measure properties of the soil that are sensitive to management.

Questions???

