

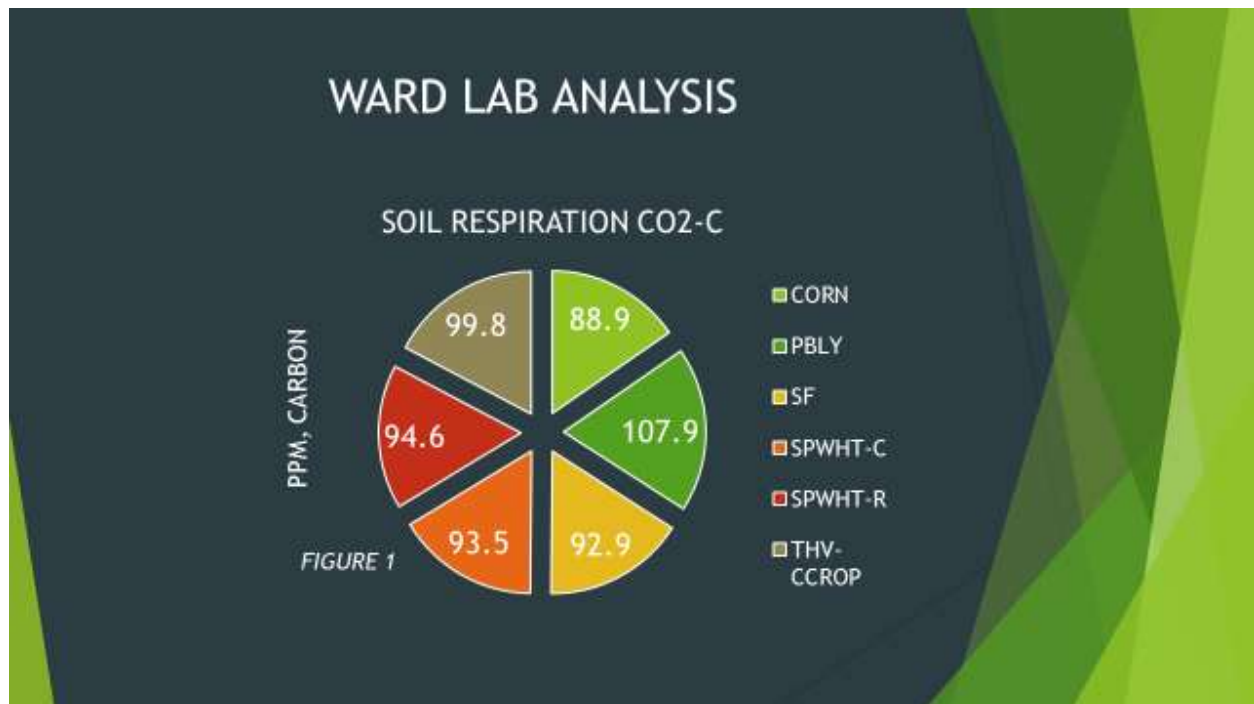
## Ward Laboratories Microbial and Traditional Soil Health Analysis

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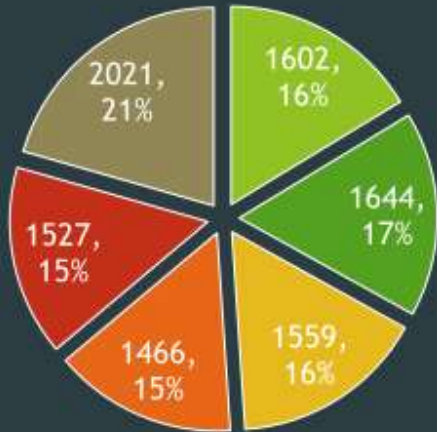
Ward Laboratories, Inc., 4007 Cherry Avenue, P.O. Box 788, Kearney, ND 68848-0788, conducts a large array of testing services for agriculture and the environment, providing chemical and biological soil test results. For 2017, the cropping season in western North Dakota and eastern Montana was negatively impacted by extreme drought. Soil samples for the Haney test soil health determination were collected from all fields in the integrated study the 3<sup>rd</sup> week of September after approximately 2.0 inches of rain was received. Ward Laboratory soil health reports contain a large amount of data. Key parts of the report summarize CO<sub>2</sub>-C (Figure 1) and microbial phospholipid fatty acid analysis for total microbial soil biomass (Figure 2), and microbial functional group diversity index (Figure 2). In addition, the relationship between soil fungi and bacteria is determined and the relationship is expressed as a fungi:bacteria ratio, which is then separated into a gram (-) and gram (+) ratio (Figure 3). From the Haney and 24-hour Solvita CO<sub>2</sub>-C test, microbial respiration CO<sub>2</sub>-C is used as a

soil health indicator. Microbial oxygen uptake and CO<sub>2</sub> release serve as indicators for soil health analysis. From the water extractable fraction, Solvita panels are analyzed for water extractable organic carbon and nitrogen, and a water extractable organic C: N ratio is established (Figure 4). With respect to soil health, the desirable C: N ratio is from 8:1 to 15:1. Crops in the SARE integrated multi-crop systems research ranged from 7.9 to 10.1. An overall soil health value is calculated by dividing the 1-day CO<sub>2</sub>-C value by the organic C:N ratio plus water extractable organic C/100 plus the water extractable organic N/10. The value can range from 0.0 to 50. A value of seven or greater is desired and by annual monitoring progress can be charted. Microbial respiration and nutrient cycling supply inorganic nutrients in the soil for plant growth. Using traditional N-P-K soil test analysis, the laboratory calculates a dollar savings for N/acre taking into account the supply of nutrients from microbial nutrient cycling during the growing season (Figure 5).



# WARD LAB ANALYSIS

## PFLA - MICROBIAL BIOMASS



## FUNCTIONAL GROUP DIVERSITY INDEX



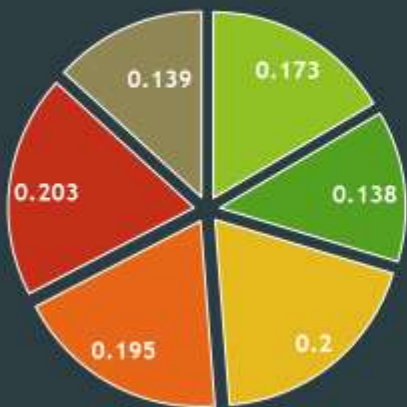
- CORN
- PBLY
- SF
- SPWHT-C
- SPWHT-R
- THV-CCROP

(Figure 2)

Nana Gram/  
Gram of Soil

# WARD LAB ANALYSIS

## FUNGI : BACTERIA RATIO



## GRAM (-) : GRAM (+) BACTERIA RATIO

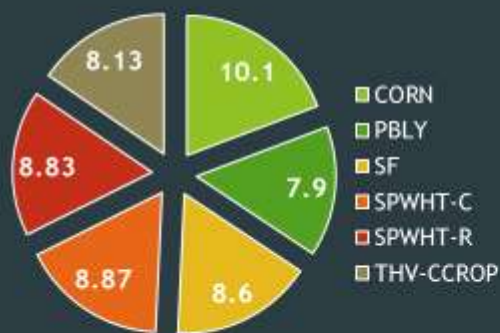


- CORN
- PBLY
- SF
- SPWHT-C
- SPWHT-R
- THV-CCROP

Figure 3

## WARD LAB ANALYSIS

### Water Extractable Organic C: N Ratio



Desirable Ratio: 8:1 to 15:1

### SOIL HEALTH CALCULATION



ABOVE 7 AND INCREASE OVER TIME  
(RANGE 0-50)

(Figure 4)

## Haney N-P-K TEST, TRADITIONAL N/Ac, DIFFERENCE AND SAVINGS/Ac

	N-P-K * VALUE, \$/Ac	TRADITIONAL LBS N/Ac	HANEY LBS N/Ac	DIFFERENCE, LBS N/Ac	N SAVINGS, \$/Ac
CORN	235	69.5	118.4	48.8	\$31.29
PEA-BLY	154	30.4	77.4	47.0	\$30.06
SUNFLOWER	174	25.3	71.6	46.3	\$29.69
SP WHEAT-C	164	20.5	65.5	45.0	\$28.80
SP WHEAT-R	151	20.8	70.2	49.4	\$31.62
TRITICALE- H-VETCH, C-CROP	174	20.2	68.5	48.3	\$30.90
* Value of N- P-K for next crop					

Figure 5