WARD Laboratories, Inc.
Ag Testing - Consulting

Account No. :

Biological Soil Analysis Report

Invoice No. :
Date Received :
Date Reported :

Results For :
Sample ID 1 :
Sample ID 2 :
Lab No. :

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	**5021.18**
Functional Group Diversity Index	**1.581**

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	**1881.75**	**37.48**
Gram (+)	**1182.99**	**23.56**
Actinomycetes	358.71	7.14
Gram (-)	**698.76**	**13.92**
Rhizobia	50.72	1.01
Total Fungi	**399.36**	**7.95**
Arbuscular Mycorrhizal	**123.64**	**2.46**
Saprophytes	**275.72**	**5.49**
Protozoa	**45.75**	**0.91**
Undifferentiated	**2694.32**	**53.66**

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Lab No. :

Community Composition Ratios

Fungi:Bacteria 0.2122

Bacteria tend to dominate in systems with fewer organic inputs or residues possibly leading to a lower C:N ratio. In addition, bacteria can be more prominent in the early spring or late fall as soil temperatures are usually cooler and vegetation is less active or absent. Dry conditions, slightly alkaline to alkaline pH values, or increased land disturbance through prolonged and extensive tillage, grazing, or compaction may also favor bacteria. While bacteria are important and needed in the soil ecosystem, fungi are desired and more often considered indicators of good soil health. Increased use of cover crops and/or other organic inputs and less soil disturbance should help the soil support more fungi. Adjustments to pH may also be recommended in some more extreme circumstances.

Scale	Rating
< 0.05	Very Poor
0.05+ - 0.1	Poor
0.1+ - 0.15	Slightly Below Average
0.15+ - 0.2	Average
0.2+ - 0.25	Slightly Above Average
0.25+ - 0.3	Good
0.3+ - 0.35	Very Good
> 0.35	Excellent

Predator:Prey 0.0243

This ratio is also expressed as protozoa to bacteria. Protozoa feed on bacteria which helps release nutrients, especially nitrogen. A higher ratio indicates an active community where base level nutrients are sufficient to support higher trophic levels or predators. However, this ratio will always be a relatively low number because the prey will greatly outnumber the predators.

Scale	Rating
< 0.002	Very Poor
0.002+ - 0.005	Poor
0.005+ - 0.008	Slightly Below Average
0.008+ - 0.01	Average
0.01+ - 0.013	Slightly Above Average
0.013+ - 0.016	Good
0.016+ - 0.02	Very Good
> 0.02	Excellent

Gram (+):Gram (-) 1.6930

Gram (+) bacteria typically dominate early in the growing season and/or following a fallow period. They also survive better under certain environmental conditions or stressors such as drought or extreme temperatures due to their ability to form spores. Therefore, it is common to see higher values when the community is coming out of dormancy or is stressed. These values will typically begin to approach those of a more balanced bacterial community as the soil conditions become more favorable throughout the growing season. A gram (-) dominated soil may be due to anaerobic conditions or other stressors such as pesticide application or heavy metal contamination.

Scale	Rating
< 0.5	Gram (-) Dominated
0.5+ - 1.0	Slightly Gram (-) Dominated
1.0+ - 2.0	Balanced Bacterial Community
2.0+ - 3.0	Slightly Gram(+) Dominated
3.0+ - 4.0	Gram(+) Dominated
> 4.0	Very Gram(+) Dominated

Stress and Community Activity Ratios

Sat:Unsat 2.6072

Bacteria alter their membranes under various environmental conditions in order to maintain optimal fluidity for nutrient and waste transport into and out of the cell. Saturated fatty acids may reflect a better adapted community to current environmental conditions. Communities under stressed conditions will increase their proportion of unsaturated fatty acids. This will likely occur most often as a result of low soil moisture or drastic changes in temperature. In general, a higher number indicates a healthier and more stable community.

Mono:Poly 10.2902

The ratio of monounsaturated to polyunsaturated fatty acids is used along with the sat:unsat ratio to further indicate the degree of community stress. A higher ratio indicates less stress, while a lower ratio would depict higher levels of prolonged stress due to conditions such as temperature, moisture, pH, or nutrient availability (starvation).

Pre 16:1ω7c:cy17:0 7.0141

Pre 18:1ω7c:cy19:0 6.9336

Cyclo (cy) fatty acids are more prominent during stationary phases of growth or under high stress conditions that influence membrane fluidity and growth rates such as temperature, pH, moisture, and nutrient availability. In general, a higher number or all Pre16/Pre18 is better and indicates an actively growing community experiencing fewer stressors. These values are typically higher early in the growing season (planting) when the community is becoming active and experiencing fast growth. The values may begin to drop towards the end of the growing season (harvest) following a decrease in plant growth activity or as the community approaches a stationary growth phase as the temperature/moisture changes between the seasons.

All ratios should be looked at separately, but should also be taken into context and compared with one another to better understand the big picture. These are general guidelines and statements regarding soil microbial communities. In addition, the scales and ranges presented here are specific for the type of extraction and analytical methods used for PLFA analysis at Ward Laboratories, Inc. They will not necessarily reflect ranges derived from other methods of analysis or the literature. The scales can and should be adjusted slightly depending on the time of year and conditions at sampling along with the climate and soil type of specific regions where comparisons are being made. Conditions such as time of year, past and present crop, moisture, pH, and fertility should be noted or measured close to sampling for PLFA analysis for a more in depth interpretation of results.

Reviewed By : Raymond Ward 3/20/2014 Copy : 1

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