Ward Laboratories, Inc.
Ag Testing - Consulting

Account No. : 24409

Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5659

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK PLOT 1
Sample ID 2 : 2

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	**2931.32**
Functional Group Diversity Index	**1.575**

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	**1491.87**	**50.89**
Gram (+)	**969.30**	**33.07**
Actinomycetes	251.56	8.58
Gram (-)	**522.57**	**17.83**
Rhizobia	35.82	1.22
Total Fungi	**319.61**	**10.90**
Arbuscular Mycorrhizal	**114.39**	**3.90**
Saprophytes	**205.22**	**7.00**
Protozoa	**48.37**	**1.65**
Undifferentiated	**1071.48**	**36.55**

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web site
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4007 Cherry Ave., P.O. Box 788
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Lab No. : 5,659

Community Composition Ratios

Fungi:Bacteria **0.2142**

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 **0.0324**

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 (-) **1.8549**

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 **1.9203**

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 **8.2951**

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 **14.1750**

Pre 18:1ω7c:cy19:0 **7.7771**

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.

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Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK PLOT 1
Sample ID 2 : 2
Lab No. : 5659
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	7.0
1:1 Soluble Salts, mmho/cm	0.14
Excess Lime Rating	1
Organic Matter, %LOI	5.8
Solvita CO2 Burst	
CO2-C, ppm C	169.0
Water Extract	
Total Nitrogen, ppm N	31.5
Organic Nitrogen, ppm N	29.1
Total Organic Carbon, ppm C	240
H3A Extract	
Nitrate, ppm NO3-N	2.5
Ammonium, ppm NH4-N	1.6
Inorganic Nitrogen, ppm N	4.1
Inorganic (FIA) Phosphorus, ppm P	109.5
Total (ICAP) Phosphorus, ppm P	135
Organic Phosphorus, ppm P	25.1
ICAP Potassium, ppm K	179
ICAP Calcium, ppm Ca	630
ICAP Aluminum, ppm Al	559.90
ICAP Iron, ppm Fe	368.5
Calculations	
Organic C:Organic N	8.2
Nitrogen mineralization, ppm N	29.1
Organic Nitrogen Release, ppm N	29.1
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	25.1
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	14.5
Phosphorus Saturation Ca, %	21.4
Soil Health	
Soil Health Calculation	25.87
Cover Crop Suggestion	10% Legume 90% Grass

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Haney - Soil Health Analysis Contd.

Lab No. : 5659

Nutrient Quantity Available for Next Crop		Nitrogen Savings by using the Haney Test	
Nitrogen, lbs N/A	66.5	Traditional evaluation, lbs N/A	4.9
Phosphorus, lbs P2O5/A	324.0	Haney Test N evaluation, lbs N/A	66.5
Potassium, lbs K2O/A	214.7	Nitrogen Difference, lbs N/A	61.6
Nutrient Value, $/A	276.24	N savings, $/A	39.39

Fertilizer Recommendations, lbs/A

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A

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1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5660

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK PLOT 2
Sample ID 2 : 2

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g 5037.12
Functional Group Diversity Index 1.568

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	**2046.18**	**40.62**
Gram (+)	**1270.24**	**25.22**
Actinomycetes	338.92	6.73
Gram (-)	**775.94**	**15.40**
Rhizobia	34.11	0.68
Total Fungi	**400.83**	**7.96**
Arbuscular Mycorrhizal	**133.89**	**2.66**
Saprophytes	**266.94**	**5.30**
Protozoa	**94.92**	**1.88**
Undifferentiated	**2495.20**	**49.54**

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Lab No. : 5,660

Community Composition Ratios

Fungi:Bacteria **0.1959**

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 **0.0464**

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 (-) **1.6370**

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 **1.5028**

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 **3.7032**

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 **ALL PRE 16:1**

Pre 18:1ω7c:cy19:0 **14.5392**

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.

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Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK PLOT 2
Sample ID 2 : 2
Lab No. : 5660
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	7.1
1:1 Soluble Salts, mmho/cm	0.15
Excess Lime Rating	1
Organic Matter, %LOI	8.2
Solvita CO2 Burst	
CO2-C, ppm C	162.0
Water Extract	
Total Nitrogen, ppm N	35.0
Organic Nitrogen, ppm N	32.4
Total Organic Carbon, ppm C	283
H3A Extract	
Nitrate, ppm NO3-N	2.5
Ammonium, ppm NH4-N	2.5
Inorganic Nitrogen, ppm N	4.9
Inorganic (FIA) Phosphorus, ppm P	141.5
Total (ICAP) Phosphorus, ppm P	176
Organic Phosphorus, ppm P	34.9
ICAP Potassium, ppm K	200
ICAP Calcium, ppm Ca	656
ICAP Aluminum, ppm Al	558.70
ICAP Iron, ppm Fe	397.1
Calculations	
Organic C:Organic N	8.7
Nitrogen mineralization, ppm N	32.4
Organic Nitrogen Release, ppm N	32.4
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	28.5
Organic Phosphorus Reserve, ppm P	6.4
Phosphorus Saturation Al/ Fe, %	18.5
Phosphorus Saturation Ca, %	26.9
Soil Health	
Soil Health Calculation	24.66
Cover Crop Suggestion	10% Legume 90% Grass

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Haney - Soil Health Analysis Contd.

Lab No. : 5660

Nutrient Quantity Available for Next Crop		Nitrogen Savings by using the Haney Test	
Nitrogen, lbs N/A	74.8	Traditional evaluation, lbs N/A	4.9
Phosphorus, lbs P2O5/A	390.9	Haney Test N evaluation, lbs N/A	74.8
Potassium, lbs K2O/A	239.6	Nitrogen Difference, lbs N/A	69.8
Nutrient Value, $/A	320.12	N savings, $/A	44.70

Fertilizer Recommendations, lbs/A

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A

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Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
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Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5661

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK CONTROL
Sample ID 2 : 2

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	**3901.04**
Functional Group Diversity Index	**1.335**

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	**1548.19**	**39.69**
Gram (+)	**1012.79**	**25.96**
Actinomycetes	236.93	6.07
Gram (-)	**535.40**	**13.72**
Rhizobia	5.22	0.13
Total Fungi	**200.78**	**5.15**
Arbuscular Mycorrhizal	**75.41**	**1.93**
Saprophytes	**125.37**	**3.21**
Protozoa	**0.00**	**0.00**
Undifferentiated	**2152.06**	**55.17**

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Lab No. : 5,661

Community Composition Ratios

Fungi:Bacteria **0.1297**

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 **ALL PREY**

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 (-) **1.8917**

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 **2.8483**

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 **7.7400**

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Pre 16:1ω7c:cy17:0 **NONE FOUND**

Pre 18:1ω7c:cy19:0 **88.6172**

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.

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Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : RED HAWK CONTROL
Sample ID 2 : 2
Lab No. : 5661
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	7.4
1:1 Soluble Salts, mmho/cm	0.13
Excess Lime Rating	1
Organic Matter, %LOI	6.3
Solvita CO2 Burst	
CO2-C, ppm C	141.0
Water Extract	
Total Nitrogen, ppm N	22.2
Organic Nitrogen, ppm N	18.9
Total Organic Carbon, ppm C	161
H3A Extract	
Nitrate, ppm NO3-N	2.9
Ammonium, ppm NH4-N	2.3
Inorganic Nitrogen, ppm N	5.2
Inorganic (FIA) Phosphorus, ppm P	82.9
Total (ICAP) Phosphorus, ppm P	103
Organic Phosphorus, ppm P	19.9
ICAP Potassium, ppm K	113
ICAP Calcium, ppm Ca	672
ICAP Aluminum, ppm Al	301.60
ICAP Iron, ppm Fe	196.4
Calculations	
Organic C:Organic N	8.5
Nitrogen mineralization, ppm N	18.9
Organic Nitrogen Release, ppm N	18.9
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	19.9
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	20.6
Phosphorus Saturation Ca, %	15.3
Soil Health	
Soil Health Calculation	20.04
Cover Crop Suggestion	10% Legume 90% Grass

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Haney - Soil Health Analysis Contd.

Lab No. : 5661

Nutrient Quantity Available for Next Crop		Nitrogen Savings by using the Haney Test	
Nitrogen, lbs N/A	48.3	Traditional evaluation, lbs N/A	5.8
Phosphorus, lbs P2O5/A	248.9	Haney Test N evaluation, lbs N/A	48.3
Potassium, lbs K2O/A	136.0	Nitrogen Difference, lbs N/A	42.4
Nutrient Value, $/A	195.93	N savings, $/A	27.15

Fertilizer Recommendations, lbs/A

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A

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Laboratories, Inc.

Ag Testing - Consulting

Account No. : 24409

Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5662

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS PLOT 1
Sample ID 2 :

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g 1889.21
Functional Group Diversity Index 1.102

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	**1057.22**	**55.96**
Gram (+)	**868.90**	**45.99**
Actinomycetes	232.67	12.32
Gram (-)	**188.32**	**9.97**
Rhizobia	0.00	0.00
Total Fungi	**49.62**	**2.63**
Arbuscular Mycorrhizal	**5.15**	**0.27**
Saprophytes	**44.47**	**2.35**
Protozoa	**0.00**	**0.00**
Undifferentiated	**782.37**	**41.41**

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Lab No. : 5,662

Community Composition Ratios

Fungi:Bacteria **0.0469**

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 **ALL PREY**

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 (-) **4.6140**

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 **4.4615**

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 **ALL MONO**

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 **NONE FOUND**

Pre 18:1ω7c:cy19:0 **37.8798**

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.

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WARD Laboratories, Inc.

Ag Testing - Consulting

Account No. : 24409

Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS PLOT 1
Sample ID 2 :
Lab No. : 5662
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	6.2
1:1 Soluble Salts, mmho/cm	0.10
Excess Lime Rating	1
Organic Matter, %LOI	6.0
WDRF Buffer pH	6.7
Solvita CO2 Burst	
CO2-C, ppm C	155.0
Water Extract	
Total Nitrogen, ppm N	15.3
Organic Nitrogen, ppm N	12.2
Total Organic Carbon, ppm C	110
H3A Extract	
Nitrate, ppm NO3-N	1.9
Ammonium, ppm NH4-N	1.7
Inorganic Nitrogen, ppm N	3.6
Inorganic (FIA) Phosphorus, ppm P	16.0
Total (ICAP) Phosphorus, ppm P	25
Organic Phosphorus, ppm P	9.2
ICAP Potassium, ppm K	92
ICAP Calcium, ppm Ca	307
ICAP Aluminum, ppm Al	216.90
ICAP Iron, ppm Fe	146.3
Calculations	
Organic C:Organic N	9.0
Nitrogen mineralization, ppm N	12.2
Organic Nitrogen Release, ppm N	12.2
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	9.2
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	6.9
Phosphorus Saturation Ca, %	8.2
Soil Health	
Soil Health Calculation	19.58
Cover Crop Suggestion	20% Legume 80% Grass

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Haney - Soil Health Analysis Contd.

Lab No. : 5662

Nutrient Quantity Available for Next Crop	
Nitrogen, lbs N/A	31.7
Phosphorus, lbs P2O5/A	97.5
Potassium, lbs K2O/A	110.1
Nutrient Value, $/A	113.40

Nitrogen Savings by using the Haney Test	
Traditional evaluation, lbs N/A	3.9
Haney Test N evaluation, lbs N/A	31.7
Nitrogen Difference, lbs N/A	27.8
N savings, $/A	17.80

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A
					1.2

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Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5663

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS PLOT 2
Sample ID 2 :

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	**2618.77**
Functional Group Diversity Index	**1.608**

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	**1363.69**	**52.07**
Gram (+)	**930.70**	**35.54**
Actinomycetes	258.61	9.88
Gram (-)	**432.99**	**16.53**
Rhizobia	73.17	2.79
Total Fungi	**376.86**	**14.39**
Arbuscular Mycorrhizal	**82.26**	**3.14**
Saprophytes	**294.59**	**11.25**
Protozoa	**25.69**	**0.98**
Undifferentiated	**852.54**	**32.55**

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Lab No. : 5,663

Community Composition Ratios

Fungi:Bacteria **0.2763**

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 **0.0188**

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 (-) **2.1495**

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 **1.9035**

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 **5.0665**

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 **3.7625**

Pre 18:1ω7c:cy19:0 **2.8807**

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.

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Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS PLOT 2
Sample ID 2 :
Lab No. : 5663
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	6.1
1:1 Soluble Salts, mmho/cm	0.10
Excess Lime Rating	1
Organic Matter, %LOI	5.6
WDRF Buffer pH	6.7
Solvita CO2 Burst	
CO2-C, ppm C	134.0
Water Extract	
Total Nitrogen, ppm N	14.0
Organic Nitrogen, ppm N	12.4
Total Organic Carbon, ppm C	116
H3A Extract	
Nitrate, ppm NO3-N	1.6
Ammonium, ppm NH4-N	1.4
Inorganic Nitrogen, ppm N	3.0
Inorganic (FIA) Phosphorus, ppm P	20.6
Total (ICAP) Phosphorus, ppm P	30
Organic Phosphorus, ppm P	9.4
ICAP Potassium, ppm K	88
ICAP Calcium, ppm Ca	295
ICAP Aluminum, ppm Al	204.20
ICAP Iron, ppm Fe	135.2
Calculations	
Organic C:Organic N	9.4
Nitrogen mineralization, ppm N	12.4
Organic Nitrogen Release, ppm N	12.4
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	9.4
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	8.8
Phosphorus Saturation Ca, %	10.2
Soil Health	
Soil Health Calculation	16.72
Cover Crop Suggestion	30% Legume 70% Grass

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Haney - Soil Health Analysis Contd.

Lab No. : 5663

Nutrient Quantity Available for Next Crop	
Nitrogen, lbs N/A	30.8
Phosphorus, lbs P2O5/A	97.6
Potassium, lbs K2O/A	105.7
Nutrient Value, $/A	110.60

Nitrogen Savings by using the Haney Test	
Traditional evaluation, lbs N/A	3.2
Haney Test N evaluation, lbs N/A	30.8
Nitrogen Difference, lbs N/A	27.6
N savings, $/A	17.64

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A
					1.2

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Account No. : 24409

Biological Soil Analysis Report

NEBRASKA MUSHROOM LLC
1982 E CITATION WAY
GRAND ISLAND NE 68801

Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016
Lab No. : 5664

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS CONTROL
Sample ID 2 :

PLFA Soil Microbial Community Analysis

Functional Group Biomass & Diversity

Total Living Microbial Biomass, Phospholipid Fatty Acid (PLFA) ng/g	**2177.76**
Functional Group Diversity Index	**1.345**

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	**1094.26**	**50.25**
Gram (+)	**861.37**	**39.55**
Actinomycetes	231.04	10.61
Gram (-)	**232.90**	**10.69**
Rhizobia	0.00	0.00
Total Fungi	**139.04**	**6.38**
Arbuscular Mycorrhizal	**52.32**	**2.40**
Saprophytes	**86.72**	**3.98**
Protozoa	**16.40**	**0.75**
Undifferentiated	**928.06**	**42.62**

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Lab No. : 5,664

Community Composition Ratios

Fungi:Bacteria **0.1271**

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 **0.0150**

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 (-) **3.6985**

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 **2.5667**

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 **15.3712**

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 **NONE FOUND**

Pre 18:1ω7c:cy19:0 **25.3527**

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.

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Biological Soil Analysis Report

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1982 E CITATION WAY
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Invoice No. : 1212203
Date Received : 07/19/2016
Date Reported : 07/21/2016

Results For : NEBRASKA MUSHROOM LLC
Sample ID 1 : CROPS CONTROL
Sample ID 2 :
Lab No. : 5664
Sample ID 3 :
Sample ID 4 :

Haney - Soil Health Analysis

1:1 Soil pH	6.2
1:1 Soluble Salts, mmho/cm	0.12
Excess Lime Rating	1
Organic Matter, %LOI	4.8
WDRF Buffer pH	6.6
Solvita CO2 Burst	
CO2-C, ppm C	141.0
Water Extract	
Total Nitrogen, ppm N	12.4
Organic Nitrogen, ppm N	10.6
Total Organic Carbon, ppm C	100
H3A Extract	
Nitrate, ppm NO3-N	1.7
Ammonium, ppm NH4-N	1.6
Inorganic Nitrogen, ppm N	3.3
Inorganic (FIA) Phosphorus, ppm P	8.0
Total (ICAP) Phosphorus, ppm P	16
Organic Phosphorus, ppm P	8.0
ICAP Potassium, ppm K	61
ICAP Calcium, ppm Ca	356
ICAP Aluminum, ppm Al	175.90
ICAP Iron, ppm Fe	116.3
Calculations	
Organic C:Organic N	9.4
Nitrogen mineralization, ppm N	10.6
Organic Nitrogen Release, ppm N	10.6
Organic Nitrogen Reserve, ppm N	0.0
Phosphorus mineralization, ppm P	8.0
Organic Phosphorus Reserve, ppm P	< 0.1
Phosphorus Saturation Al/ Fe, %	5.5
Phosphorus Saturation Ca, %	4.5
Soil Health	
Soil Health Calculation	17.04
Cover Crop Suggestion	30% Legume 70% Grass

Reviewed By : Lance Gunderson 7/21/2016 **Copy : 1**

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Haney - Soil Health Analysis Contd.

Lab No. : 5664

Nutrient Quantity Available for Next Crop		Nitrogen Savings by using the Haney Test	
Nitrogen, lbs N/A	27.8	Traditional evaluation, lbs N/A	3.4
Phosphorus, lbs P2O5/A	70.9	Haney Test N evaluation, lbs N/A	27.8
Potassium, lbs K2O/A	73.7	Nitrogen Difference, lbs N/A	24.4
Nutrient Value, $/A	82.30	N savings, $/A	15.61

Crop	Yield Goal	Nitrogen N	Phosphorus P2O5	Potassium K2O	Lime, ECC T/A
					1.6

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