Final Report

Sweet Hollow Farm, Victor, Idaho

10/11/2024

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Objective:

Improving Soil Health: Soil samples will be collected at the beginning and end of the study period in the test and control produce beds. The soil samples will be analyzed for chemical, physical, and biological soil health indicators set out at the University of Wyoming. Comparing results will show if soil health is improving in the cardboard layering and deep compost system compared to our standard tilling practice. Soil health results from Sweet Hollow Farm will also be compared with soil samples from partnering farm, Foraging Farm, which has used the same CLDCM methods since it began five years ago.

Summary:

As of 5/13/2022 all of the baseline testing has been conducted for the objective.

The Cardboard has been layered and the compost has been applied in alignment with the CLDCM method. The soil monitoring methods and comprehensive reports for the test and control plots can be found on the following pages.

The experiment continued until the follow up testing was conducted on 8/14/2024.

Below are the Baseline and Follow up Test Results.

The Final Page Lists Comparisons and Conclusions of the Results.

Soil monitoring research methods

Physical properties to be analyzed on soil samples include soil texture, stable aggregate content, and in situ resistance to penetration. Soil texture will be measured using a sedimentation test to quantify sand, silt, and clay content. Soil texture interacts with many properties as well as with growth of crops and weeds. Stable aggregate content will be tested using a slake analysis. Stable aggregate content is a robust soil health indicator because water stable aggregates form with increasing soil organic matter content and decreasing tillage. They provide resistance to erosion and protect active organic matter fractions from rapid decomposition and loss. Resistance to penetration will be measured twice a season 24 hours after irrigation using a depth increment penetrometer pushed as deeply as possible into the soil. We expect to detect a dense tillage pan root restricting layer beneath tilled plots which will degenerate with time with no till treatments.

Chemical properties will be analyzed using a Mehlich-3 extraction method through Logan Labs. The Logan Labs complete soil test plus extra includes PH, organic matter, base saturation, total exchange capacity, Melich-3 extractable sulfur, phosphorus, calcium, magnesium, potassium, sodium, boron, iron, manganese, copper, zinc, aluminum, and estimated nitrogen release. Conversion to no till often temporarily constrains nutrient availability as recovery microbial communities aggressively immobilizes readily available nutrients. We expect that the decomposing high C:N cardboard layer might also drive some nutrient immobilization but that constrained availability should cease over time. These protocols will be used once a season through the extent of the project.

Biological soil properties will be measured using a microbial density and diversity analysis. Microscopy techniques and protocols set by Dr. Elaine Ingham will be utilized to determine estimations of bacterial biomass, fungal biomass, actinobacteria, protozoa, amoeba, nematode, and microarthropods. We will also perform in-situ counts of earthworms and other soil mesofauna. Frequent tillage, especially with incorporation with organic amendments and irrigation, drives rapid cycling and release of available nutrients in an environment that favors opportunistic organisms and high populations of bacteria relative to fungi. Reduced or no tillage tightens nutrient cycling and, along with reduced physical disruption favors growth of both saprophytic and mycorrhizal fungi populations, both very important for building soil aggregates, cycling organic materials, and increasing nutrient supply to plants. We expect that as biological soil communities fluctuate towards more fungal activity that we will also see the weeds growing in succession on the land change. These protocols will be used at the beginning and the end of each season through the extent of the project

Baseline Comprehensive Soil Report

Earth Grower LLC (949) 302 8771
Client: Sweet Hollow Farm **Location:** Victor, Idaho **Sample Collected:** 5/13/2022 **Sample ID:** Control Block

Biological Analysis:

Fungi: None
Bacteria: Low Diversity (Bacterial Dominated)
Predators None (poor nutrient cycling)
Anaerobic Conditions? Yes (ciliates present)
Earthworms: 4

Microbial Recommendations Amount:

Good Quality Fungal Compost Aim for 2-4" over the entire Garden (4-10 yards) Fish Hydrolysate 1 ounce/gallon as needed as a Nitrogen Source and Fungal Food

Chemical Analysis:

pH: Good Range
Phosphorus: Low/Moderate
Sulfur: Okay Range
Calcium: Slightly Low
Potassium Very High **(Locks Up Calcium)**
Magnesium: Good Range
Sodium: Good Range
Boron: Low
Copper: Low
Manganese High
Iron: Good Range
Zinc: Good Range

Chemical Recommendations: Amount:

Gypsum (calcium and Sulfur) Mix with Compost (10-15 lb per yard of compost)
Borax (Boron) 1/2 ounce per 1000 sq ft Diluted into water (once a year) Soft Rock Phosphate (phosphorus) 1-2 lb per 100 sq ft
Sea-90 (trace minerals) 2 Cups Per 100 Gallons of Water (once a year) **Avoid Fertilizers that contain Potassium and Magnesium**

Physical Properties:

Soil Type: Loam
Sand: 50%
Silt: 30%
Clay: 20%
Humic Acids: 4 out of 6
Organic Matter: Good Range

Baseline Comprehensive Soil Report

Earth Grower LLC (949) 302 8771 **Client:** Sweet Hollow Farm **Location:** Midvale Idaho **Sample Collected:** 5/13/2022 **Sample ID:** Test Block

Biological Analysis:

Fungi: Very Little
Bacteria: Low Diversity
Predators: None (poor Nutrient Cycling)
Anaerobic Conditions? Minor
Earthworms: 3

Microbial Recommendations Amount:
Good Quality Fungal Compost Aim for 2-4" over the entire Garden (4-10 yards) Fish Hydrosolate 1 ounce/gallon as needed as a Nitrogen Source and Fungal Food

Chemical Analysis:
pH: Good Range
Phosphorus: Low Moderate
Sulfur: Okay Range
Calcium: Slightly low
Potassium Very High **(Locks Up Calcium)**
Magnesium: Good Range
Sodium: Good Range
Boron: Low
Copper: Low
Manganese Good Range
Iron: Good Range
Zinc: Good Range

Chemical Recommendations: Amount:
Gypsum (calcium and Sulfur) Mix with Compost (15-20lb per yard of compost) Once a year Soft Rock Phosphate (phosphorus) 1-2 Pounds per 100sqft (Dusted or mixed with compost Borax (Boron) 1/2 ounce per 1000sqft Diluted into water (once a year) Sea-90 (trace minerals) 2 Cups Per 100 Gallons of Water (Applied once a year) **Avoid Fertilizers that contain Potassium and Magnesium**

Physical Properties:
Soil Type: Loam
Sand: 50%
Silt: 40%
Clay: 10%
Humic Acids: 5 out of 6
Organic Matter: Good Range

Physical Baseline Testing

Earth Grower LLC		949-302-8771			
Client	Sweet Hallow Farm	**Protocols**			
Date	5/14		**Control Beds**		**Test Beds**
Purpose	Physical data		W 20' L 100'		W 20' L 100'
Type of test	Penetrometer		Pathway 20-22"		Pathway 20-22"
			10 tests per bed		10 tests per bed
		Data correlates left to right			
Test Bed					
		Row			
	Penetrometer Data	1	2	3	4
	1	8" @ 200 psi	3.5" @ 200 psi	9.5" @ 200 psi	6.5" @ 200 psi
	2	11" @ 200 psi	2" @ 200 psi	3.5" @ 200 psi	4.5" @ 200 psi
	3	14" @ 200 psi	2.5" @ 200 psi	5" @ 200 psi	7.5" @ 200 psi
	4	6" @ 200 psi	2.5" @ 200 psi	4.5" @ 200 psi	5" @ 300 psi
	5	6.5" @ 200 psi	2.5" @ 200 psi	2" @ 200 psi	4.5" @ 200 psi
	6	6" @ 200 psi	3.5" @ 200 psi	3" @ 200 psi	4.5" @ 200 psi
	7	27.5" **sunk**	5" @ 200 psi	4" @ 200 psi	27.5" @ 150 **sunk**
	8	20.5" @ 200 psi	6" @ 200 psi	27.5" **sunk**	23" @ 200 psi
	9	6.5" @ 200 psi	18" @ 200 psi	3" @ 200 psi	15" @ 200 psi
	10	5" @ 200 psi	3" @ 200 psi	2" @ 200 psi	15" @ 200 psi
Control Bed					
		Row			
	Penetrometer Data	1	2	3	4
	1	14" @ 200 psi	10" @ 200 psi	11" @ 200 psi	10" @ 200 psi
	2	7.5" @ 200 psi	13" @ 200 psi	10.5" @ 200 psi	12.5" @ 200 psi
	3	14" @ 200 psi	13" @ 200 psi	14" @ 200 psi	13" @ 200 psi
	4	16.5" @ 200 psi	15.5 @ 200 psi	14" @ 200 psi	13.5" @ 200 psi
	5	7" @ 200 psi	15.5" @ 200 psi	22" @ 200 psi	18" @ 200 psi
	6	6.5" @ 200 psi	27.5" @ 150 psi **sunk**	24" @ 200 psi	25" @ 200 psi **sunk**
	7	18.5" @ 200 psi	10" @ 200 psi	22" @ 200 psi	24.5" @ 200 psi **sunk**
	8	27.5" **sunk** 150 psi	8" @ 200 psi	19" @ 200 psi	20" @ 200 psi **sunk**
	9	21" @ 200 psi	9.5" @ 200 psi	27.5" @ 200 psi **sunk**	24" @ 200 psi
	10	15.5" @ 200 psi	19" @ 200 psi	17.5" @ 200 psi	27.5" @ 200 psi **sunk**

Slake Anyalsis

Earth Grower LLC 949 302 8771

Client: Sweet Hollow Farm

Sample Collected: 5/14/2022

Tested: 5/18/2022

Purpose: Physical Testing

This is a test of aggregate stability. Each sample is a composite sample of 10 cores from each bed.

Protocols: One TBSP of Soil is dropped in a basket with 1cm submerged in water and a timer is set to see how long it takes to disso

Samples Sit for 2 minutes before data is Collected. The percentae of soil left is logged as the aggregate stability.

Control Beds	C1	C2	C3	C4
Dissolved	95%	96%	94%	99%
Aggregate Stability	5%	4%	7%	1%

Test Beds	T1	T2	T3	T4
Dissolved	90%	90%	90%	80%
Aggregate Stability	10%	10%	10%	20%

Follow Up Testing Comprehensive Soil Report

Earth Grower LLC (949) 302 8771

Client: Sweet Hollow Farm **Location:** Victor, Idaho **Sample Collected:** 8/14/2023 **Sample ID:** Control Block

Biological Analysis:

Fungi: None
Bacteria: Low Diversity (Bacterial Dominated)
Predators None (poor nutrient cycling)
Anaerobic Conditions? No
Earthworms: 3
Microbial Recommendations Amount:
Good Quality Fungal Compost Aim for 2-4" over the entire Garden (4-10 yards) Fish Hydrolysate 1 ounce/gallon as needed as a Nitrogen Source and Fungal Food.
JADAM Microbial Solution Diluted 50:1 Once per year to relieve compaction and increase microbial diversity.
Chemical Analysis:
pH: Good Range
Phosphorus: Good Range
Sulfur: Good Range
Calcium: Low
Potassium Very High **(Locks Up Calcium)**
Magnesium: High
Sodium: Good Range
Boron: Low
Copper: Low
Manganese High
Iron: Good Range
Zinc: Good Range
Chemical Recommendations: Amount:
Gypsum (calcium and Sulfur) Mix with Compost (10-15 lb per yard of compost)
Borax (Boron) 1/2 ounce per 1000 sq ft Diluted into water (once a year)
Sea-90 (trace minerals) 2 Cups Per 100 Gallons of Water (once a year)
Avoid Fertilizers that contain Potassium and Magnesium
Physical Properties:
Soil Type: Loam
Sand: 50%
Silt: 30%
Clay: 20%
Humic Acids: 4 out of 6
Organic Matter: Good Range

Follow Up Testing Comprehensive Soil Report

Earth Grower LLC (949) 302 8771 **Client:** Sweet Hollow Farm **Location:** Midvale Idaho **Sample Collected:** 8/14/2022 **Sample ID:** Test Block

Biological Analysis:

Fungi: None
Bacteria: Low Diversity
Predators: None (poor Nutrient Cycling)
Anaerobic Conditions? Minor
Earthworms: 3

Microbial Recommendations Amount:

Good Quality Fungal Compost Aim for 2-4" over the entire Garden (4-10 yards) Fish Hydrosolate 1 ounce/gallon as needed as a Nitrogen Source and Fungal Food

JADAM Microbial Solution Diluted 50:1 Once per year to relieve compaction and increase microbial diversity.

Chemical Analysis:

pH: Good Range
Phosphorus: Good Range
Sulfur: Good Range
Calcium: Low
Potassium Very High **(Locks Up Calcium)**
Magnesium: High
Sodium: Good Range
Boron: Low
Copper: Low
Manganese High
Iron: Good Range
Zinc: Good Range

Chemical Recommendations: Amount:

Gypsum (calcium and Sulfur) Mix with Compost (15-20lb per yard of compost)
Borax (Boron) 1/2 ounce per 1000sqft Diluted into water (once a year)
Sea-90 (trace minerals) 2 Cups Per 100 Gallons of Water (Applied once a year)

Avoid Fertilizers that contain Potassium and Magnesium

Physical Properties:

Soil Type: Loam
Sand: 50%
Silt: 40%
Clay: 10%
Humic Acids: 4 out of 6
Organic Matter: Good Range

Physical Follow Up Testing

8/13	Control 1	Control 2	Control 3	Control 4	Test 1	Test 2	Test 3	Test 4
All in inches	8.5	9.5	10.75	11	6.5	7	14	12
	10.5	10	7.5	8	13	16.5	13.25	9
	11	24	12	6	7	18.75	13.25	8
	10.25	23	12.5	18.5	18	19.5	20	21.25
	13	21.5	18.25	22.5	6	7.5	22	9.75
	25.25	22	FULL 100 PSI	20.5	20	9.5	FULL 180 PSI	21.5
	23	FULL 140 PSI	17	FULL 75 PSI	7.5	7.75	FULL 120 PSI	9.25
	13.5	15.5	24	16	10.5	6	23.5	13.5
	17.25	13	17.75	17	FULL 70 PSI	20	7	2.5
	7.5	19	17	13.5	22.5	9	21	7.5

Slake Analysis

Earth Grower LLC (949) 302 8771

Client:	Sweet Hollow Farm
Samples Collected:	8/14/2023
Date of Test:	8/17/2023

Sample name	Dissolved	Aggregate stability	notes
C1	95%	5%	
C2	98%	2%	
C3	90%	10%	
C4	97%	3%	
T1	90%	10%	
T2	92%	8%	
T3	90%	10%	
T4	85%	15%	

Experiment Conclusions

Biological Comparison

The follow up microbial testing on the test plots shows lower bacteria counts than the baseline test results and comparable fungal counts. The soil is still lacking in predators for nutrient cycling such as nematodes, protozoa, and Amoebae. Low bacterial counts could be due to allium crops being grown in the plot this season. Lack of microbial predators is common in field production and not seeing them in follow up testing could be due to the quality of the compost applied in not being biocomplete. Applications on JADAM Microbial Solution are recommended to increase microbial diversity and to improve compaction layers in the soil.

Chemical Comparison

The follow up chemical testing on the test plots shows lower calcium content than the baseline results, and higher magnesium and potassium; leaving a calcium deficit and excess magnesium and potassium in the soil. Phosphorus has increased to more suitable ranges as well as Sulfur and these no longer need to be supplemented currently. Trace Minerals have not made a significant change and Sea-90 Applications are still recommended annually. The Compost used in the experiment may have provided the needed Phosphorus and Sulfur. The parent material of the soil in the area is naturally high in Potassium and Magnesium, and this is also true of the groundwater in the area. The sand content of the soil on the farm tends to leach calcium; the high Magnesium and Potassium are also taking up exchange sites on the soil's clay content making it harder to hold Calcium. Gypsum Applications are still recommended and also testing on future compost is recommended.

Physical Comparison

Follow up testing doesn't show any significant increase in Organic Matter or Aggregate Stability. Sand, Silt and Clay percentages remain the same. Penetrometer data from follow up testing does show signs of increased compaction in certain areas of the control and test bed but the results are not conclusive on the entire growing area. The compaction layer could potentially be correlated with high potassium and magnesium content as well. Applications of JADAM Microbial Solution have been shown to improve compaction layers in soil.