NO-TILL METHODS FOR SOIL REGENERATION IN THE TROPICS: LESSONS LEARNED IN OUR FIRST YEAR OF IMPLEMENTATION

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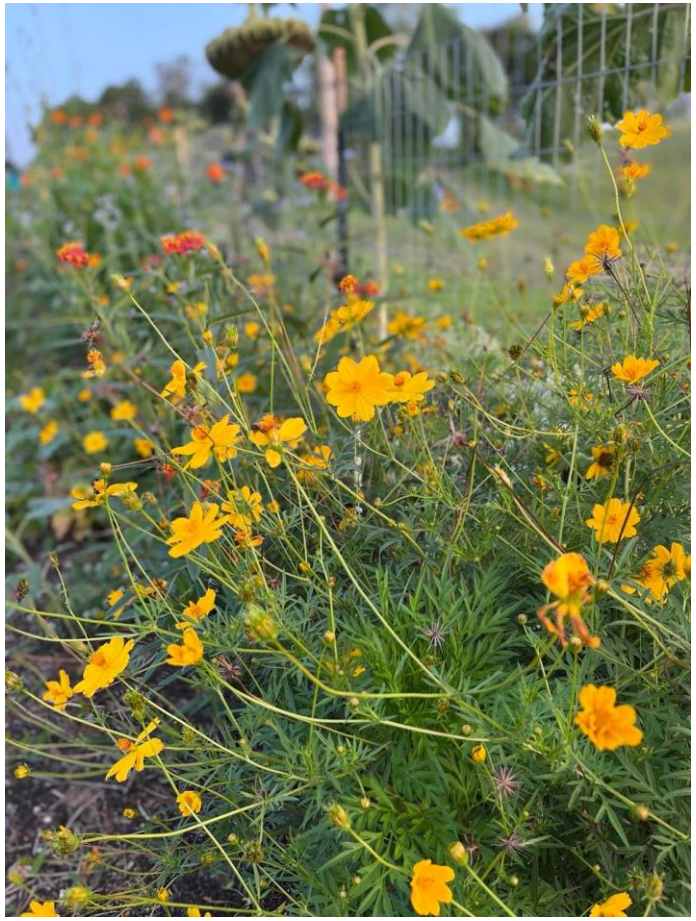
NRCS Natural Resources Conservation Service

Finca JEVANA

Cidra, Puerto Rico
~1,300ft elevation
Warm (~85F), tropical, humid




Ball

Regenerative Agriculture

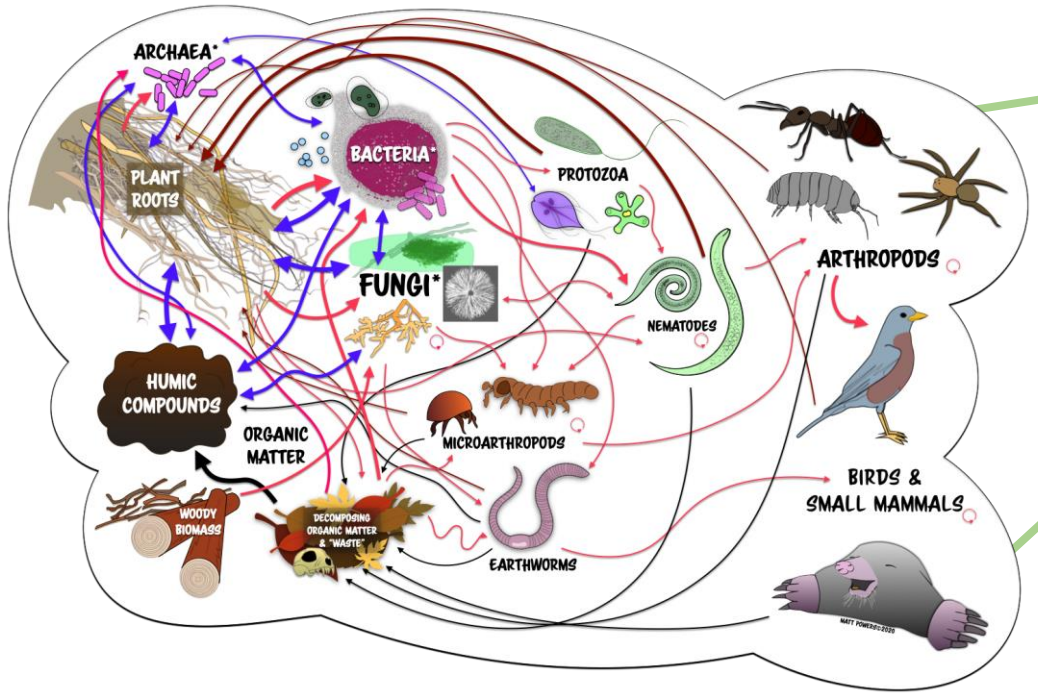
A conglomerate of practices with a singular purpose:

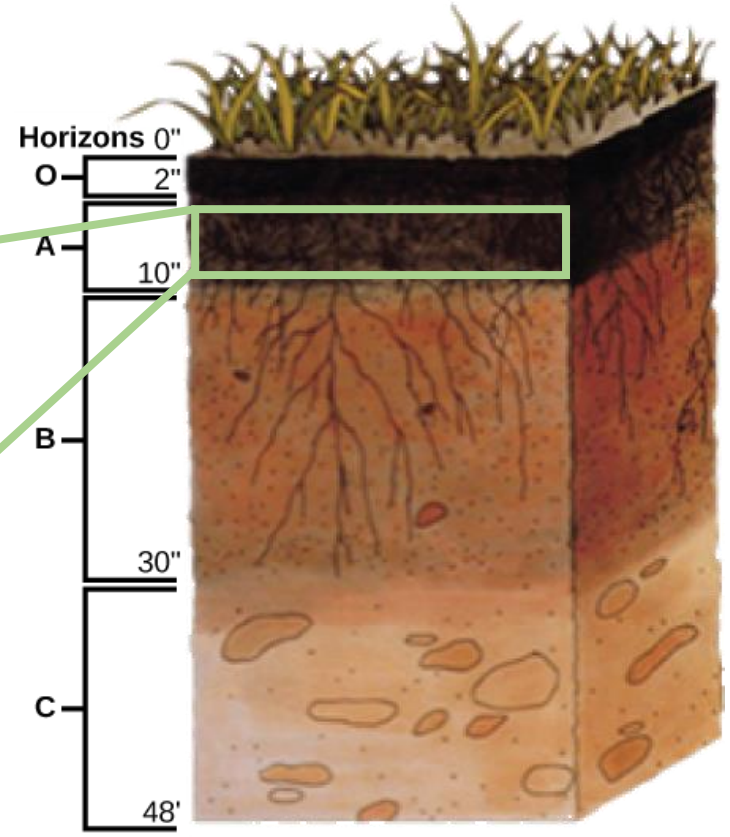
To restore soil fertility

Soils as living organisms

A subterranean web of nutrient exchange:

The soil bank



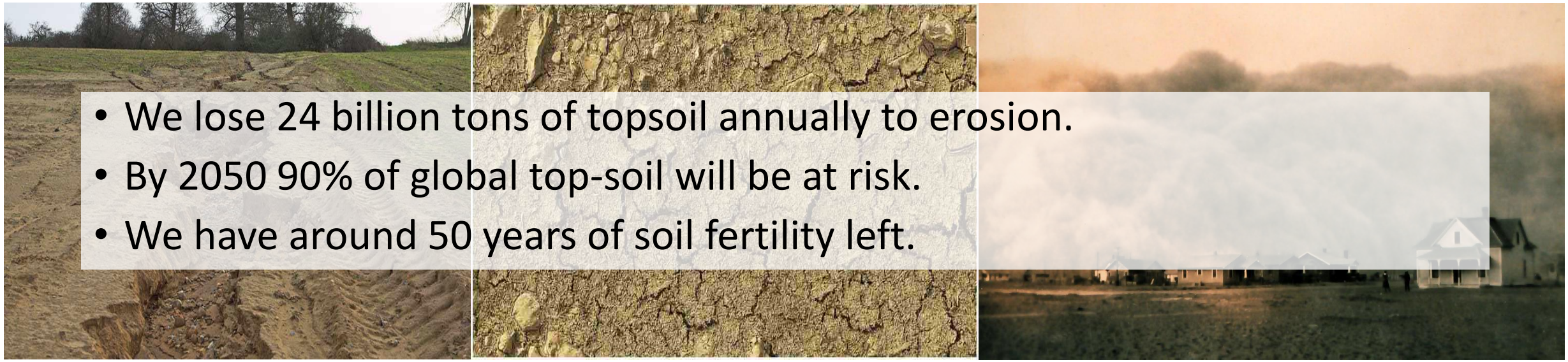


One teaspoon of good soil may contain: 5 billion bacteria, 20 million fungi, & 1 million protozoa.

We are our soil

"**Hum**ane, **hum**ble and **hum**ility all come from the same Indo-European word root that means "**humus**" or fertile earth. – Peter Warshall

Yet…



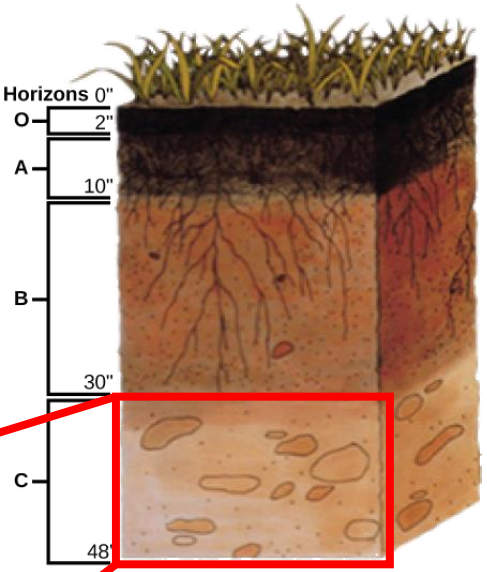
- We lose 24 billion tons of topsoil annually to erosion.
- By 2050 90% of global top-soil will be at risk.
- We have around 50 years of soil fertility left.

Degraded landscapes

San Juan Area, Puerto Rico (PR686)

San Juan Area, Puerto Rico (PR686)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
CaF	Caguabo clay loam, 40 to 60 percent slopes	0.1	1.0%
NaE	Naranjito silty clay loam, 20 to 40 percent slopes	3.6	36.0%
RoC2	Rio Arriba clay, 5 to 12 percent slopes, eroded	6.2	63.0%
Totals for Area of Interest		**9.9**	**100.0%**

Degraded landscapes



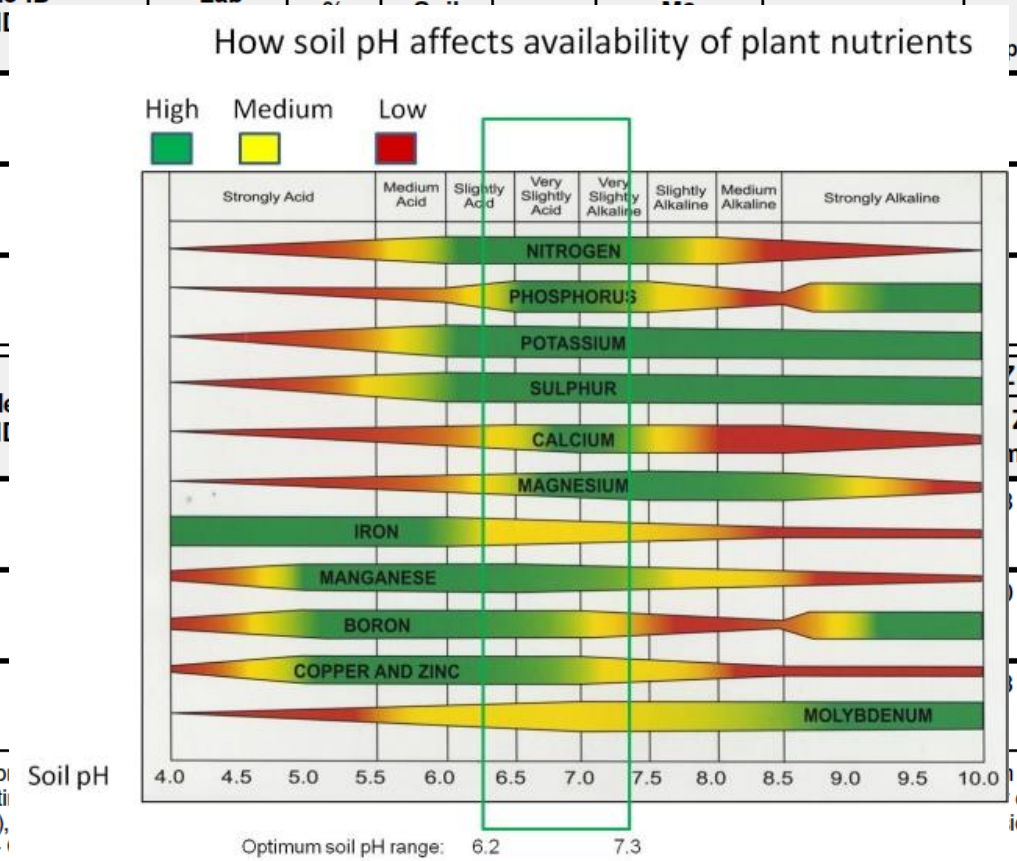
SOIL ANALYSIS REPORT

Analytical Method(s): Mehlich 3 SMP Buffer pH Loss On Ignition Water pH

Date Received: 03/21/2022 **Date Of Analysis:** 03/22/2022 **Date Of Report:** 03/22/2022

Sample ID / Field ID	Lab	OM	W/V	ENR	Phosphorus		Potassium		Magnesium		Calcium		Sodium		pH		Acidity	C.E.C
						Rate	K ppm	Rate	Mg ppm	Rate	Ca ppm	Rate	Na ppm	Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
1							61	L	201	VH	395	L	45	L	5.4	6.77	1.6	5.6
2							48	VL	261	VH	391	L	70	M	5.5	6.77	1.6	6.2
3							108	L	855	VH	908	VL	74	VL	5.5	6.50	4.3	16.6

Sample / Field ID	Zinc Zn ppm	Rate	Manganese Mn ppm	Rate	Iron Fe ppm	Rate	Copper Cu ppm	Rate	Boron B ppm	Rate	Soluble Salts SS ms/cm	Rate
1		L	369	VH	142	VH	1.4	M	0.4	L		
2		VL	289	VH	127	VH	1.2	M	0.3	VL		
3		L	82	VH	173	VH	1.2	M	0.6	M		



Values o soil. Rati H (High), C.E.C. -

(parts per million), lbs/A centimeter), meq/100g ions: ppm x 2 = lbs/A, Soluble

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Pauric Mc Groary

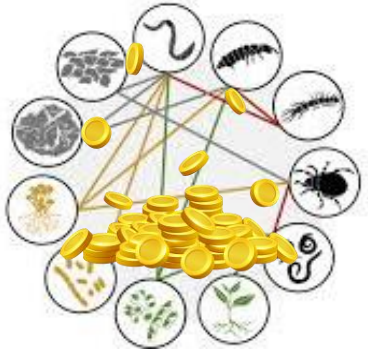
Pauric Mc Groary Ph.D., CPAg

Despite our degraded starting material…

We've been able to use **regenerative** methods to **grow our top-soil** and…

- Amplify the conditions for the 'soil food web'
- Minimize erosion
- Maximize water retention
- Maximize carbon sequestration
- Maximize nutrient retention
- Eliminate the need for petroleum-dependent artificial inputs
- Eliminate the need for toxic chemicals

Making deposits into our soil bank



Permanent no-till raised beds & cover crops

Capturing indigenous microorganisms (IMO) – Johnson-Su Bio-reactor

Making and spraying compost tea

Permanent no-till raised beds & cover crops

Broad fork

Rotary plow

Tillage radish

Permanent no-till raised beds & cover crops

- Sunn hemp (*Crotalaria juncea),* Sorghum sudangrass (*Sorghum x drummondii*), tillage radish (*Raphanus sativus*)
- Flail mower -> to terminate and pulverize cover crop

Capturing indigenous microorganisms (IMO) – Johnson-Su Bio-reactor

Johnson-Su aerobic compost

Mycelium

Finished compost

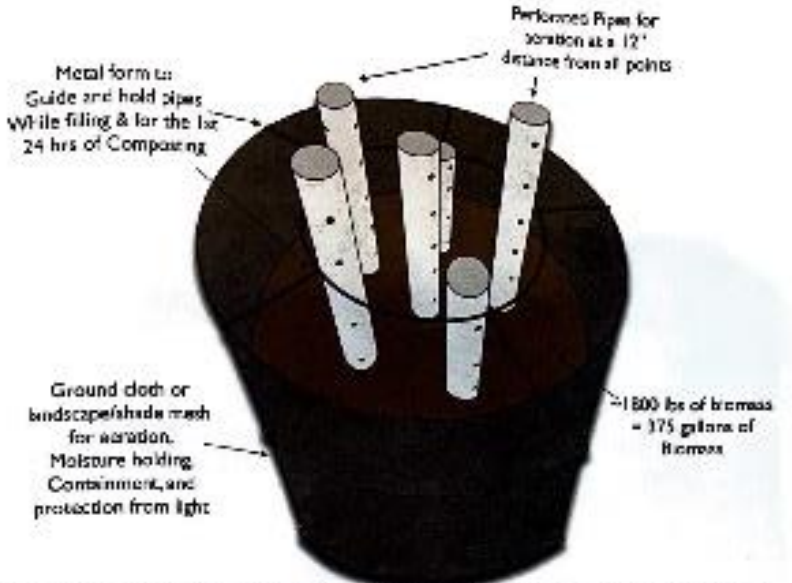
the pile, and nor do they give fungi complete free rein. We can do smaller bioreactors than the 375 gal version Dr. Johnson uses and use different ingredients, but we must maintain these key attributes for similar results to be had.

When analyzed, BEAM compost has an incredible diversity of microbes including some that have not been documented since Louis Pasteur himself was scanning the

Global Gardener: In The Tropics (1989) with Bill Mollison

resources, and investment to make it happen.

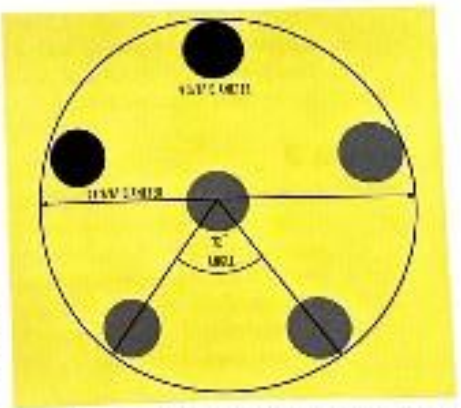
JOHNSON-SU "BEAM" COMPOST PREP



You don't have to create the same sized bioreactor, so please don't be intimidated by the size and dimensions mentioned here, BUT you do have to maintain the length of time (a full year), the 12" distance to open air from anywhere in the pile, the protection from light, and the static nature of the pile. You don't have to have a metal form to hold your pipes while you fill your bioreactor, and you don't have to make it as large. Ideally, all materials should be dried before composting and then shredded or chipped for maximum surface area. You don't have to do the exact ingredients listed (it can be entirely leaves), but to get similar results, I'd stick with the original recipe. Once your materials are the proper size, soak them in water for 60 seconds to adequately wet them. This is similar to how some folks soak straw before using it. This type of composting method requires 70% or greater moisture levels for microbes to do their best; this is why an irrigation hose ring is used to irrigate the bioreactor daily for 1 minute a day.

DAY 1

1. Gather all the supplies and tools needed for construction
2. Create a cutting guide for the pipe holes using the diagram above
3. Cut holes in your pallet using your newly created guide to avoid cutting all the way through any planks - if you cut through any planks, use bricks or another support



Guide for cutting holes in the pallet platform and ground cloth mesh covering the pallet

"Regenerative Soil" - Matt Powers

"Using only 1 application of the advanced BEAM compost on only 20% of the arable land, we would see ALL excess atmospheric carbon taken into the soil within 1 year – it's just that easy, but it requires time, effort, resources, and investment to make it happen"

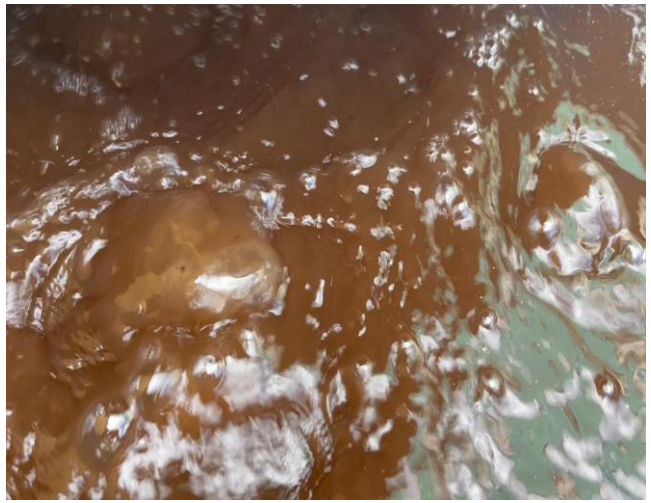
– Matt Powers, Regenerative Soil

Living soil is the key to regenerative agriculture

Making and spraying compost tea

Finished Johnson-Su compost

- 55 gallons of rainwater
- 15 lbs Johnson-Su compost
- 1 oz Bloomcity Humic Acid
- 0.50 oz PR KNF - Oriental Herbal Nutrients (OHN)
- 4 oz Bloomcity KleanKelp
- 4 oz PR KNF - Fish Amino Acids
- 8 Tbs Mycos WP Mycorrhizal Fungi



Oxygenate with Aquarium air pump ~24hrs

SOIL ANALYSIS REPORT

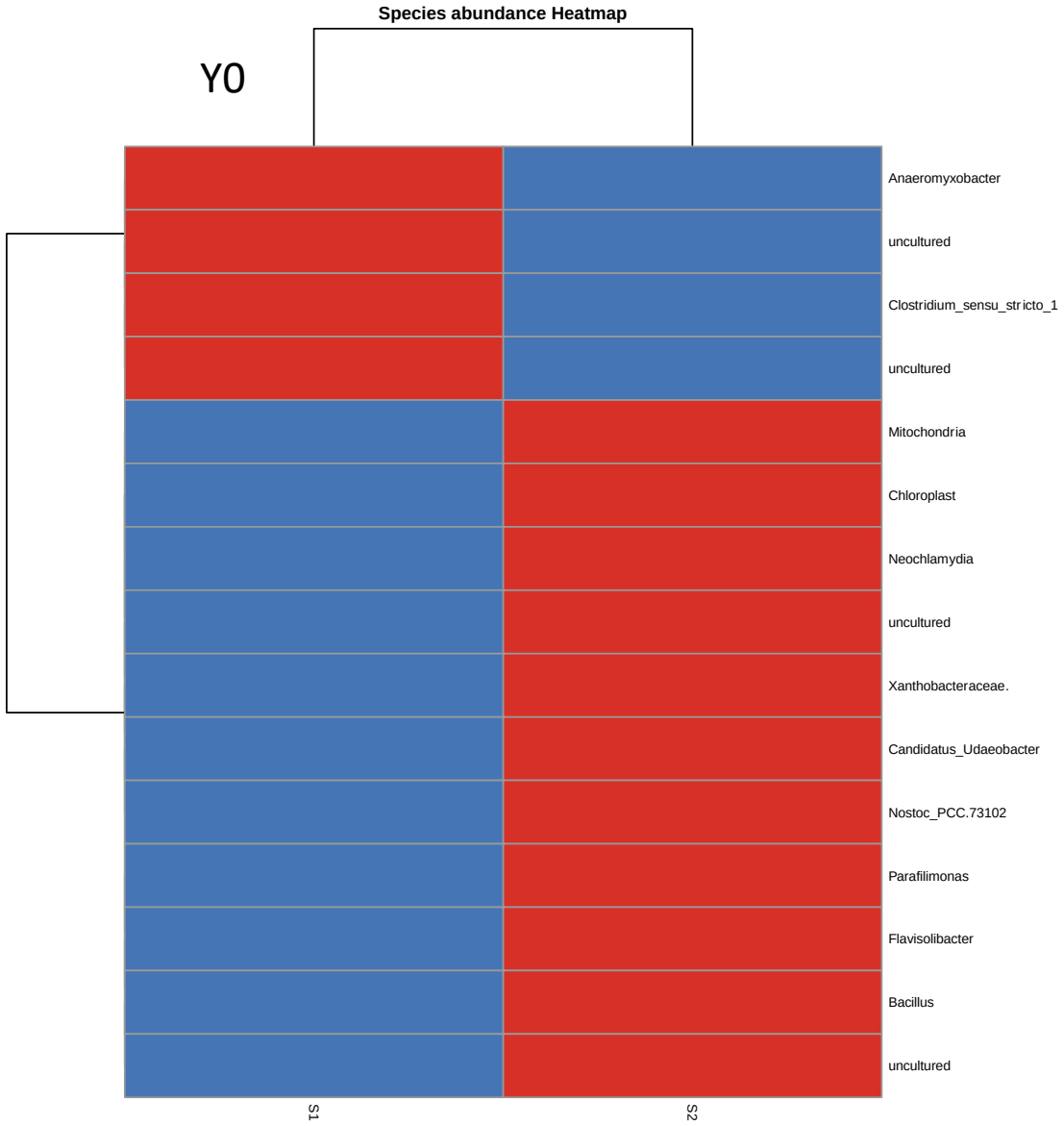
Analytical Method(s): Mehlich 3 SMP Buffer pH Loss On Ignition Water pH

Date Received: 09/25/2023 **Date Of Analysis:** 09/26/2023 **Date Of Report:** 09/26/2023

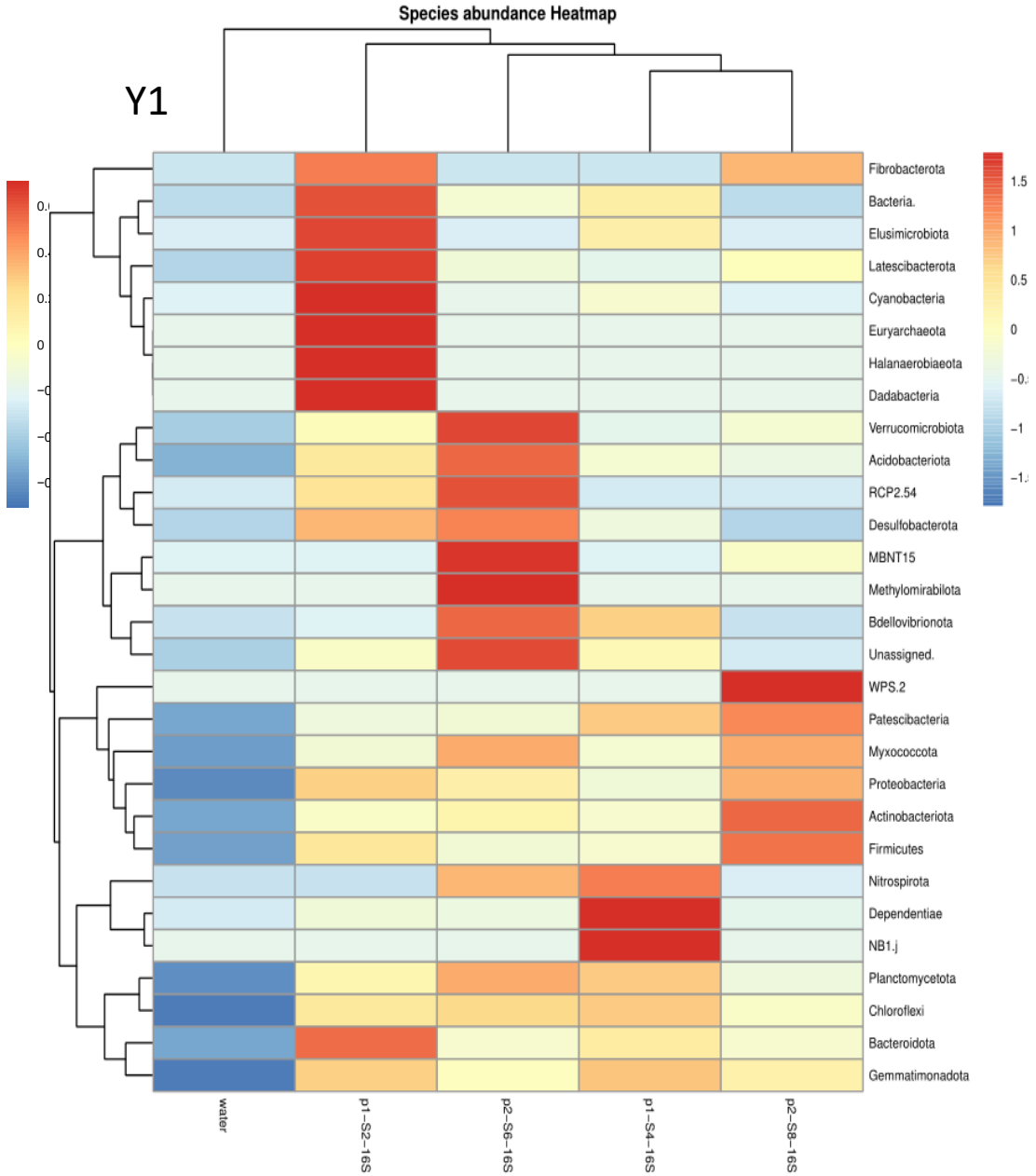
Sample ID / Field ID	Lab Number	OM	W/V	ENR	Phosphorus			Potassium	Magnesium	Calcium	Sodium	pH		Acidity	C.E.C
		% Rate	Soil Class	lbs/A	M3 ppm Rate	ppm Rate	ppm Rate	K ppm Rate	Mg ppm Rate	Ca ppm Rate	Na ppm Rate	Soil pH	Buffer Index	H meq/100g	meq/100g
P1	25293	9.7 VH		150	420 VH			690 VH	588 H	3101 M	92 VL	7.0		0.0	22.6
P2	25294	5.7 H		149	156 VH			393 VH	362 VH	1092 M	79 L	6.4		1.0	10.8

Sample ID / Field ID	Percent Base Saturation					Nitrate	Sulfur	Zinc	Manganese	Iron	Copper	Boron	Soluble Salts		
	K %	Mg %	Ca %	Na %	H %	NO_3 N ppm Rate	S ppm Rate	Zn ppm Rate	Mn ppm Rate	Fe ppm Rate	Cu ppm Rate	B ppm Rate	SS ms/cm Rate		
P1	7.8	21.7	68.6	1.8	0.0	21 H	237 VH	23.3 VH	91 VH	227 VH	12.5 VH	1.7 H			
P2	9.3	27.9	50.6	3.2	9.3	11 M	33 H	5.8 H	178 VH	354 VH	2.6 H	0.5 L			

Bacteria

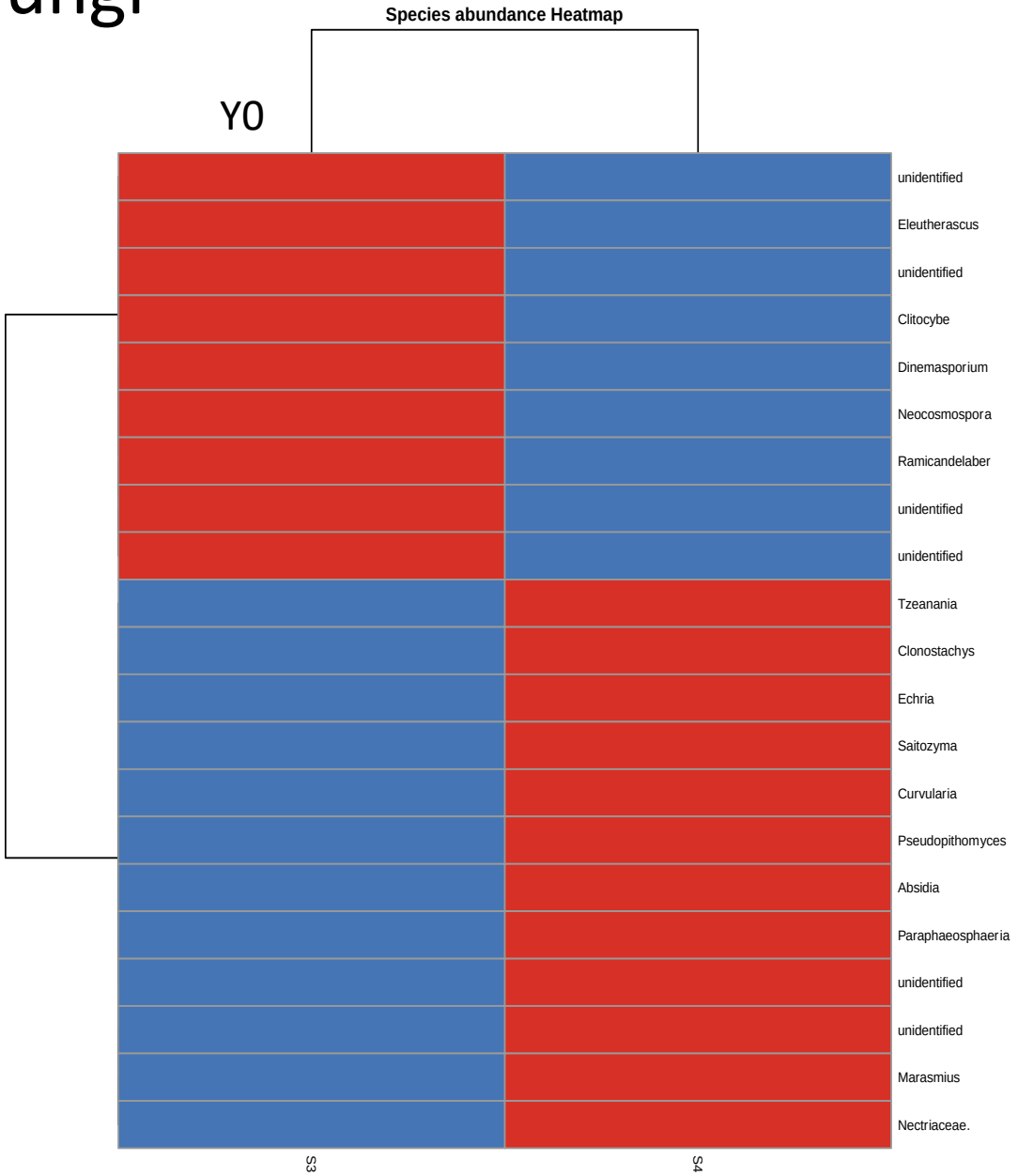


Shannon alpha diversity: ~4

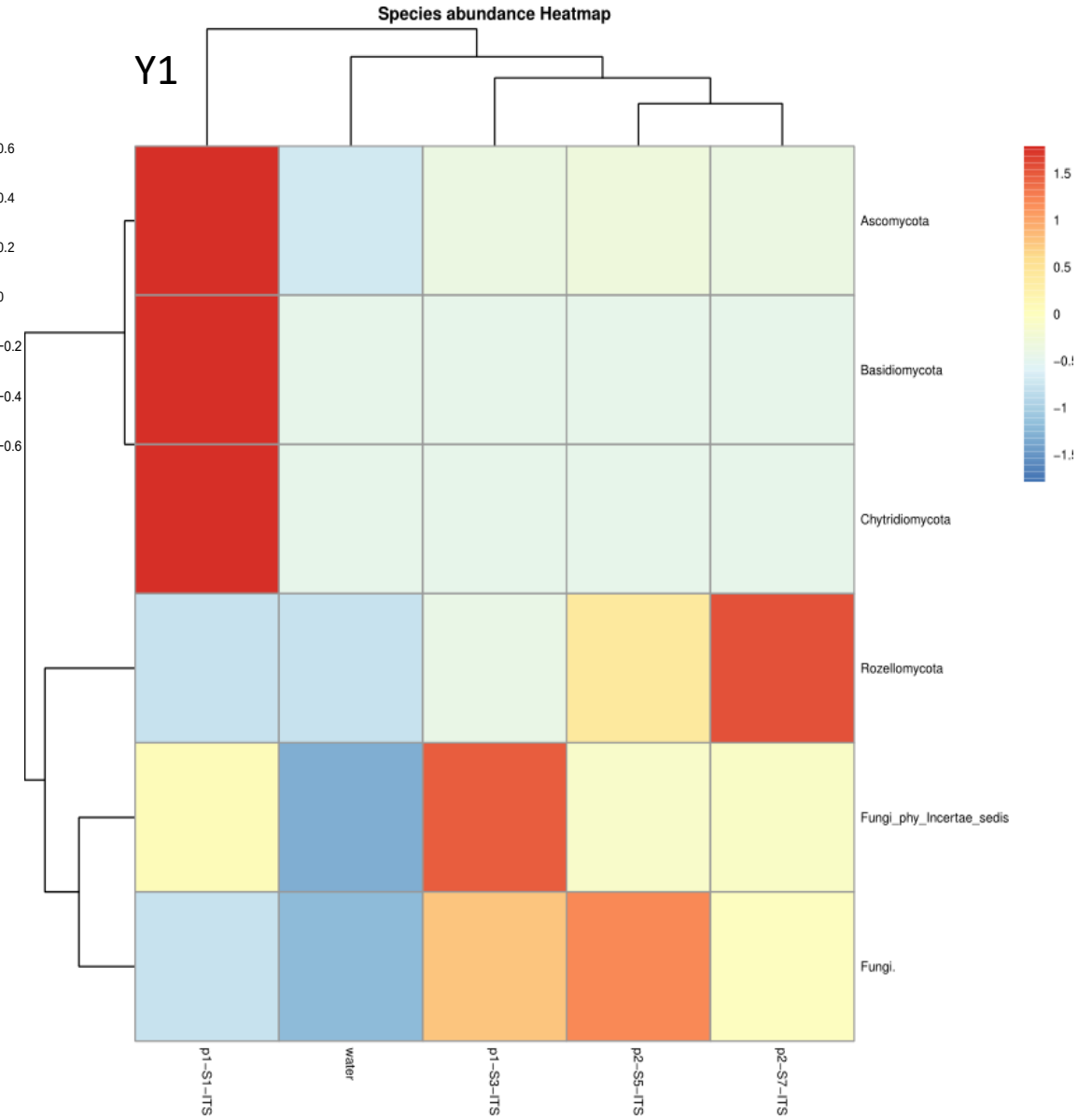


Shannon alpha diversity: ~7

Fungi



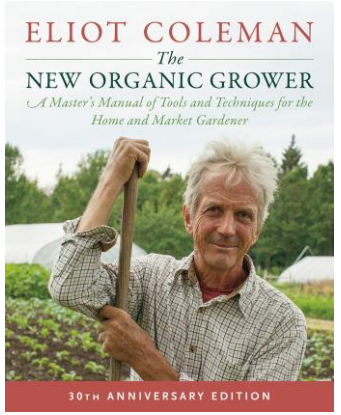
Shannon alpha diversity: ~5

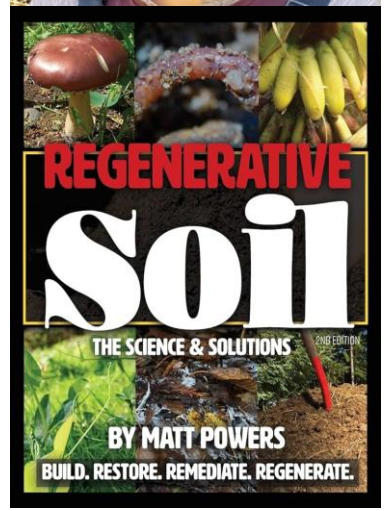


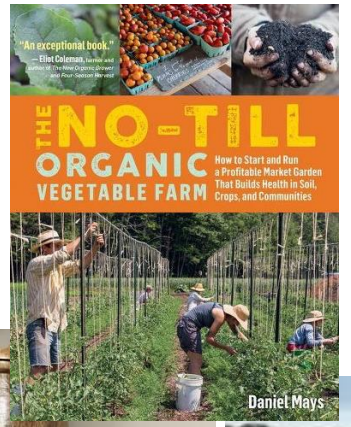
Shannon alpha diversity: ~4

Resources

- Elliot Coleman - “The New Organic Grower”
- Matt Powers – “Regenerative Soil”
- Dr. Elaine Ingham - The Soil Food Web
- Daniel Mays – “The No-till Organic Vegetable Farm”
- Ian Jiménez – PR KNF
- Harvey Acosta – Regeneración de Suelos PR







USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

CIG: Conservation Innovation Grants

Excited about regenerative soil? Get in touch!

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Jesyka & Dylan