Ranching in the Arid West

Restoring pastures to be self-sustaining

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Civilizations fail because they fail to regenerate the soils on which they were founded.

Drought resilience

Drought Mitigation Strategies

- **Having a Drought Mitigation Plan with Trigger Dates and on Paper**
- **Confinement Feeding Cows – being creative**
- **Residue Grazing**
- **Annual forages – as a replacement to a grain crop or behind a grain crop**
- **Grazing substitution on pasture**
- **Others –**
- **Running cows and yearlings**
- **WHAT DO WE DO IN DRY YEARS AND WET YEARS**

Grazing Management during drought-recovery of key species

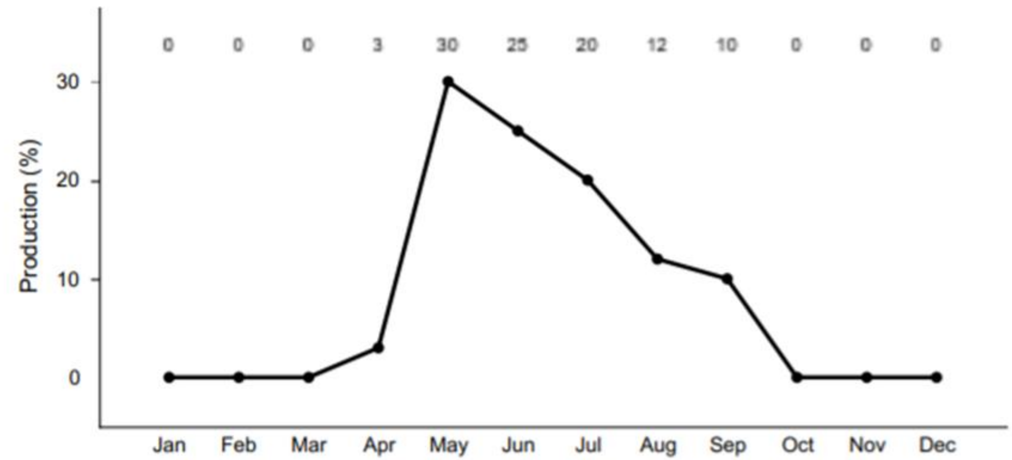


Figure 11. Plant community growth curve (percent production by month). CO5108, Cool-season Dominant Warm-season Subdominant, MLRA 51 Alluvial Fans & fan Remnants. Reference Plant Community for Chico Fan located in LRU 51-5 on fans and fan remnants above valley floor, pre-dominantly in areas surrounding Villa Grove and Saguache, Saguache County..

Indian ricegrass

Western wheatgrass

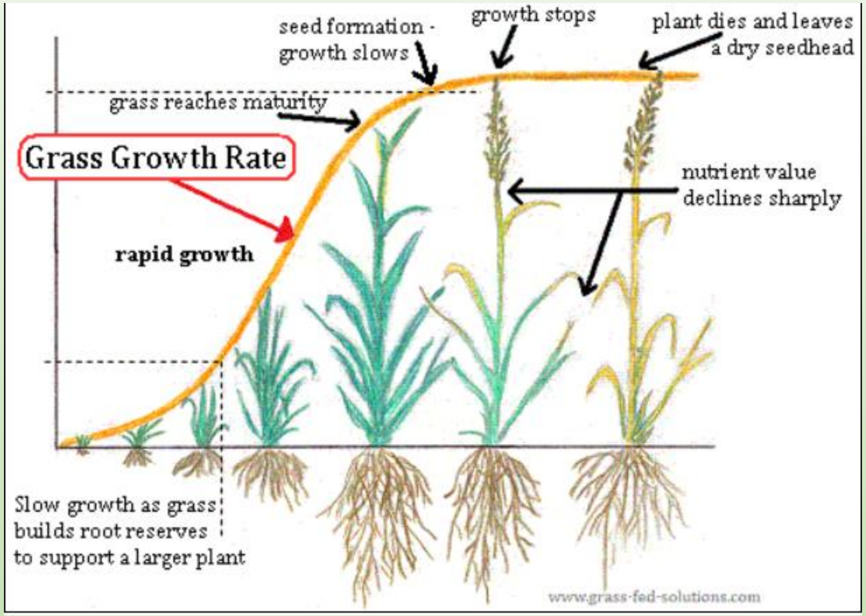
Blue grama

IN TERMS OF GRAZING MANAGEMENT- RECOVERY is KEY

Minimum Recommended Grazing Height during Growing Season

Do not graze below this minimum height during growing season.

SPECIES	MINIMUM HEIGHT
Kentucky bluegrass	3"
Smooth bromegrass	6"
Buffalograss	3"
White clover	3"
Tall fescue	4"
Eastern gamagrass	12"
Blue grama	3"
Indiangrass, big bluestem	6"



Good rule of thumb is 6-10 inches for bunch grasses and rhizomatous species

Sod formers??

What is happening with photosynthesis with no water? What about grazing with no water?

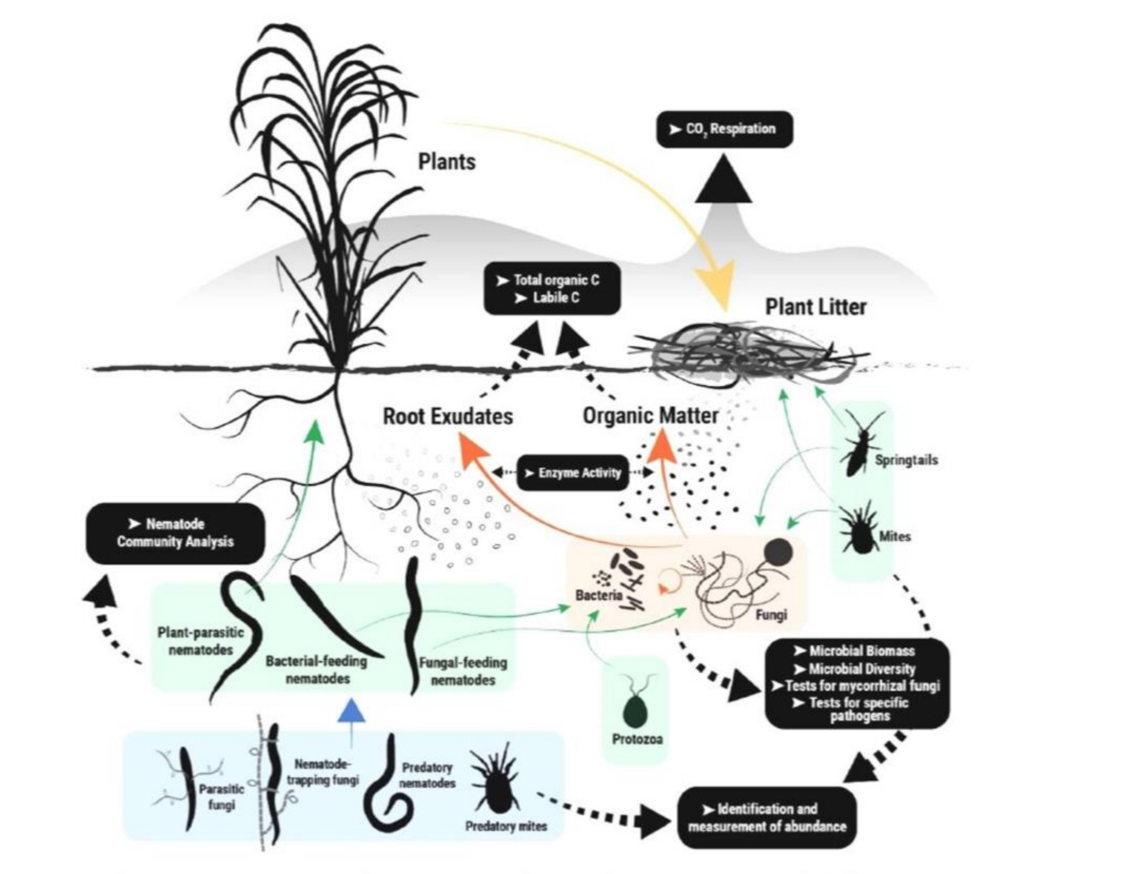
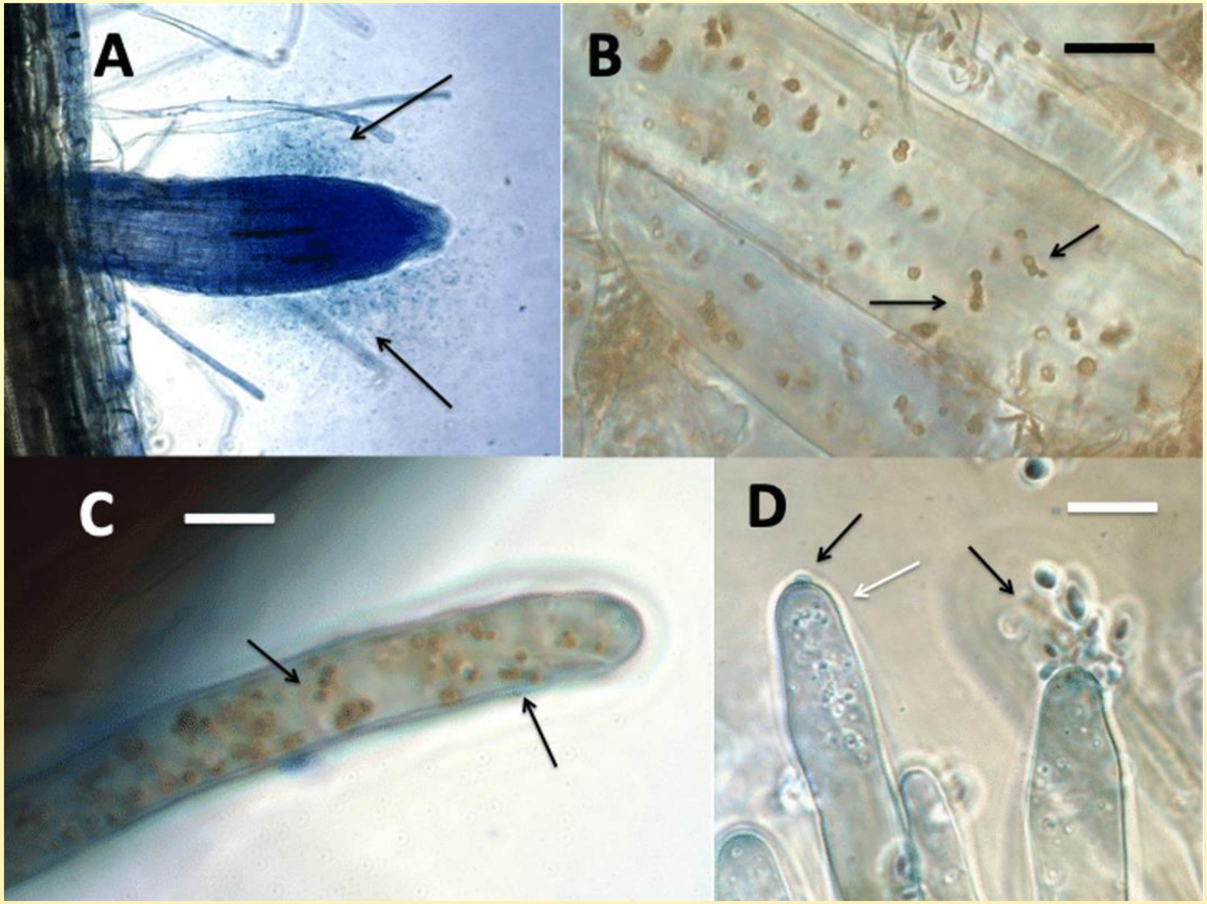


Fig. 2—The soil food web with various indicators of soil health overlaid (black boxes).

Soil biology creates structure- coffee beans

Rhizophagy cycle- how plants get nutrients from microbes

Dr. James White



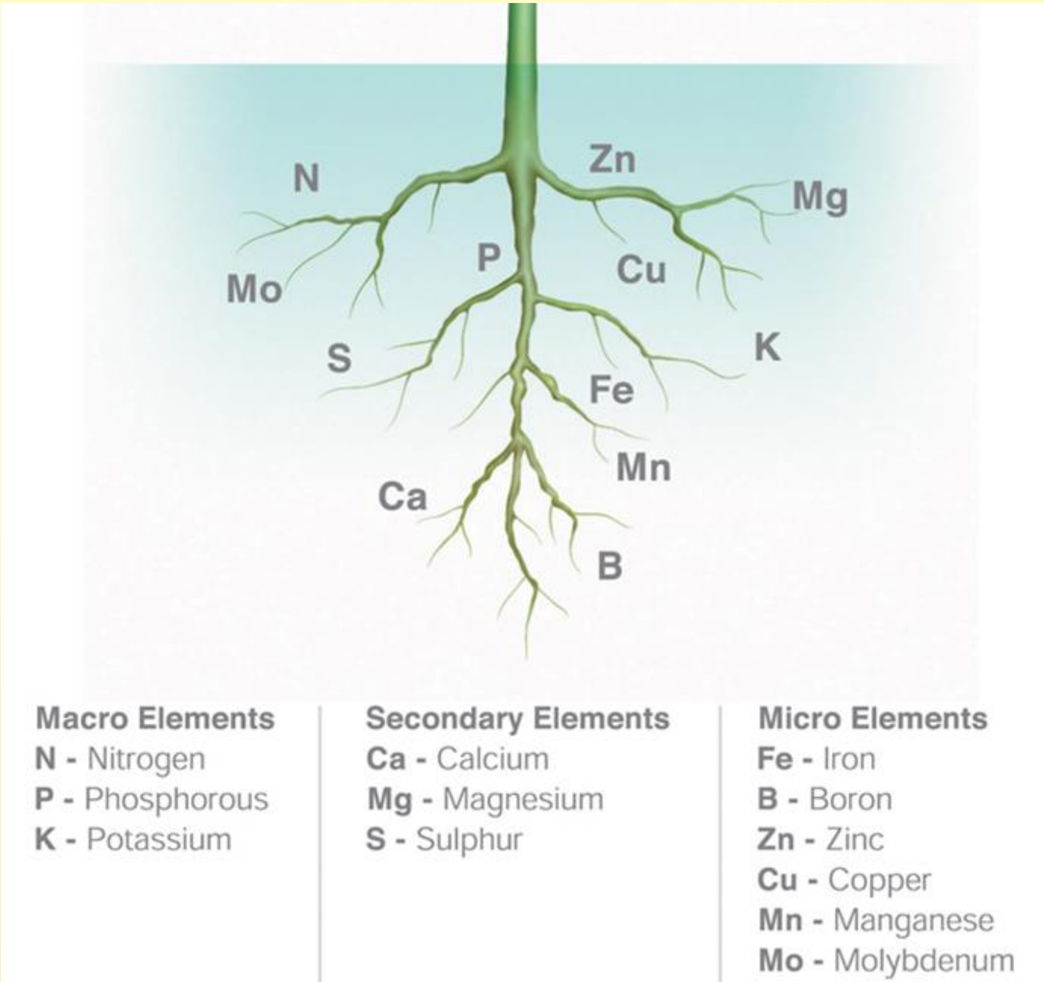
Plants get nutrients from microbes through root hairs.

Microbes trigger root hair elongation

HAPPENS IN SOLUTION

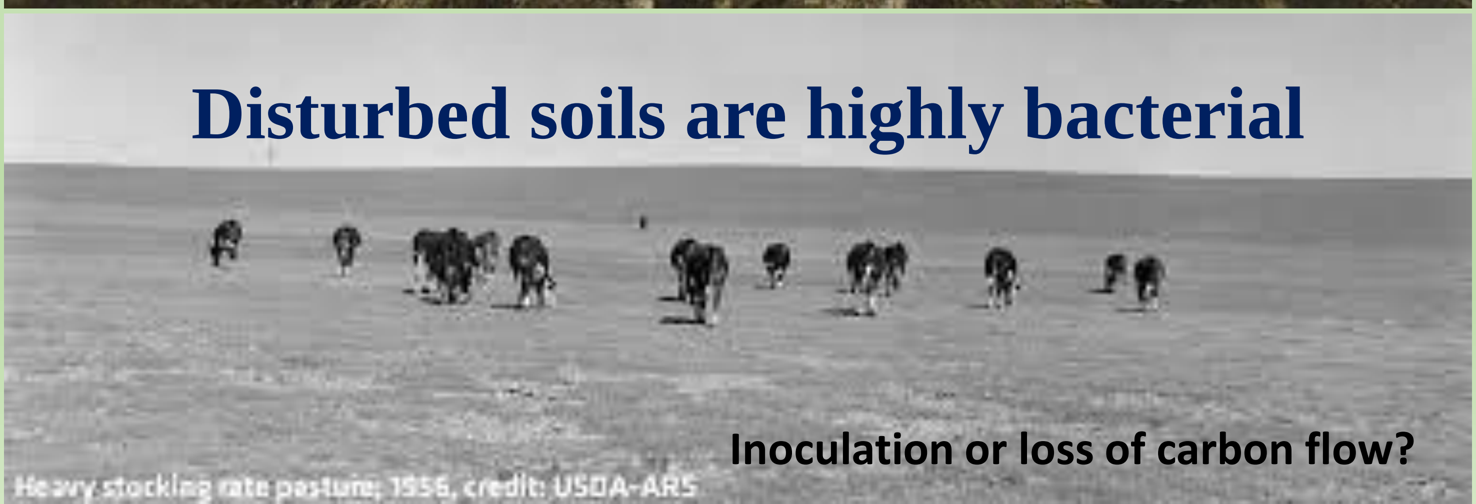
A. Cloud of bacteria B. Bacteria replicating C. Root hair of Bermuda grass inoculated with bacterium Pseudomonas sp. D. Root hairs of clover inoculated with endophytic yeast (Rhodotorula sp.) showing yeast being expelled from the root hair tips. Plants require oxygen to extract these nutrients. Plants can't perform this process in compacted soils.

Processes of nutrient to plant- happens in solution



- Ca^+ cell division
- Cu essential for making energy
- B translocation of sugars- requires water
- Mg core mineral of chlorophyl, activates over 300 enzymes
- Mn nitrogen and carbon dioxide assimilation, germination

Actions exacerbating water stress



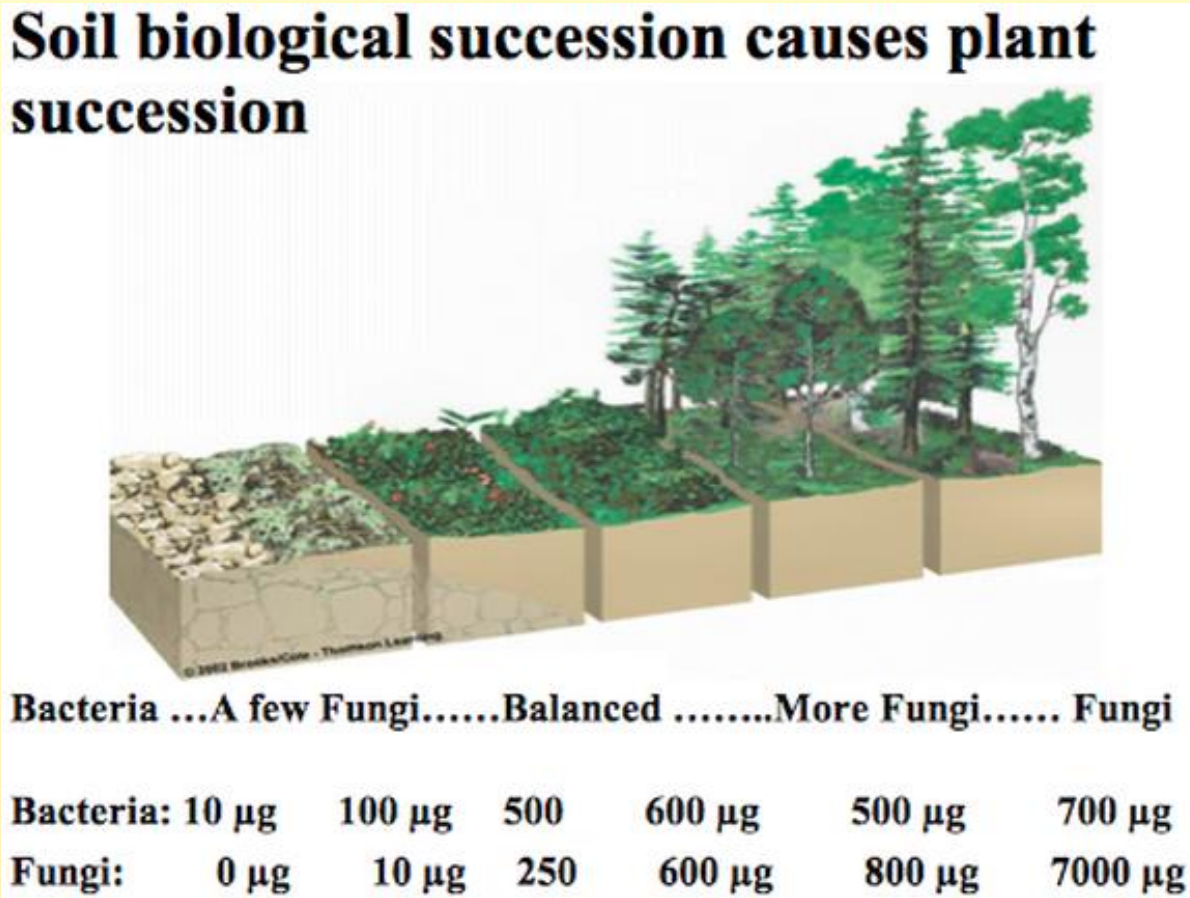
Disturbed soils are highly bacterial

Inoculation or loss of carbon flow?

Coffee beans turn into espresso

Late succession grasslands = fungi:bacteria

Elaine Ingham



Bacterially dominated pasture are not good at holding water- why?

WHY WE DON'T DISTURB THE STRUCTURE OF NATIVE RANGE

	Mine pasture (blue grama)	Purslane Cheatgrass pasture
test	Earthfort	PLFA
Total Fungi ug/g	2560- good biomass	61
Total Bacteria ug/g	476- good	1286
Active Fungi ug/g	4.40	0
Active Bacteria ug/g	16.03	0
TF: TB Ratio	5.38 (good range 1-10)	.049
AF: AB Ratio	0.27	0

Steve Oswald-
Fremont County

increasing resilience- fix that old field

Plateau with grazing

Why these fields?

How much to buy hay?

Assumptions:

1) Currently, the land produces 300 pounds of forage per acre per year.
2) Land will be grazed if available forage is greater than 600 lbs/acre/year. Grazing plan is to "take half and leave half".
3) Forage to hay ratio is one to one (a pound of forage = one pound of hay).

		Strategy "A"						Strategy "B"					
		Year 1	Year 2	Year 3	Year 4	Year 5	Total	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Forage Production (lbs/acre)		300	600	1,000	1,500	1,800		300	800	1,500	1,800	1,800	
Forage Available (lbs/acre)		0	0	500	750	900	2,150	0	400	750	900	900	2,950
Costs													
Seed ($/ac)		60	30	0	0	0	90	60	0	0	0	0	60
Additive ($/ac)		10	0	0	0	0	10	10	0	0	0	0	10
Planting ($/ac)		30	30	0	0	0	60	30	0	0	0	0	30
Total Costs		100	60	0	0	0	160	100	0	0	0	0	100
Hay Price ($/ton)	149												
Savings of Hay ($/acre)		0	0	37	56	67	160	0	30	56	67	67	220
Cost or Benefit ($/ac)		**(100)**	**(60)**	**37**	**56**	**67**	**0**	**(100)**	**30**	**56**	**67**	**67**	**120**

Our approach in 2019- pre biology

Dig a hole- compaction/texture

Aggregate stability

Water infiltration

CEC

Approach- Pasture Renovation 2019- didn't know as much about soil biology

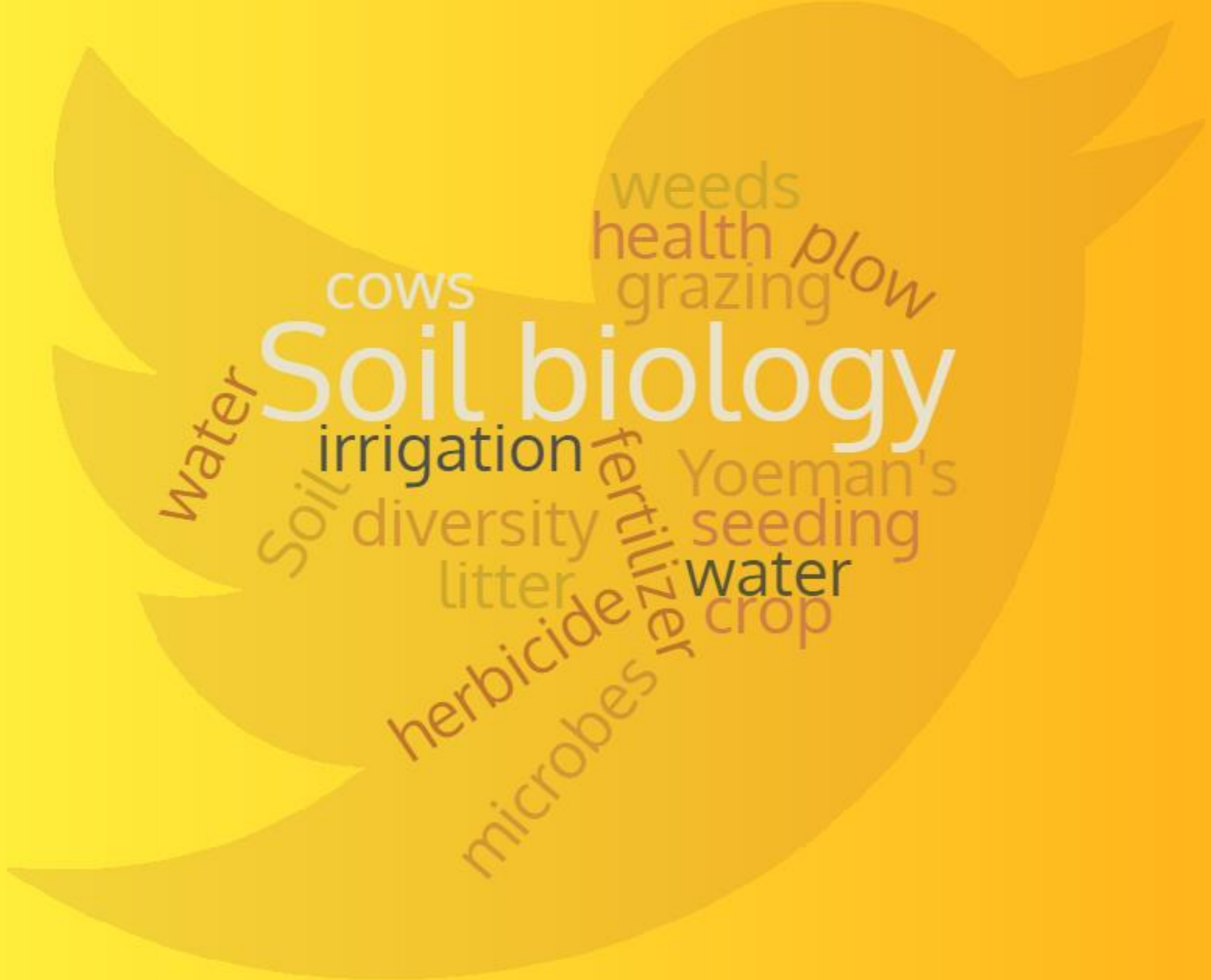
- High intensity graze= competition

- Cover crop with a cool season (April)

*Hairy vetch, alfalfa, clover, **spring barley, **triticale, collards, beets, flax, safflower phacelia, chicory, plantain*

Conditions: cool spring, great moisture

Results: very little


weeds
health
plow
cows
grazing
Soil biology
water
irrigation
fertilizer
Yoeman's
Soil
diversity
seeding
litter
water
crop
herbicide
microbes

High Fungal Compost and vermicast

<u>Johnson-Su process at Dave West's in SLV (</u>community effort)

White wood chip, native grass, manure, water, aerated with PVC "holes", never turned

Thermophilic phase 160 degrees lasts 3 days

Added red wigglers when temp is 80 degrees

Composts 18 months under aerobic conditions

Nexus of applying old practices with new knowledge
Soil Health

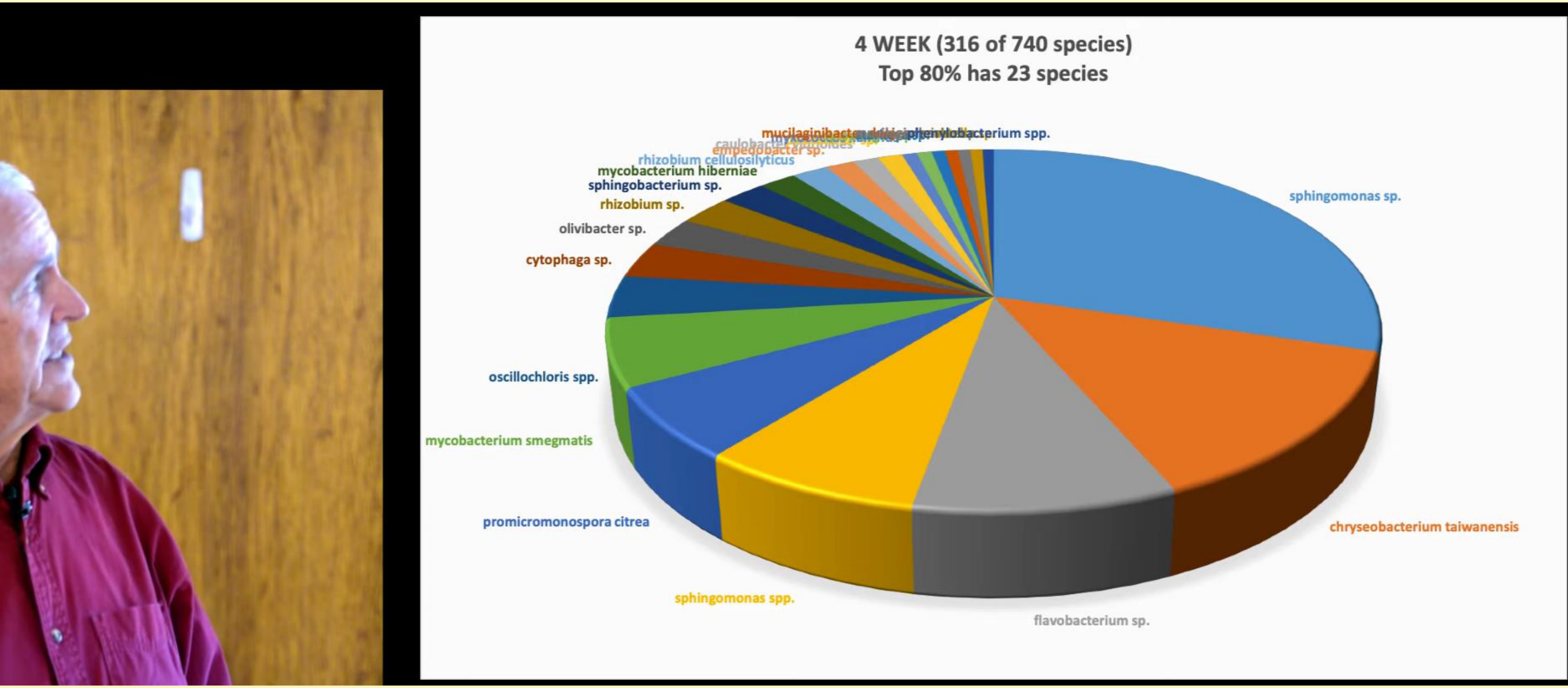
WHAT DOES COMPOST EXTRACT DO?

Enzymes, metabolites, spores, exudates

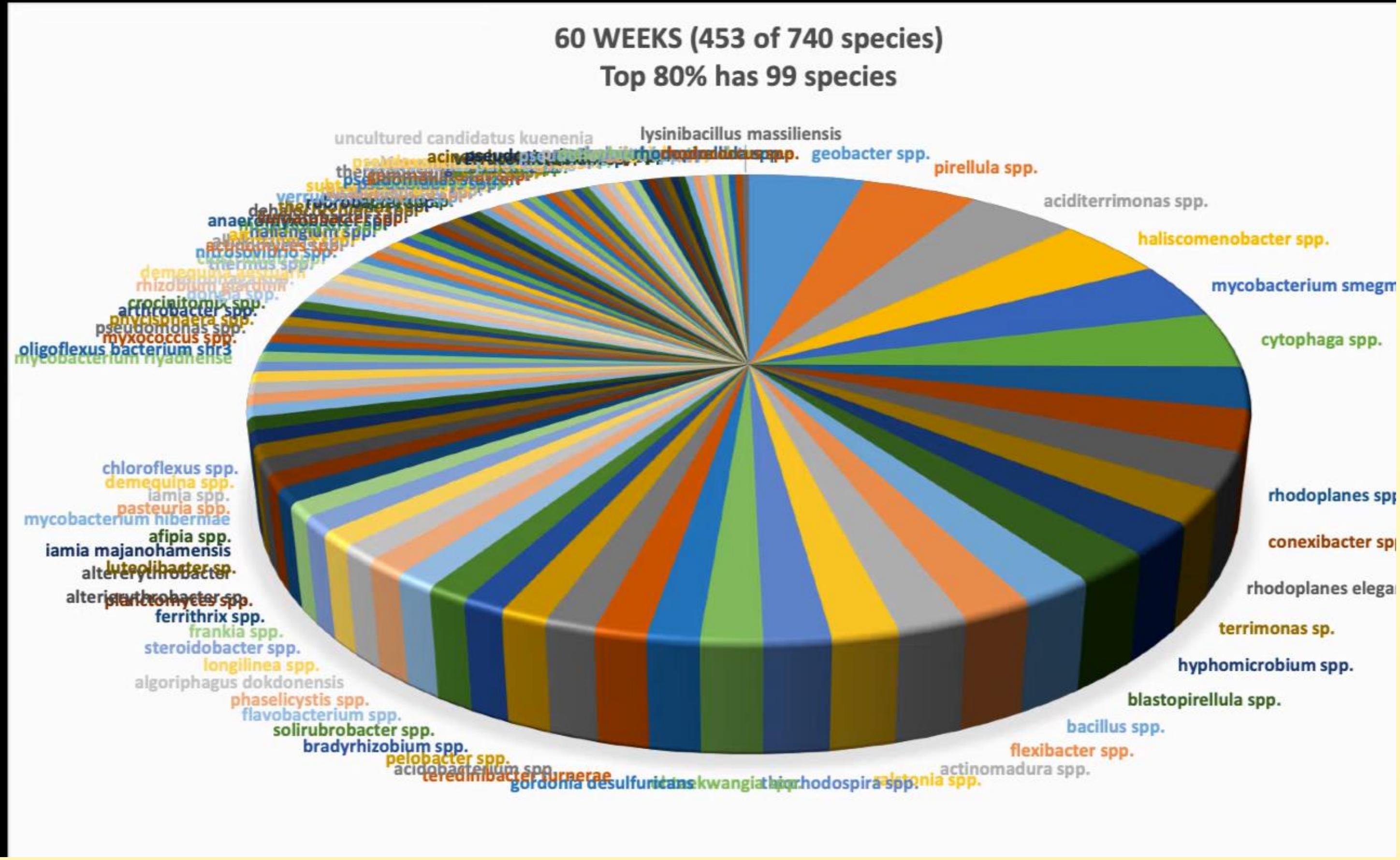
Create conditions to signal a suite of species through Quorum Sensing

Compost does not provide nutrients- it enables microbes to mine nutrients

Restores microbial diversity in the soil



David Johnson- numbers of microbial species in compost at week four



San Luis Valley Static Pile (August 2, 2019) soil details		
Total Fungi	1,845.60 µg/g	Good fungal biomass. - Fairly good fungal diversity. Hyphal diameter: 1.5 to 7.5µm.
Total Bacteria	933.99 µg/g	Bacterial activity within normal levels
TF:TB ratio	1.98	Correctly balanced fungal and bacterial biomass for most plants.
Flagellates	369,697.62	Nutrients are being cycled and made available to plants in good rates
Amoeba	1,534,366.45	
ciliates	12,283.25	

IMPORTANT TESTING ADDITIONS- Nicole Masters

What is your limiting factor- maybe it's not management

Measure your brix

Plant tissue test

Look at minerals- what's limiting?

Soil biology

Read your weeds

Look at roots

NEW GOAL:

Making sure we are prepared when it does rain.

Understanding the minerals, how they support photosynthesis

Don’t want to apply amendments after a few runs- self sustaining

WARD Laboratories, Inc.

PAP-Accredited NAPT 2021

Ag Testing - Consulting

Account No. : 23789

OSWALD, STEVE
PO BOX 304
COTOPAXI, CO 81223-0304

Soil Analysis Report

Invoice No. : 1347040
Date Received : 06/21/2021
Date Reported : 06/23/2021

Results For : STEVE OSWALD
Location :

Sample ID / Lab No.	Soil pH 1:1	Modified WDRF BpH	Soluble Salts 1:1 mmho/cm	Excess Lime Rating	Organic Matter LOI-%	KCl Nitrate ppm N	Depth / Nitrate Lbs N/A	Method / Phosphorus ppm P	-Ammonium Acetate- K ppm	Ca ppm	Mg ppm	Na ppm	M-3 Sulfate ppm S	-DTPA- Zn ppm	Fe ppm	Mn ppm	Cu ppm	Hot Water Boron ppm B	CaNO3 Chloride ppm Cl	Sum of Cations me/100g	% Base Saturation H	K	Ca	Mg	Na
KAESS MEADOW							0 - 8 in	O-P																	
72611	7.3		0.13	NONE	2.7	1.4	3	22.4	321	1731	237	25	1.1	0.77	38.4	12.4	1.10	0.58		11.6	0	7	75	17	1
POND FIELD							0 - 8 in	O-P																	
72612	7.2		0.14	NONE	3.0	0.9	2	17.7	213	1692	202	17	7.2	1.11	18.7	12.5	0.66	0.57		10.8	0	5	78	16	1
CHEATGRASS FIELD							0 - 8 in	O-P																	
72613	6.9		0.18	NONE	1.9	9.3	22	33.8	439	1153	165	22	1.9	1.38	33.0	11.6	0.54	0.49		8.4	0	13	69	16	1
HOUSE FIELD							0 - 8 in	O-P																	
72614	7.3		0.18	NONE	4.0	0.7	2	37.6	428	1711	243	27	8.0	1.76	20.3	7.8	0.67	1.12		11.8	0	9	73	17	1
CRESTED WHEAT FIELD							0 - 8 in	O-P																	
72615	6.7		0.08	NONE	2.1	0.9	2	18.1	228	1235	129	25	5.2	1.15	24.2	13.8	0.70	0.29		7.9	0	7	78	14	1

K:Mg ratios, B, Cu, Zn

Plant Tissue Test 2020

PLANT TISSUE TEST OSWALD- Data taken 7/24/2020

Sample ID	% N	% P	% K	% S	% Ca	% Mg	ppm Zn	ppm Fe	ppm Mn	ppm Cu	ppm B	% Cl	% Na	ppm Al	ppm Mo
Green needle in CHEATGRASS	2.129	0.148	1.77	0.15	0.373	0.122	35	658	67	10.3	4.8	0.45	0.01		0.65
BINDWEED IN CHEAT GRASS	3.933	0.323	3.43	0.29	1.098	0.280	28	1011	142	10.0	20.4	0.48	0.01		0.69
KNAPWEED DRY MEADOW	1.270	0.256	1.74	0.21	1.446	0.158	45	252	63	10.3	36.2	0.74	0.02		0.79
SMOOTH BROME DRY MEADOW	2.880	0.248	1.35	0.19	0.531	0.171	16	329	106	7.8	10.3	0.41	0.01		2.31
THISTLE IN TRITICALE RUSSIAN	4.483	0.297	5.52	0.28	3.112	1.110	22	138	48	7.4	24.4	1.03	0.03		0.37
SWEET CLOVER KAESS PLACE	2.774	0.242	1.85	0.37	1.605	0.304	18	218	54	7.3	27.8	0.24	0.02		4.25
SMOOTH BROME KAESS PLACE	3.121	0.338	2.45	0.28	0.947	0.209	27	909	221	10.7	12.6	0.46	0.02		3.3

Russian thistle, mustard, curly top gumweed, cheatgrass (perfect conditions), different weed each season

Pasture Renovation 2021

Strategy: high intensity graze cheatgrass

Warm season cover *(**Sorghum sudan, soybean, foxtail millet, fava bean, field pea, Proso millet, buckwheat)*

Cool season cover (Triticale, winter wheat, **peas, hairy vetch, *oats, *barley, winter rye, radish)

High fungal extract- coated seed, sprayed in test plots 1 m^2
25 lbs/acre to make extract (83 gallons/acre of extract)

Conditions: cool spring, great moisture

2021 Results High Fungal Compost Extract (warm and cool season covers)

FROM TESTS, WEEDS, trials- What have we learned?

Pigweed, mustards, Russian thistle still very common

Extract increased nutrient availability through biology

When to plant, time with moisture, whacked back the competition just prior and areas of bare ground

What cover crops grow at 7500 feet- Triticale, Sorghum, proso and foxtail millet, radish, oats, hairy vetch

Concentrated level of extract

Oats and sorghum have good mycorrhizae

Water infiltration test

Active fungi is low, Boron low

2022 Goals- Only if we have water

- **Build OM**
- **Capture water**
- **Increase fungi to increase brix**

Cover crops: species that support mycorrhizae fungi- *oats, buckwheat, chicory, triticale- perennial cover crop? Hairy vetch*

Add trace minerals

Add carbon source- energy for microbes

Inoculate with concentrated HFC- to turn on signals to right plants

Apply as a slurry

Prioritize based on minerals too

Acknowledgements:

Dr. David Johnson- static pile fungal compost
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Ron Meyer- CSU Extension
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Jeff Tranel
Steve and Nancy Oswald
WSARE
The Ranchers and Farmers
The Livingston Family
The Purvis Family and my family

http://websoilsurvey.sc.egov.usda.gov/

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