Adaptive Grazing and Relationship to Soil Health

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Grass Fed Insights, LLC


105

Three Principles

- Principle of Compounding
- Principle of Diversity
- Principle of Disruption

Conventional Grazing

Adaptive Grazing

Adaptive or Flex Grazing

- Allows Practitioner to address multiple goals and objectives.
- Not a routine or rigid system
- Adapt to changing conditions

Principles of Adaptive Grazing

- Goal Oriented
- Stock Density vs. Stocking Rate
- Management and flexibility are key
- Frequent Movement & Frequent Rest
- Plant Root System Recovery
- Highly reliant on temporary fencing technology
- **Compounding & Cascading Effects**

Regenerative Grazing Research Shows:

- Ecological function and profitability increase with increasing number of paddocks.
- Short periods of grazing with adequate recovery gave the greatest profit and ecological function.
- Adjusting grazing management with changing conditions increases ecological function and profitability.
- Fixed management protocols reduced benefits.
- Profitability decreases if recovery is too short or too long.
- Stocking rates can be increased without damaging ecological function as number of paddocks is increased

Teague et al. 2015. Journal of Environmental Management

What Does It Look Like?

Simulate Nature

Mimic Nature: Biomimcry/Ecomimcry

Nurtures Ecological Memory

Soil Carbon Cowboy Series

- **Soil Carbon Cowboys - 12 minutes;** https://vimeo.com/80518559
- **One Hundred Thousand Beating Hearts - 15 minutes:** https://vimeo.com/170413226
- **A Fence and an Owner - 9 1/2 minutes:** https://vimeo.com/201215707
- **During The Drought - 12 minutes:** https://vimeo.com/200109813
- **Luckiest Places on Earth - 25 minutes:** https://vimeo.com/181861077
- **Soil Carbon Curious - 6 minutes:** https://vimeo.com/130721684
- **Next…..”Givers and Takers”**

Additional Resources

- www.pastureproject.org
  - Grass Fed Beef Decision Calculator
  - PowerPoint Presentations
  - “How –To Video” series
  - Webinars
  - http://www.stonebarnscenter.org/images/content/3/9/39629/Grassfed-MarketStudy-F.pdf
- “Before You Have A Cow”
  - www.joyce-farms.com

Case Studies

Mississippi Farm

- Case Study

Condition at Purchase

Starting Point

- Soil OM – 1.3% to 1.6%
- Water Infiltration Rates – < ½ in/hr
- Plant Brix – 2%
- Major forage species – 3-4
- Stocking Rate – 1 AU/6 acres

Implemented Strategy

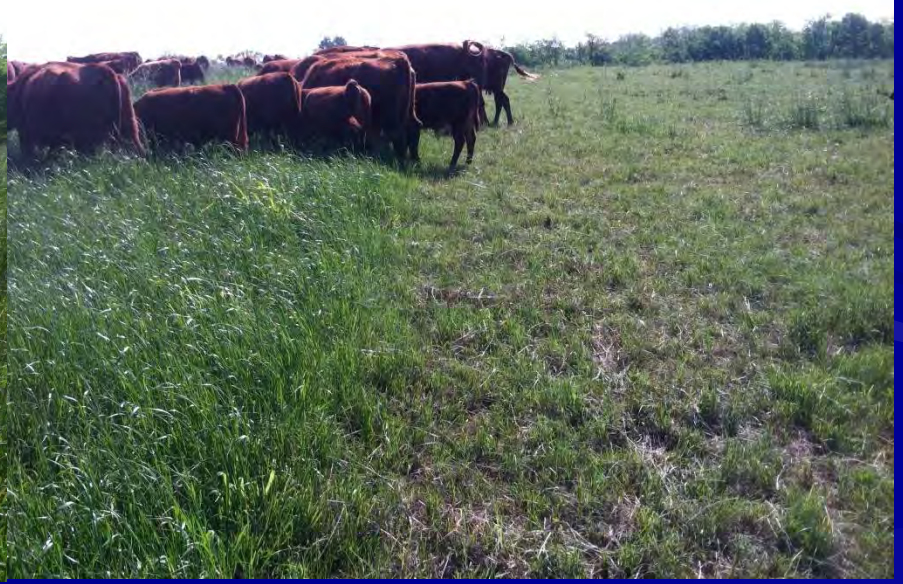
- Bale Grazing 1st winter.
- High Stock Density/Short Duration Grazing.
- Long rest periods.
- Strategic use of microbial quorum sensing.

Year 1 Grazing Season

Grazing Weeds

Year 2 Grazing Season

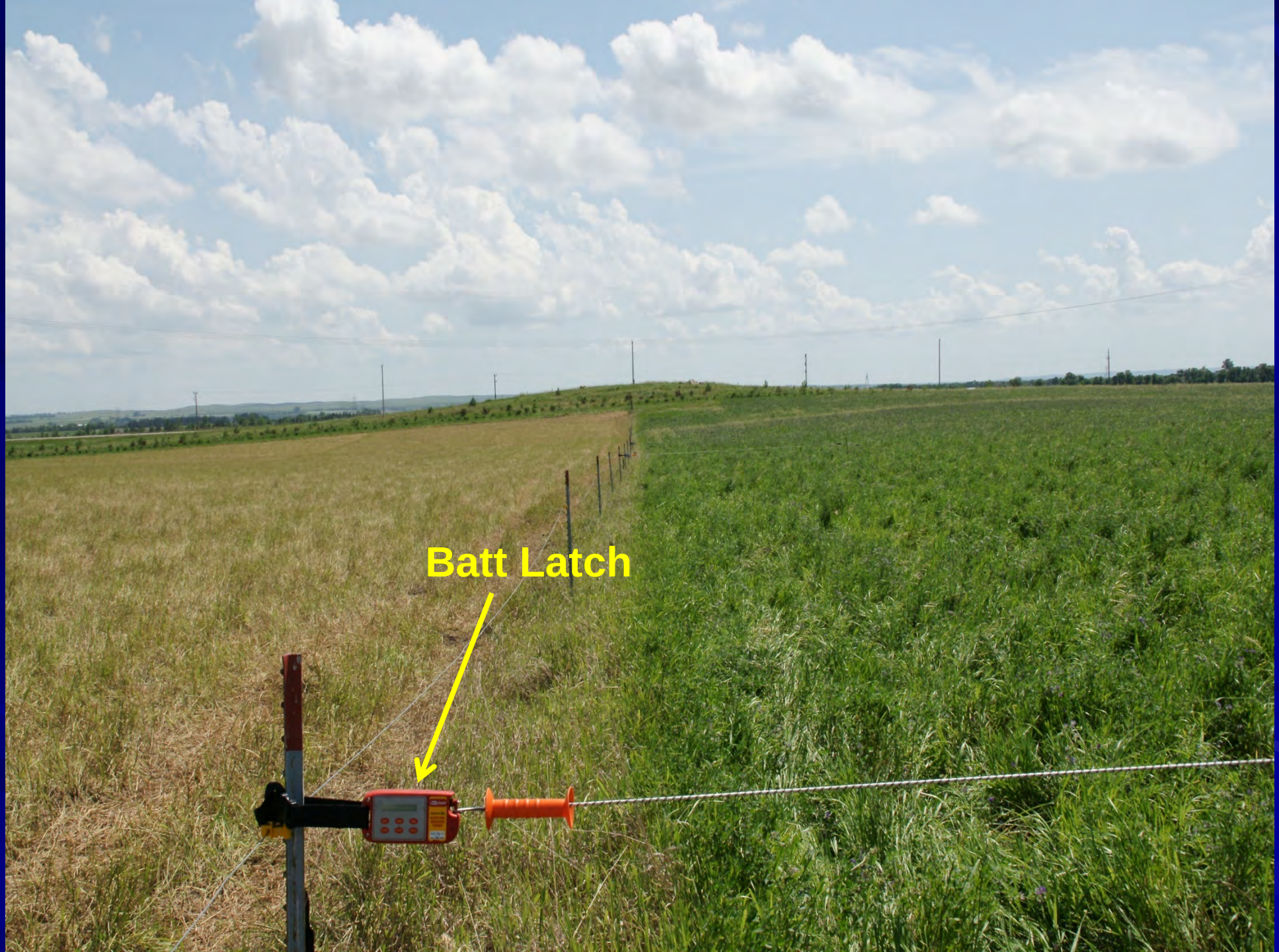
Year 3 Grazing Season



Year 4 Grazing Season

Progress

- Soil OM – 5.2% to 5.6%
- Forage species – 43, including natives.
- Plant Brix – Avg 15 – 22%
- Water infiltration – 10+ in/hr
- Stocking Rate – 1 AU/1.5 acres.
- FREE ACRES!!!
- Significant increase in earthworms, soil level insects, pollinators, and wildlife.


Batt Latch


11:33
AUTO


11:33 AM
SET CLOCK
START TIME
HOW LONG
HOW OFTEN
OFF
AUTO

Multi-Paddock Construction for Multiple Daily Moves

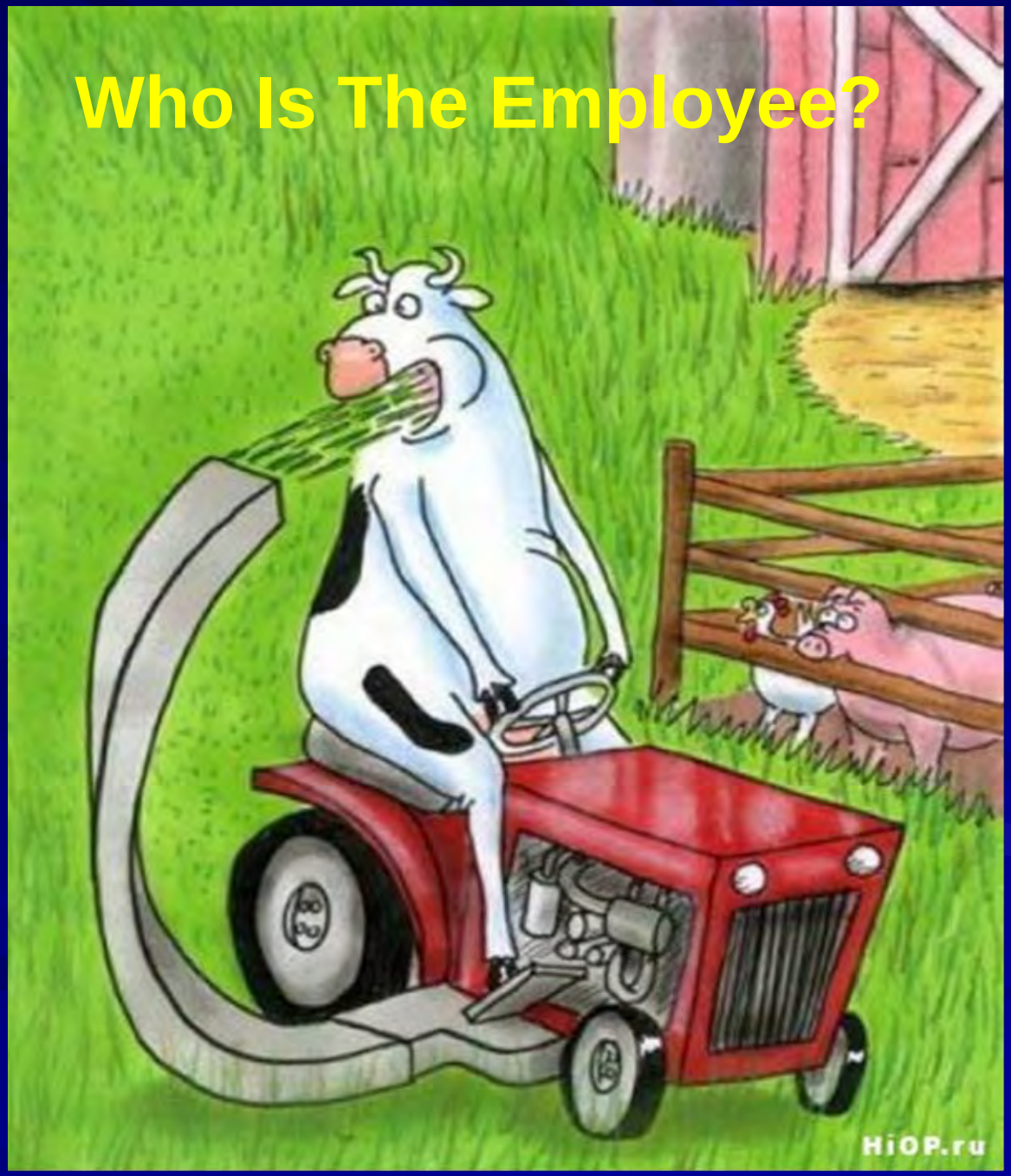
Allen's Fencing Rig

Keeping Cattle Out Of Ponds

Stockpiled Prairie

Moving Cows to Fresh Stockpile

Who Is The Employee?



South Carolina

Pompey's Rest Farm

- ***Soil Destroyer to Soil Builder***
- Dec. 2016 National GLCI Conference
- New Soil Carbon Cowboys film
  - *Givers & Takers*

Initial Pasture Condition

After One Year of Adaptive Grazing

Abundant Grass….

Kansas

- **Neighboring farms comparison**
  - Farm 1: Corn/soybean rotation for 25+ years.
    - No cover crops
    - No-till last 10 years
    - Center pivot irrrigation
    - Grazes cornstalks every other year – set-stock
    - High synthetic use
    - TLMB = 730 ng/g

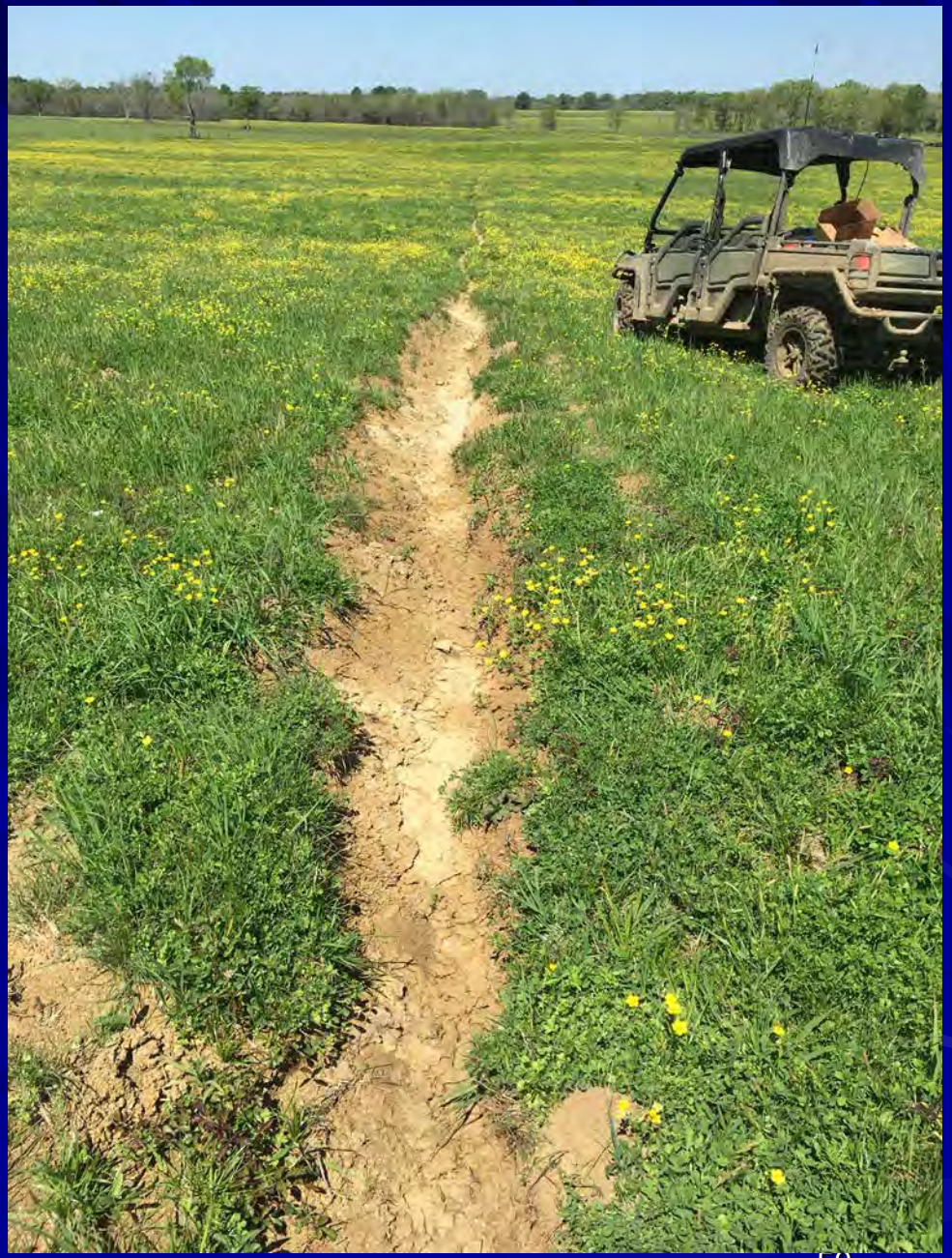
Farm 2

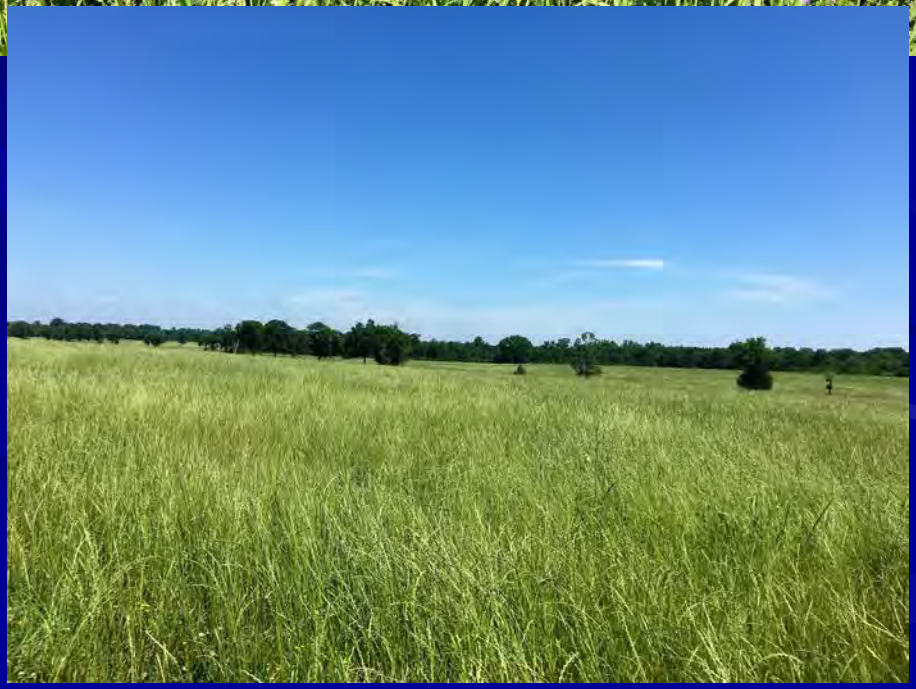
- Corn/soybean rotation until 2004.
- Conventional till & high synthetic use.
- Transitioned into eastern gammagrass, alfalfa, birdsfoot trefoil, chicory, clovers, several other plant species from latent seed bank.
- Started grazing in 2006.
- TLMB in 2014 = 3590 ng/g
- Significant **mycorrhizal fungi** population.
- Soil pits in 2014, 15, 16 – Change in root depth and AMF tremendous. Soil C and OM significantly better at depth.
- Went from 4-6 inches topsoil in 2004 to 42 inches topsoil in 2016. Most significant changes in last three years since ramping up AMP grazing.

Alabama

- South Central par of state
- Black Belt Prairie
- 5300 acres
- Organic Grains and cattle
- Started Adaptive Grazing less than 2 years ago.
- Started cover crops & No-Till 2 years ago.

Starting Point

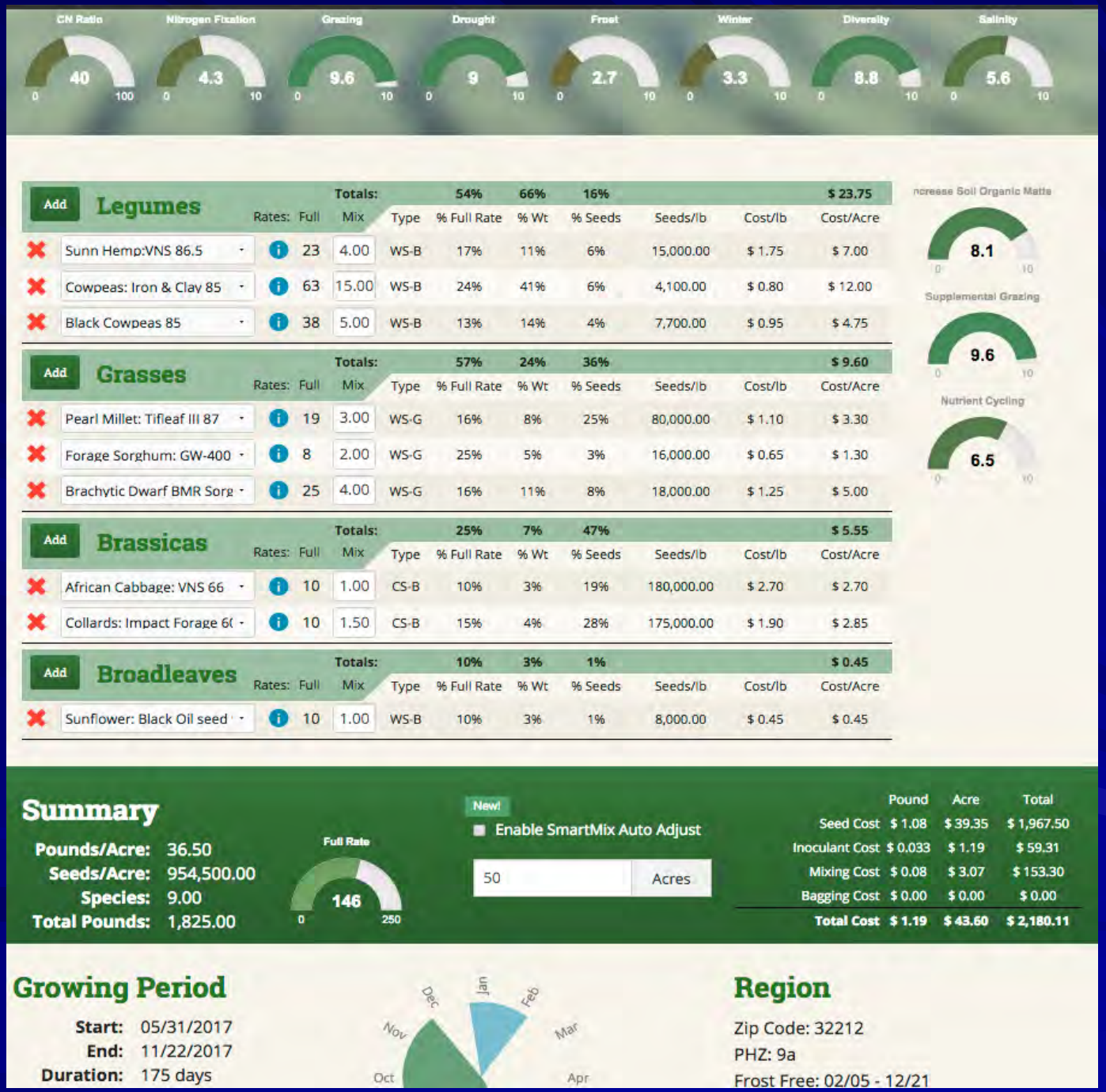




Rolled Cover Crop – 10K+ Biomass

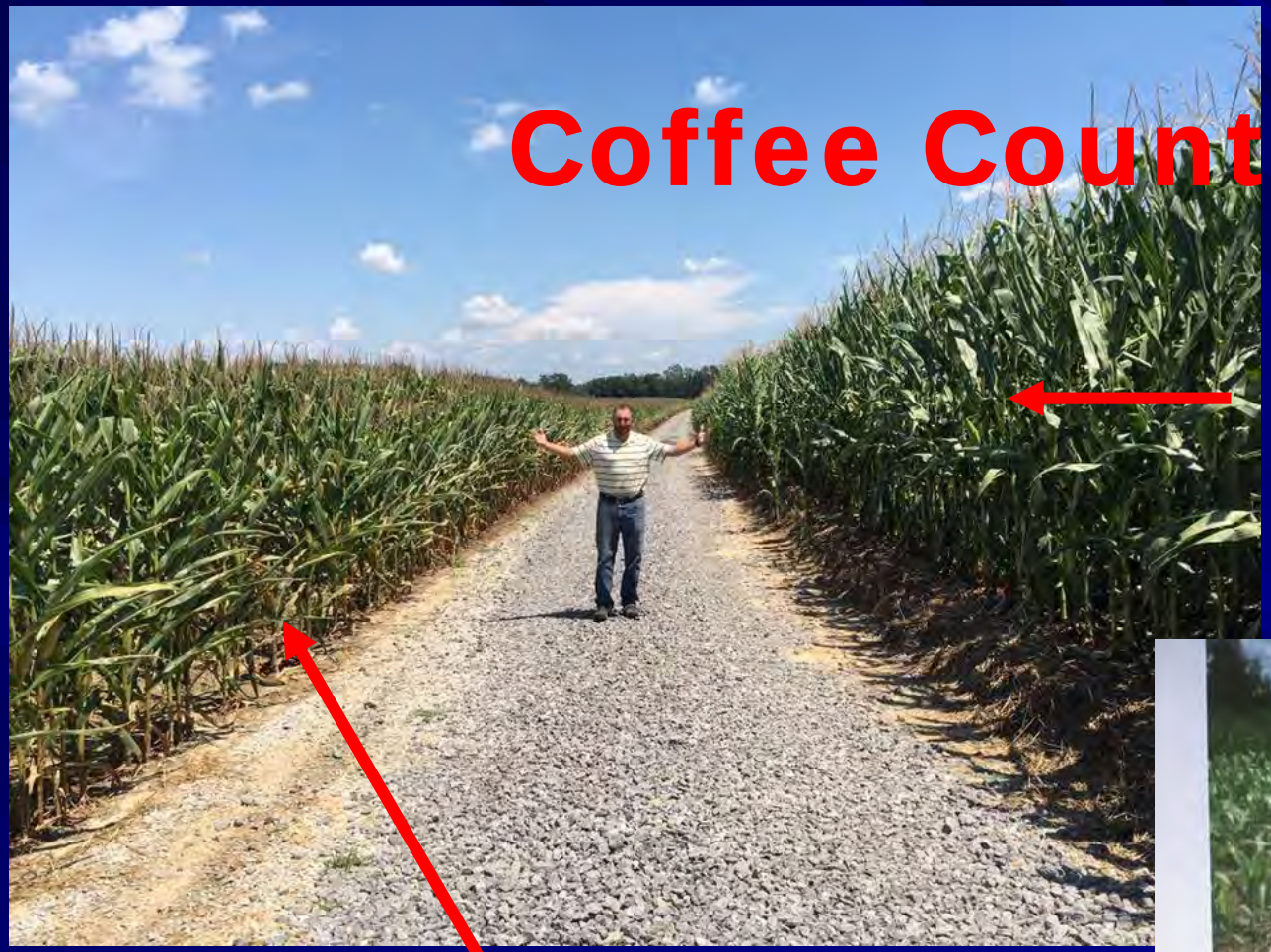
Soybeans drilled into 9 seed CC after roll down. Beans emerging through mat. Rolled 5/1/17. Picture taken 5/21/17

50 Bushel/Ac Organic Wheat


C:N Ratio
40
0
100
Nitrogen Fixation
4.3
0
10
Grazing
9.6
0
10
Drought
9
0
10
Frost
2.7
0
10
Winter
3.3
0
10
Diversity
8.8
0
10
Salinity
5.6
0
10
Add
Legumes
Totals:
54%
66%
16%
$ 23.75
Rates: Full
Mix
Type
% Full Rate
% Wt
% Seeds
Seeds/lb
Cost/lb
Cost/Acre
Sunn Hemp:VNS 86.5
23
4.00
WS-B
17%
11%
6%
15,000.00
$ 1.75
$ 7.00
Cowpeas: Iron & Clay 85
63
15.00
WS-B
24%
41%
6%
4,100.00
$ 0.80
$ 12.00
Black Cowpeas 85
38
5.00
WS-B
13%
14%
4%
7,700.00
$ 0.95
$ 4.75
Add
Grasses
Totals:
57%
24%
36%
$ 9.60
Rates: Full
Mix
Type
% Full Rate
% Wt
% Seeds
Seeds/lb
Cost/lb
Cost/Acre
Pearl Millet: Tifleaf III 87
19
3.00
WS-G
16%
8%
25%
80,000.00
$ 1.10
$ 3.30
Forage Sorghum: GW-400
8
2.00
WS-G
25%
5%
3%
16,000.00
$ 0.65
$ 1.30
Brachytic Dwarf BMR Sorg
25
4.00
WS-G
16%
11%
8%
18,000.00
$ 1.25
$ 5.00
Add
Brassicas
Totals:
25%
7%
47%
$ 5.55
Rates: Full
Mix
Type
% Full Rate
% Wt
% Seeds
Seeds/lb
Cost/lb
Cost/Acre
African Cabbage: VNS 66
10
1.00
CS-B
10%
3%
19%
180,000.00
$ 2.70
$ 2.70
Collards: Impact Forage 6(
10
1.50
CS-B
15%
4%
28%
175,000.00
$ 1.90
$ 2.85
Add
Broadleaves
Totals:
10%
3%
1%
$ 0.45
Rates: Full
Mix
Type
% Full Rate
% Wt
% Seeds
Seeds/lb
Cost/lb
Cost/Acre
Sunflower: Black Oil seed
10
1.00
WS-B
10%
3%
1%
8,000.00
$ 0.45
$ 0.45
ncrease Soil Organic Matte
8.1
Supplemental Grazing
9.6
Nutrient Cycling
6.5
Summary
Pounds/Acre: 36.50
Seeds/Acre: 954,500.00
Species: 9.00
Total Pounds: 1,825.00
Full Rate
146
0
250
New!
Enable SmartMix Auto Adjust
50
Acres
Pound
Acre
Total
Seed Cost $ 1.08 $ 39.35 $ 1,967.50
Inoculant Cost $ 0.033 $ 1.19 $ 59.31
Mixing Cost $ 0.08 $ 3.07 $ 153.30
Bagging Cost $ 0.00 $ 0.00 $ 0.00
Total Cost $ 1.19 $ 43.60 $ 2,180.11
Growing Period
Start: 05/31/2017
End: 11/22/2017
Duration: 175 days
Dec
Jan
Feb
Mar
Apr
Nov
Oct
Region
Zip Code: 32212
PHZ: 9a
Frost Free: 02/05 - 12/21

Tennessee

Coffee County, TN



Planted into rolled down cover crop

Long Term No-Till on Left. Planted 2 weeks earlier. No Cover crop.


GENERAL
75.0

What They Did

- Cover Crop – 8 Seed Mix – Cereal Rye, Winter Oats, Triticale, Winter Pea, Hairy Vetch, Crimson Clover, Daikon Radish, Canola
- Rolled down Early May. Planted into 20K+ standing biomass.
- C:N ratio > 30:1.
- Planted using a Roller and JD Air Seeder.
- Lost all fear of biomass. If we can get it on the ground we can plant.
- Less than 5.5 inches rain from planting until August. 55+ days with 90-98 temp.
- **Cover Crop** Field yield **215 bu/ac**. **No-Till** yield **160 bu/ac**.

OHIO

Green Acres Research Farm: Cincinnati, Ohio

Chad Bitler, M.S.
Agriculture Resource Coordinator (ARC)
Email – cbitler@green-acres.org
Direct – (513) 898-3159

Green Acres Research Farm: Cincinnati, Ohio

55 Days after planting – 8500 lbs/ac DM

- No fertilizer
- Steers gained >3.0 lbs/day.
- 4500 lbs/ac DM 2nd Grazing.

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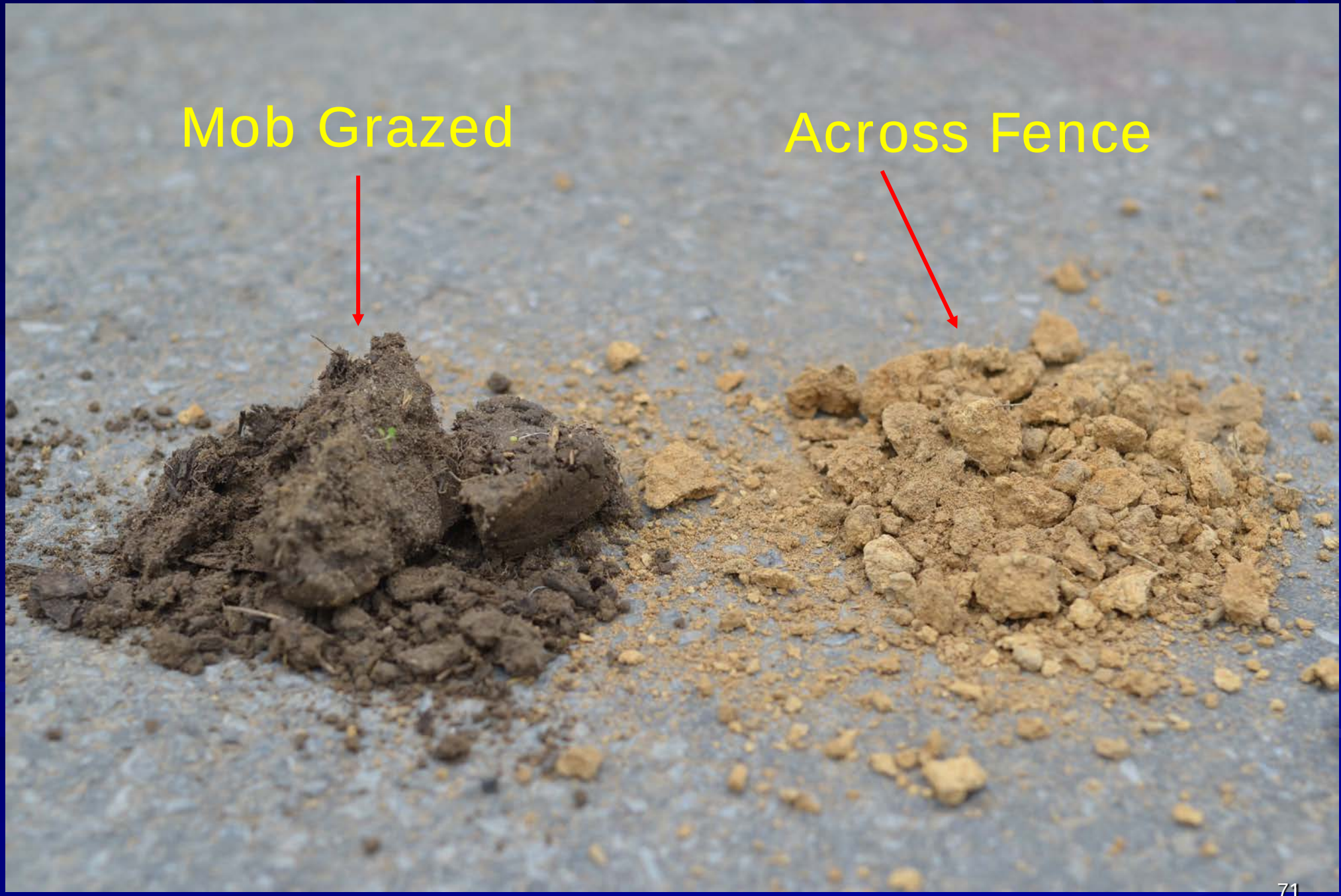
Green Acres - Results

- 18 species warm season cocktail mix.
- SOM increased 3.6% to 4.4% in the 120 day grazing period – A gain of 0.8%
- Added 20,000 gallons/ac water holding capacity.
- Over 100 acres that is 2 million gallons.
- Soil N increased 58 lbs/ac.
- Soil mineral value increased $105/ac.
- Soil microbial activity increased 44%.
- Earthworms increased to >130,000/ac.

George Lake - Pennsylvania

- 2016 Forage and Grassland Council Presentation.
- Turned ground adjacent to an abandoned sand quarry into productive soil with cattle.
- 20+ years ago ground averaged 37 bushels of corn/acre, with side dressing.
- Corn Yields now in the **170's** with no fertilization. Non-GMO Corn.
- Picture shows soil taken about 10 yards apart. The one sample has been mob grazed for about 20 years. The other sample is from the other side of the fence.
- Runs 600 head of grass fed beef and about 100 sheep.
- Host about 15 tours a year. Just hosted a delegation from the Ukraine.


Mob Grazed
Across Fence

North Dakota

Farm Comparisons

- **Farm 1:**
  - Organic operation that is very diverse in its cropping system.
  - The operator grows spring wheat, barley, oats, corn, sunflowers, peas, soybeans, dry edible beans and alfalfa.
  - Natural, organic fertilizers are used.
  - **No livestock or covers** integrated.

- **Farm 2:**
  - No-till, low diversity. Operator plants only flax and spring wheat in rotation
  - Anhydrous ammonia is used.
  - Crop yields are average for the area.
  - **No livestock or covers.**

- **Farm 3:**
  - No-till, medium diversity, high synthetic use.
  - Grows corn, barley, sunflowers, spring wheat and soybeans.
  - It has not been tilled for nearly twenty years.
  - Yields are high but to get those yields high rates of synthetics are used.
  - Fertilizers, fungicides, pesticides and amendments are all used.
  - **No livestock or covers.**

Farm 4:

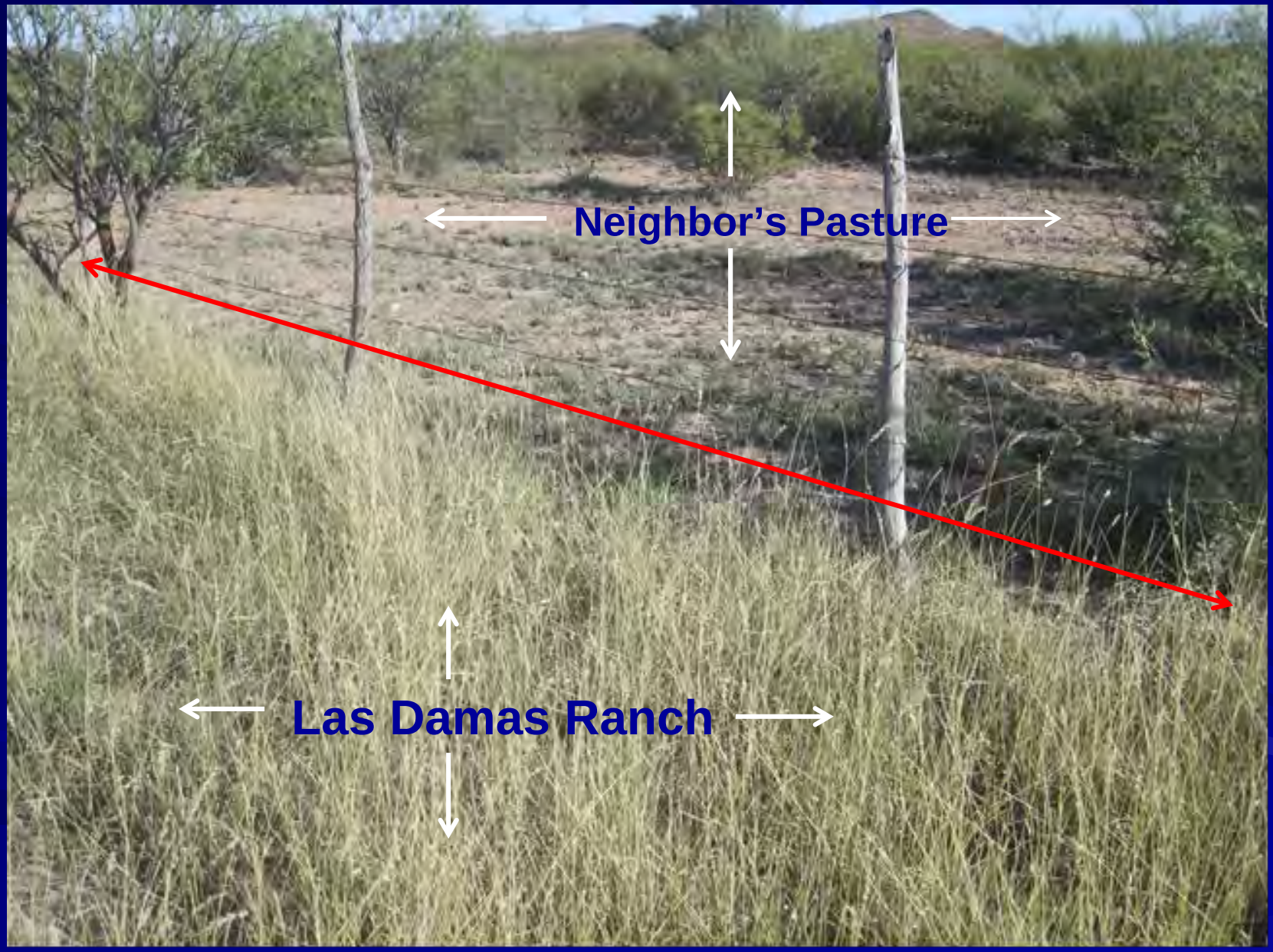
- No-Till since 1993.
- Grow corn, spring wheat, barley, oats, peas, cereal rye, winter triticale, and hairy vetch as our cash crops.
- All fields have a **complex cover crop** each year. Either before the cash crop, along with the cash crop or after the cash crop.
- No synthetic fertilizer since 2007. Do not use any purchased fertilizers, compost tea, or other soil amendments.
- Small amount of compost which is used on gardens.
- **Livestock fully integrated** onto cropland. Beef cow/calf pairs, stockers, grass finishers, sheep, pork, laying hens and bees, all are integrated throughout the ranch.

Haney Test Results - 2016

Management	N (lbs/ac)	P (lbs/ac)	K (lbs/ac)	WEOC (PPM)
Organic, CT Farm 1	7	156	95	233
NT, LD Farm 2	27	244	136	239
NT, MD, HS Farm 3	37	217	199	262
NT, HD, NS, Lvst Farm 4	281	1006	1749	1095

CT = Conventional Tillage, NT – No-Till, LD = Low Diversity, MD = Moderate Diversity, HS = High Synthetics, NS = No Synthetics, Lvst = Livestock.

Las Damas Ranch
Mexico


Neighbor's Pasture
Las Damas Ranch

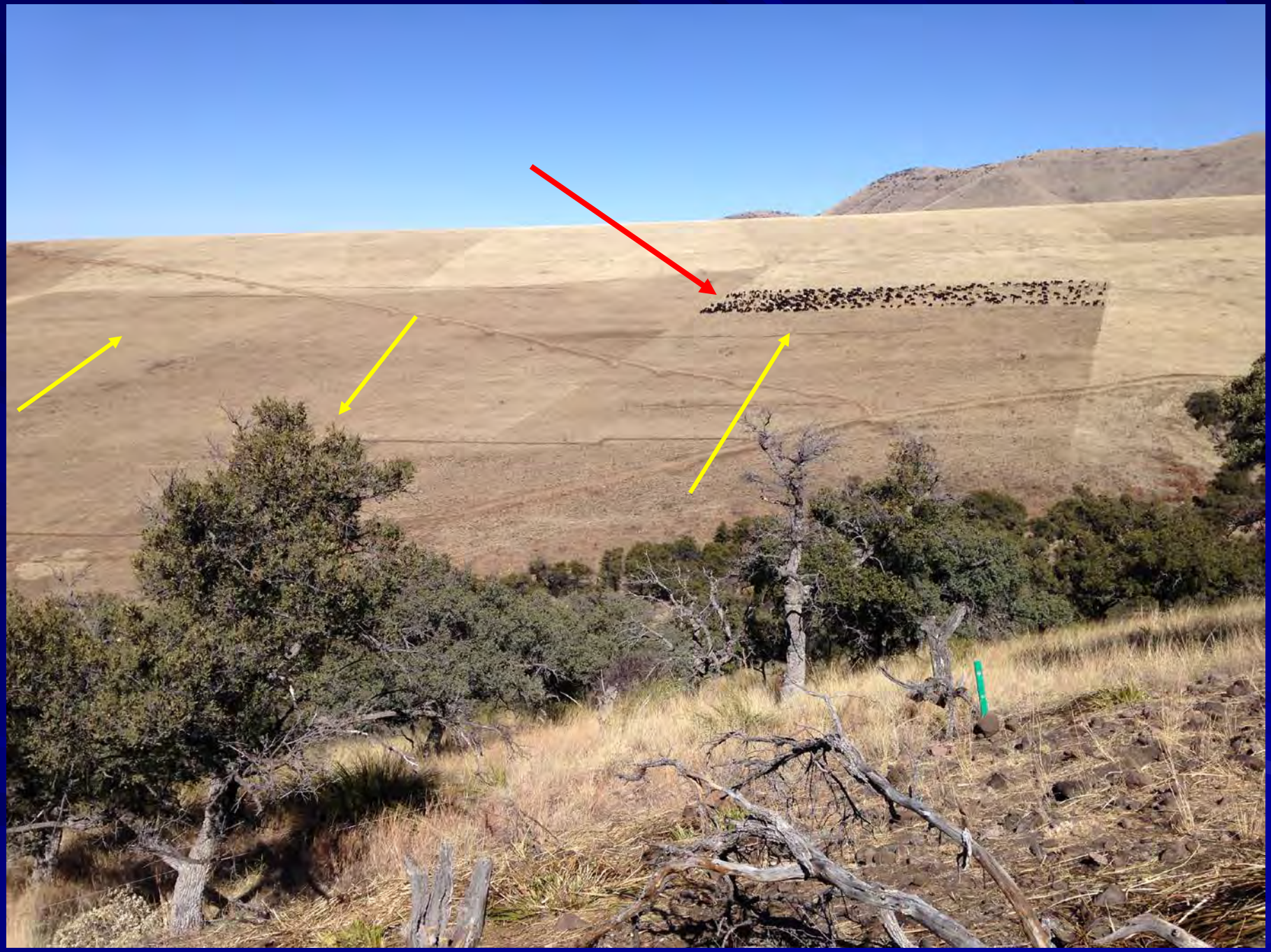

Las Damas Ranch

Background

- Typical 11 inch rainfall region.
  - Last 4 years – **10”, 9”, 8”, 5” inches**.
- 5 years ago – monoculture of tobosagrass
  - Now = More than **4 dozen** species…..
- Run 1 cow/calf per **40 acres**.
- FREE ACRES!!!
- Neighbor ranch runs 1 cow/calf per **200 acres**.

Luis Robles Ranch – Chihuahua, Mexico

Caterras Cattle Co. – Chihuahua, Mexico



Australia

Adaptive Grazing

Set Stock Grazing

Long-chain, non-labile, stable carbon

Short-Chain, unstable, Labile carbon

Comparisons

Set-Stock:

- Decades of combining conventional cropping with set-stock grazing.
- Used a range of chemical fertilizers and herbicides.
- Accelerated soil C loss at depth.
- Biodiversity loss.
- Significant mineral loss.
- Increase in metabolic diseases.

Comparisons

- Adaptive Grazing:
  - No fertilizer in last 30 years.
  - Levels of total and available plant minerals have improved significantly.
  - Solubilization of mineral fraction by microbes.
    - Energized by increase in liquid carbon.
  - Stable, long-chain, humic substances formed via plant-microbe sequestration pathway.
    - Cannot disappear in a drought.

Data

- **68.2 tons more C** sequestered per acre from 1990 – 2010 vs. Set-stock.
- **78%** of new carbon was Stable, Non-labile.
- Mineral increases:
  - Ca – 277%, Mg – 138%, K – 146%, Su -157%, P – 151%, Zn – 186%, Fe – 122%, Cu – 202%, B – 156%, Se – 117%.
  - Mineral value increase: **$208/ac/yr**
- Carrying capacity **doubled.**
- **High N & P applications inhibit formation of plant-microbe bridge.**

BENEFITS

Does Grazing Strategy & Methodology Matter?

Soil Carbon Data

- Three types of farms/ranches sampled:
  - 2014 – 2015
  - Farm/ranch Type Descriptions:
    - AHSD/AMP Grazing for minimum of 5 years
    - High Level Conventional Grazing Management
      - CG – Slow Rotation - 10+ years minimum
    - Low Level Conventional grazing management
      - CG – Continuous - 10+ years
    - All same soil types

Soil Carbon Data

- Soil pits dug in random locations at each farm. Same topography.
- Each pit 3 feet deep and 3 feet square.
- Collected soil samples within every 6 inch section.
- Noted root growth and structure.
- Noted soil life, texture, aggregation.

Soil Carbon Data – Total Soil Carbon

Horizon	AHSD	CG - Rotation	CG – Cont.
1	4.67	1.64	1.36
2	4.00	1.88	1.37
3	2.95	1.03	0.40
4	2.04	1.02	0.54
5	1.71	0.38	0.40
6	1.42	0.41	0.34

Soil Carbon Data – Soil Organic Matter

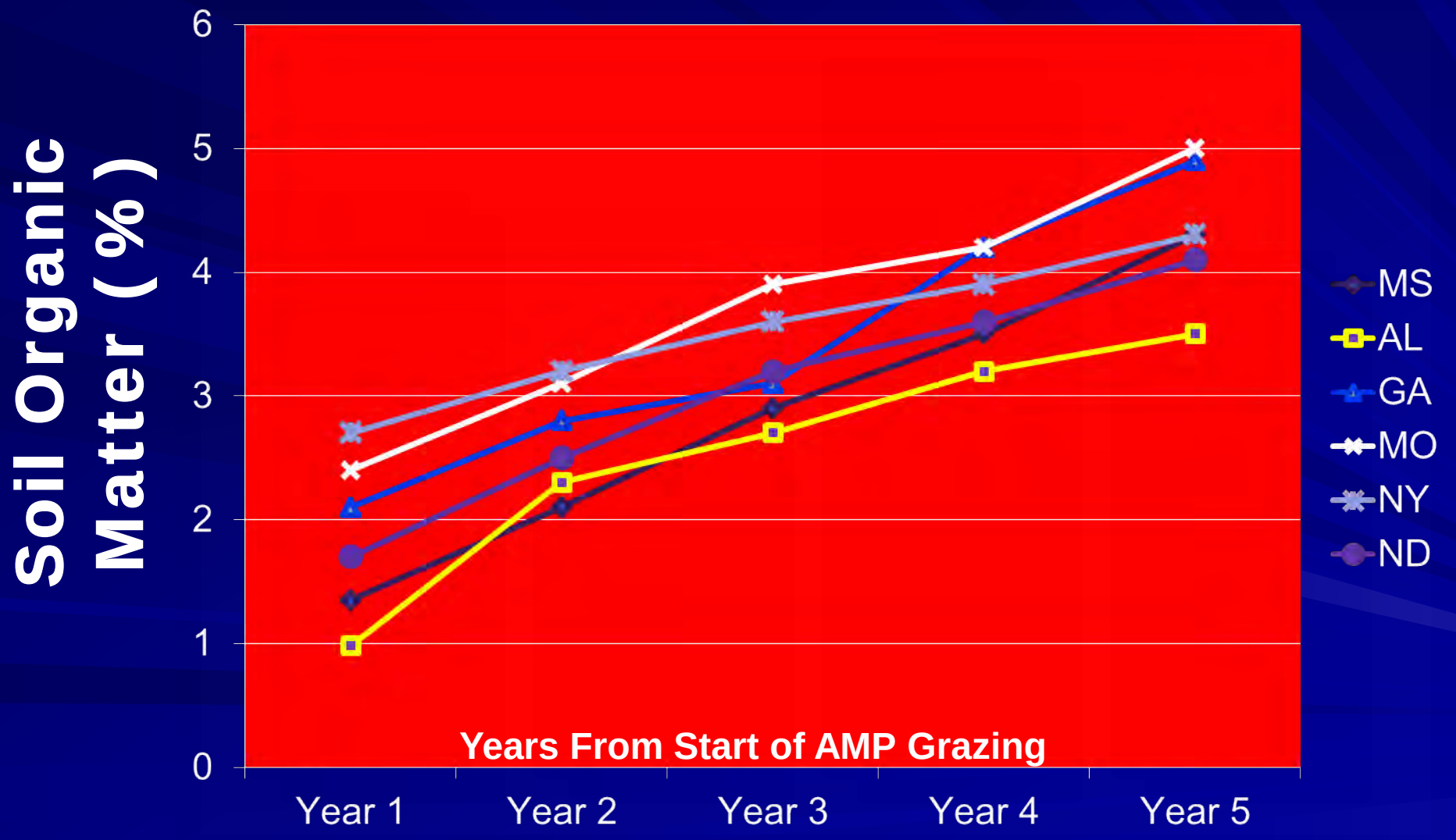
Horizon	AHSD	CG - Rotation	CG – Cont.
1	4.26	3.28	2.72
2	3.22	3.76	2.74
3	3.10	2.06	0.80
4	2.98	2.04	1.08
5	2.80	0.76	0.80
6	1.98	0.82	0.68

Soil Carbon Data – Carbon Assessment Per Acre

Farm Descrip	Carbon (kg/sq meter	Carbon (Ton/ac)	Carbon (Ton CO2 Equiv)
AHSD	12.69	51.41	188.13
CG – Rotation	7.09	28.71	105.07
CG – Cont.	5.47	22.16	81.09

Can Make Rapid Improvements in Soil Organic Matter and Total Soil Carbon

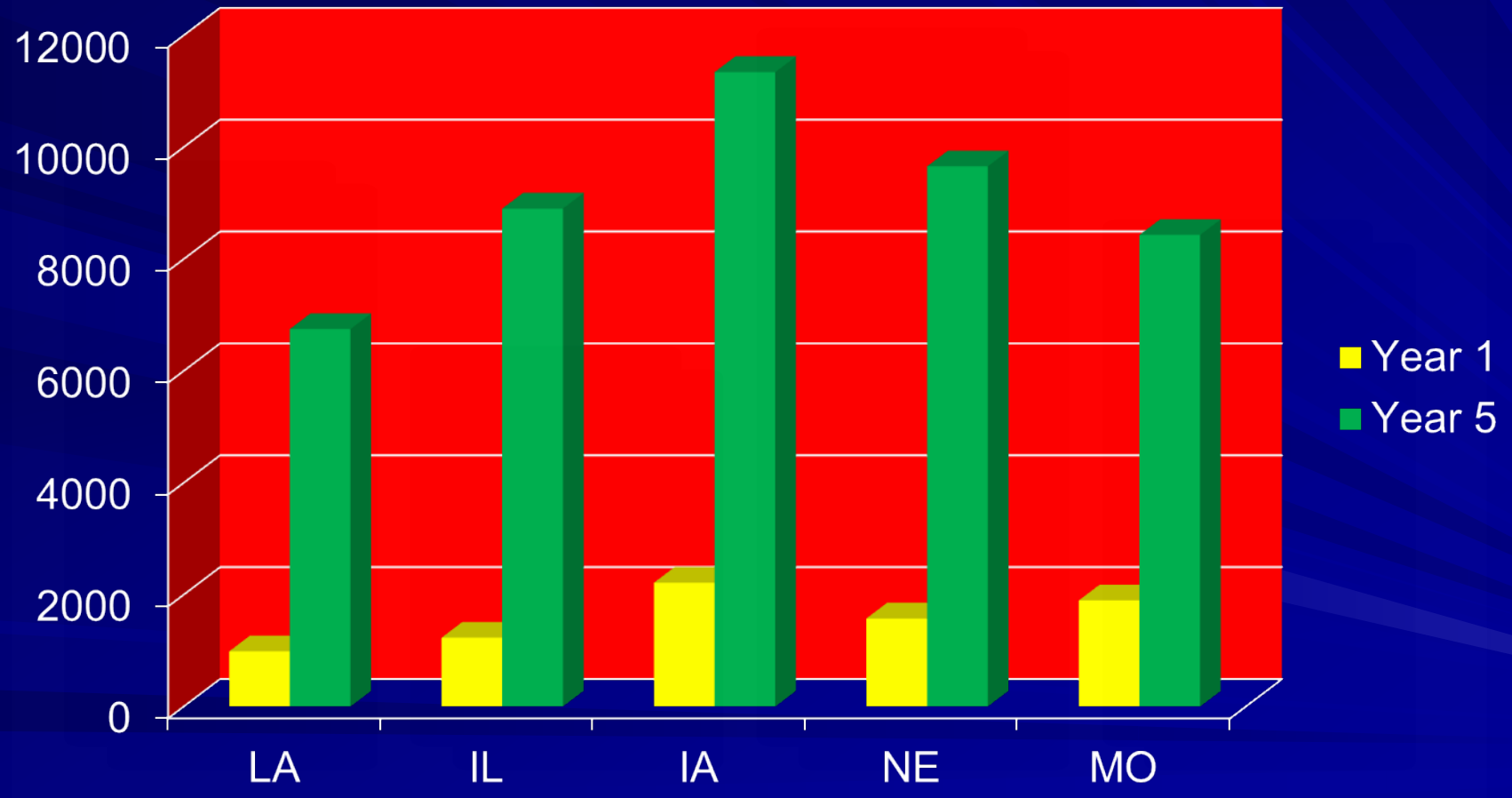
Improvement in Soil Organic Matter Using AMP Grazing



Source: Grass Fed Insights, LLC

Rebuilds Soil Microbial Biomass and Restores Microbial Balance

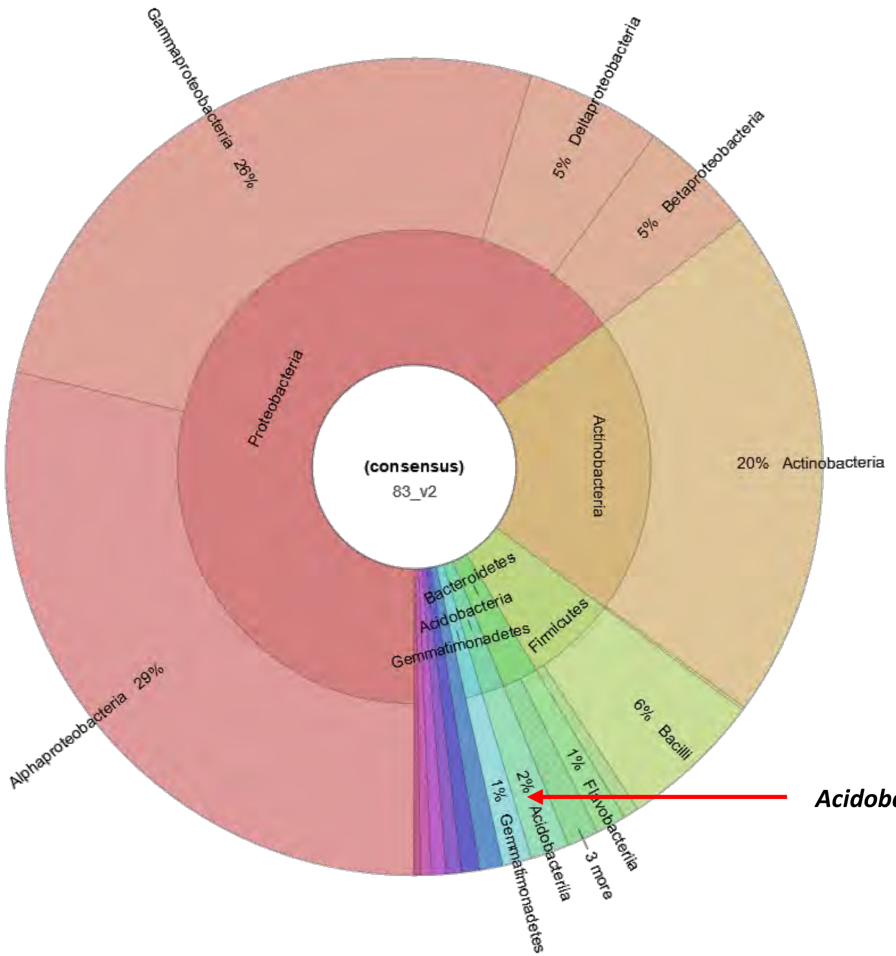
Building Microbial Biomass
(ng/g of Soil)



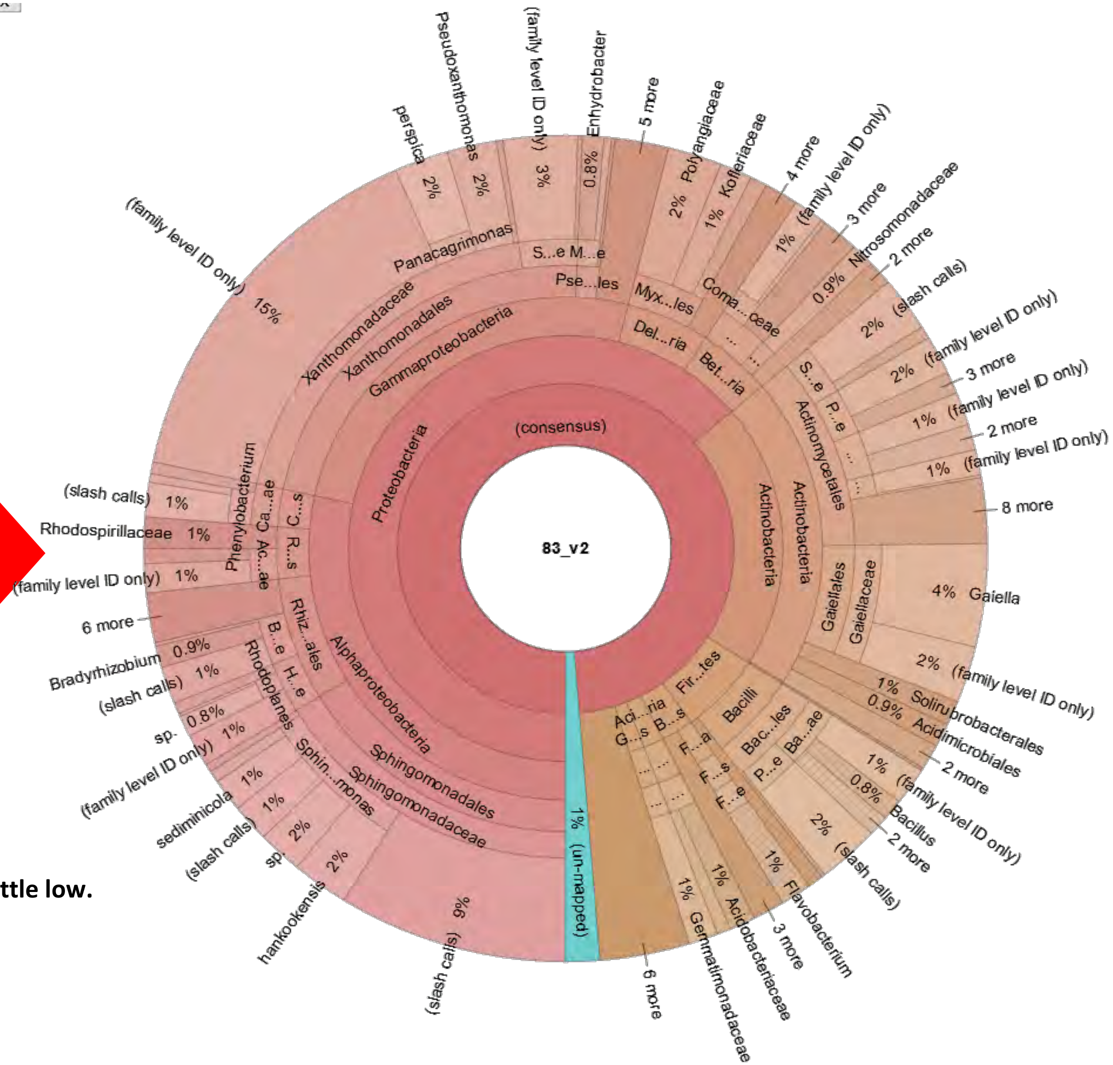
New Soil Health Analytics

- **Quorum Labs, Eldorado, IL**
  - Complete Soil Bio-Profile
    - Active & Inactive fractions of soil microbes
    - Non-Sporulated & Sporulated
    - Individual microbial species specification & identification
    - Metagenomics, Proteogenomics, PCR, GC capabilities
  - Haney Test
  - Plant Tissue analysis
  - Pathology
  - Water Quality
  - Affluent Testing

Scenario One – Reasonably Healthy Soil



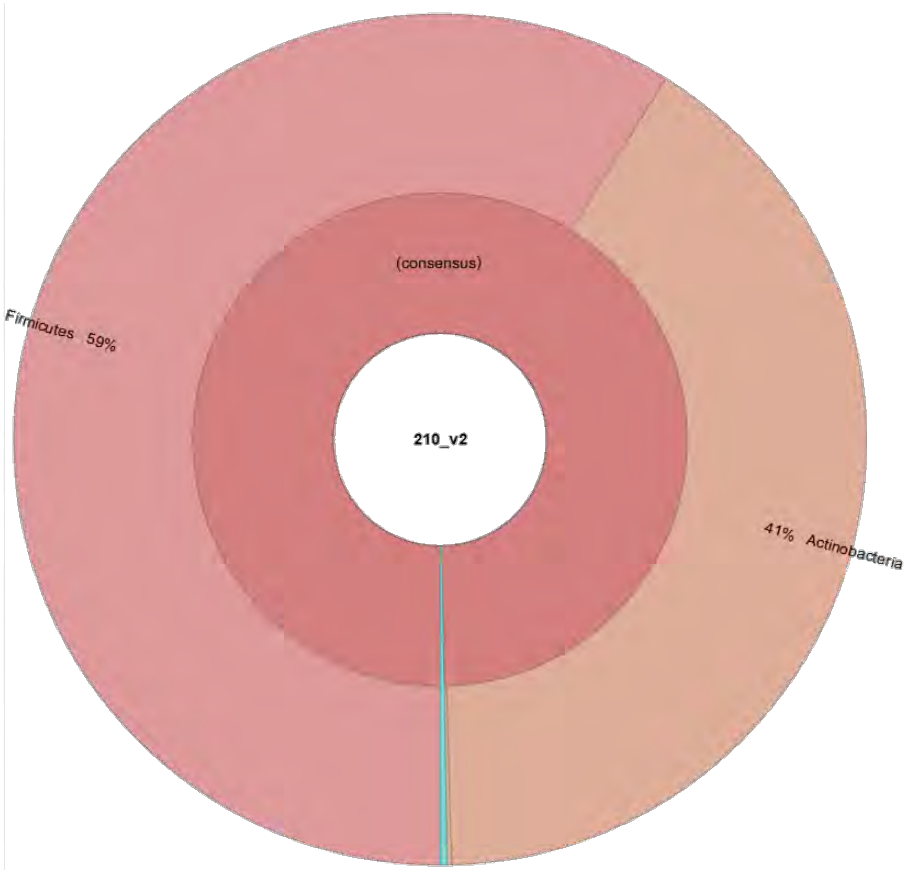
Acidobacteria **a little low.**



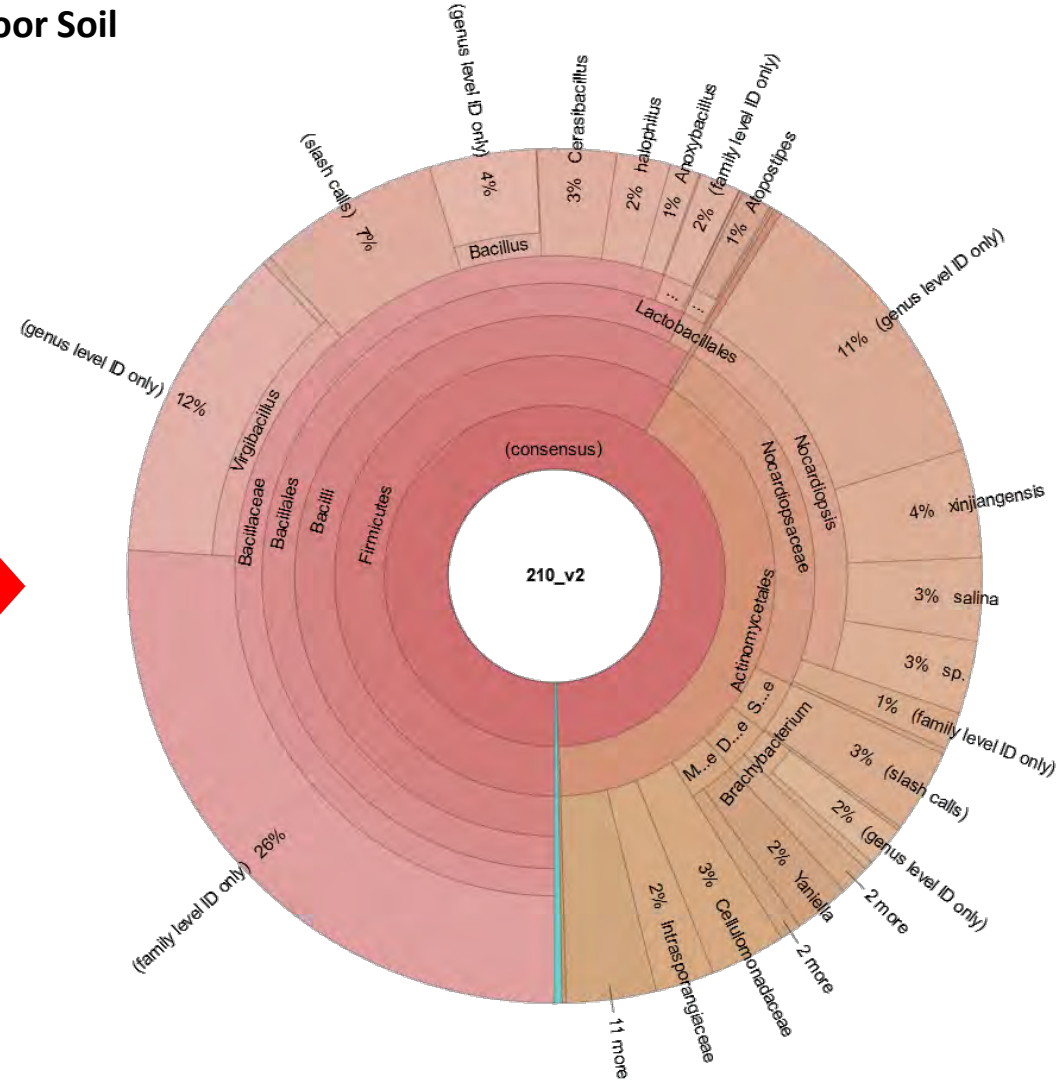
Genus (16 Groups Present)

Species – 16000 Species Present

Scenario Two – Poor Soil

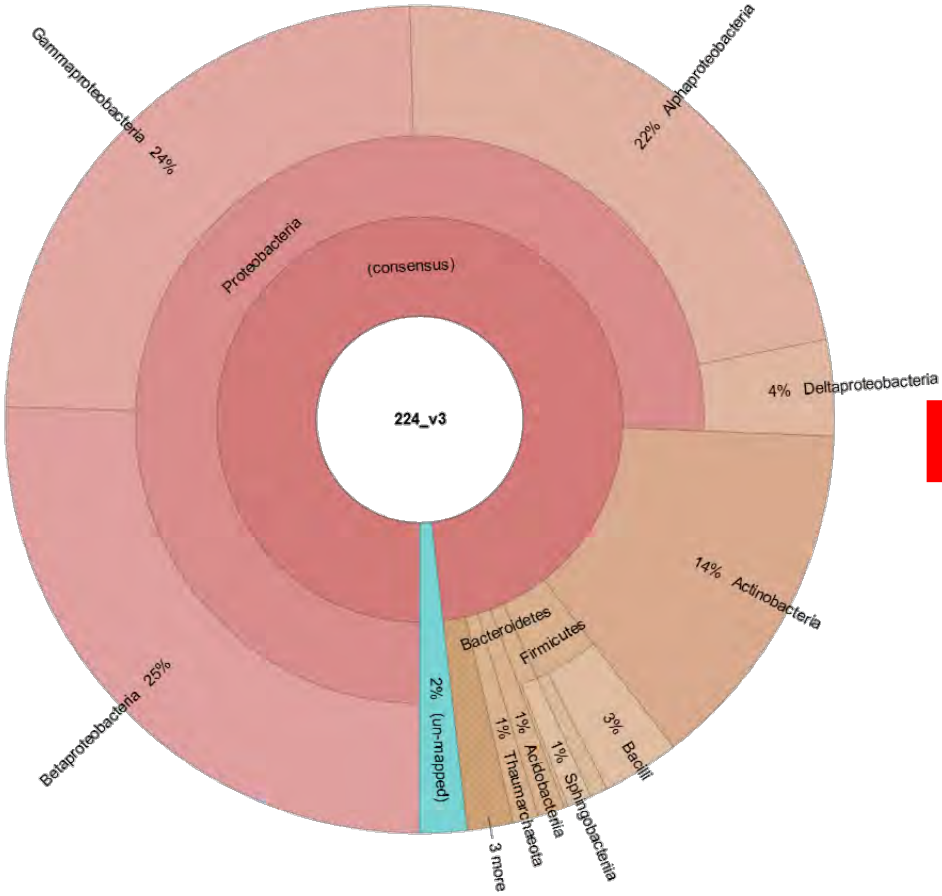


Genus (2 Groups Only)

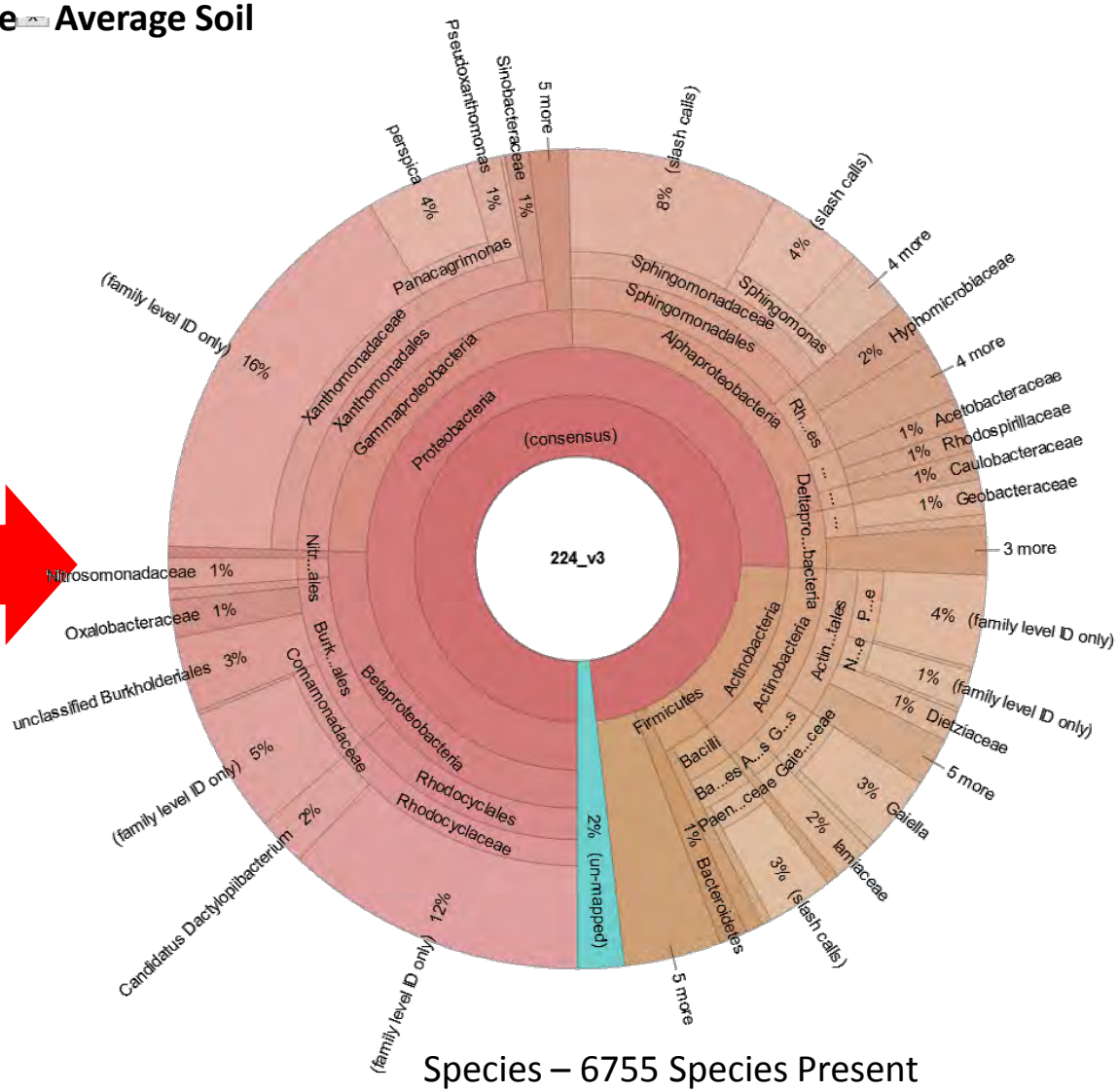


Species – 1480 Species Present

Scenario Three – Average Soil

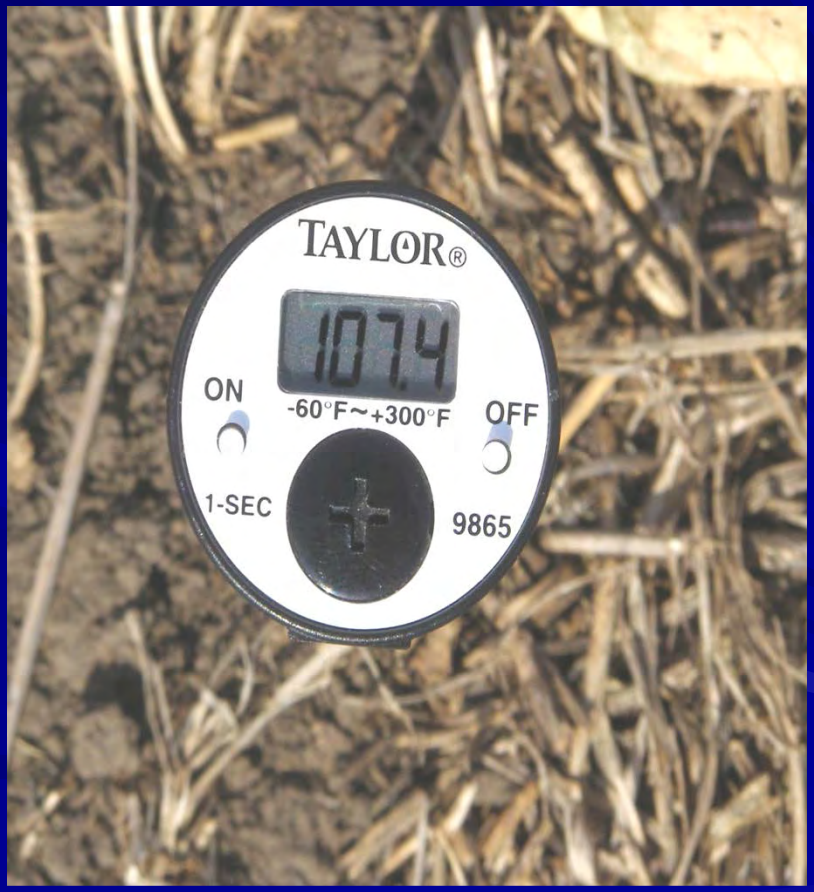


Genus (12 Groups Only)

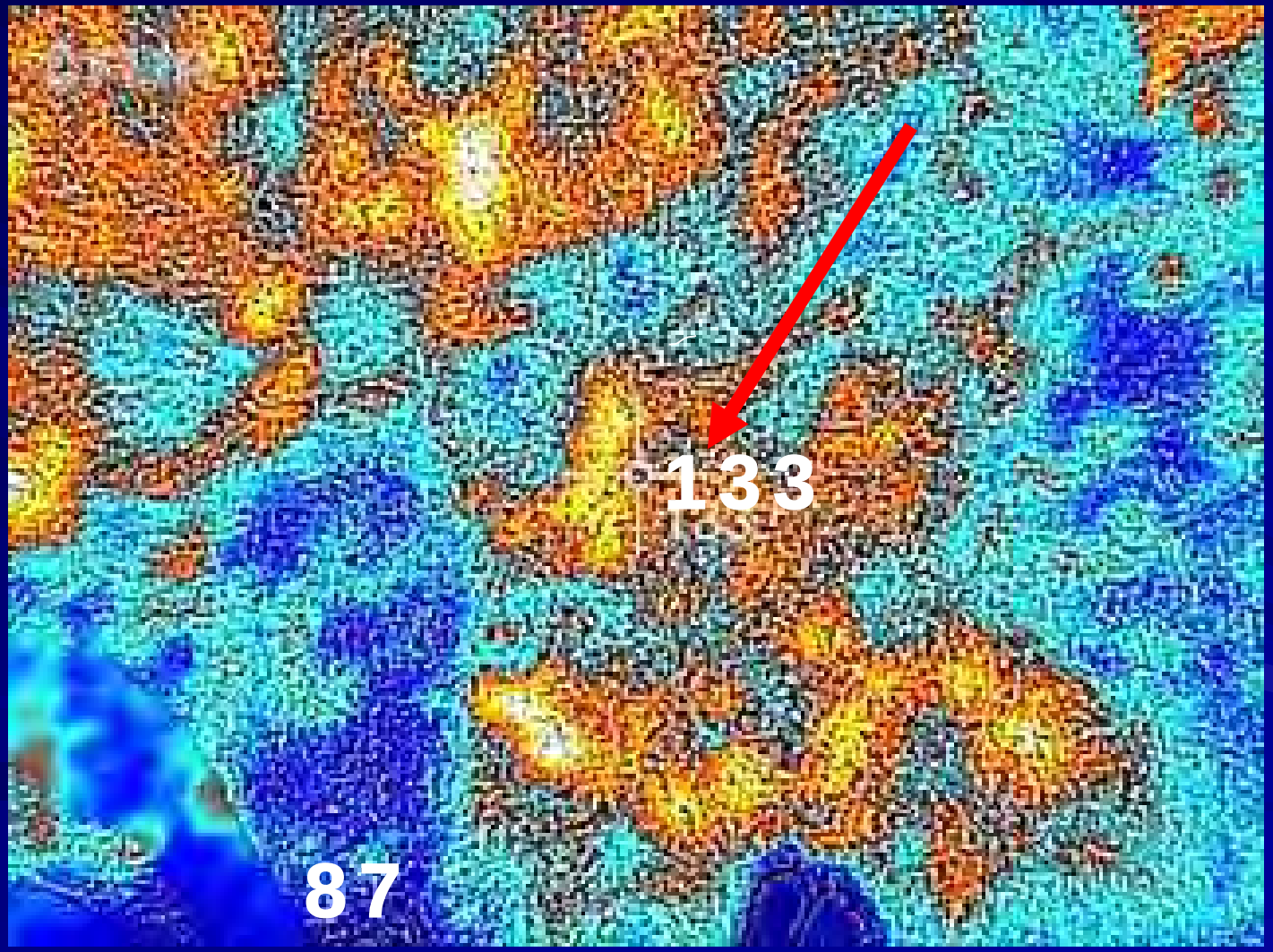


Species – 6755 Species Present

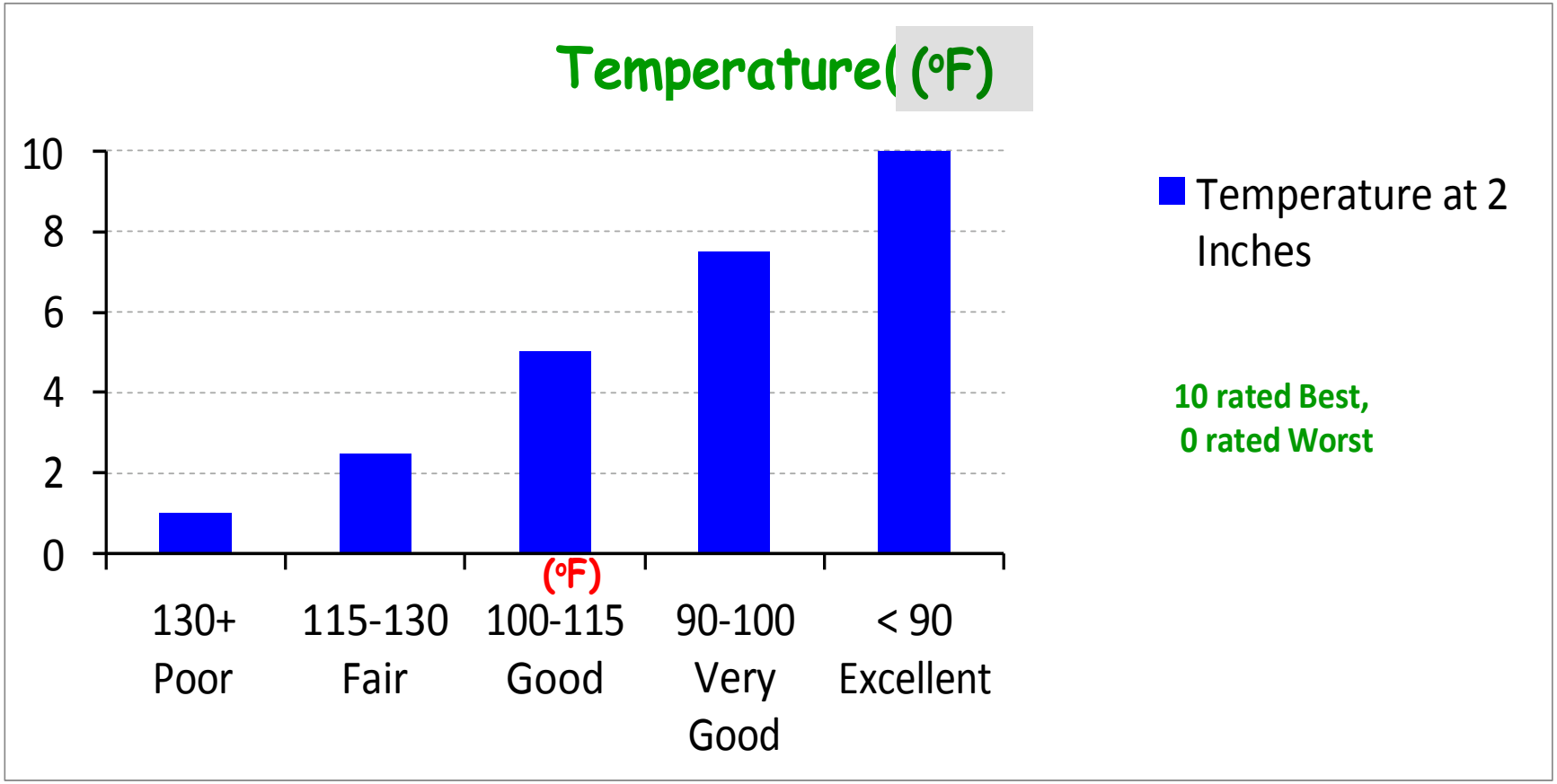
Protect Soil Temperatures



FLIR – Air Temp 96º

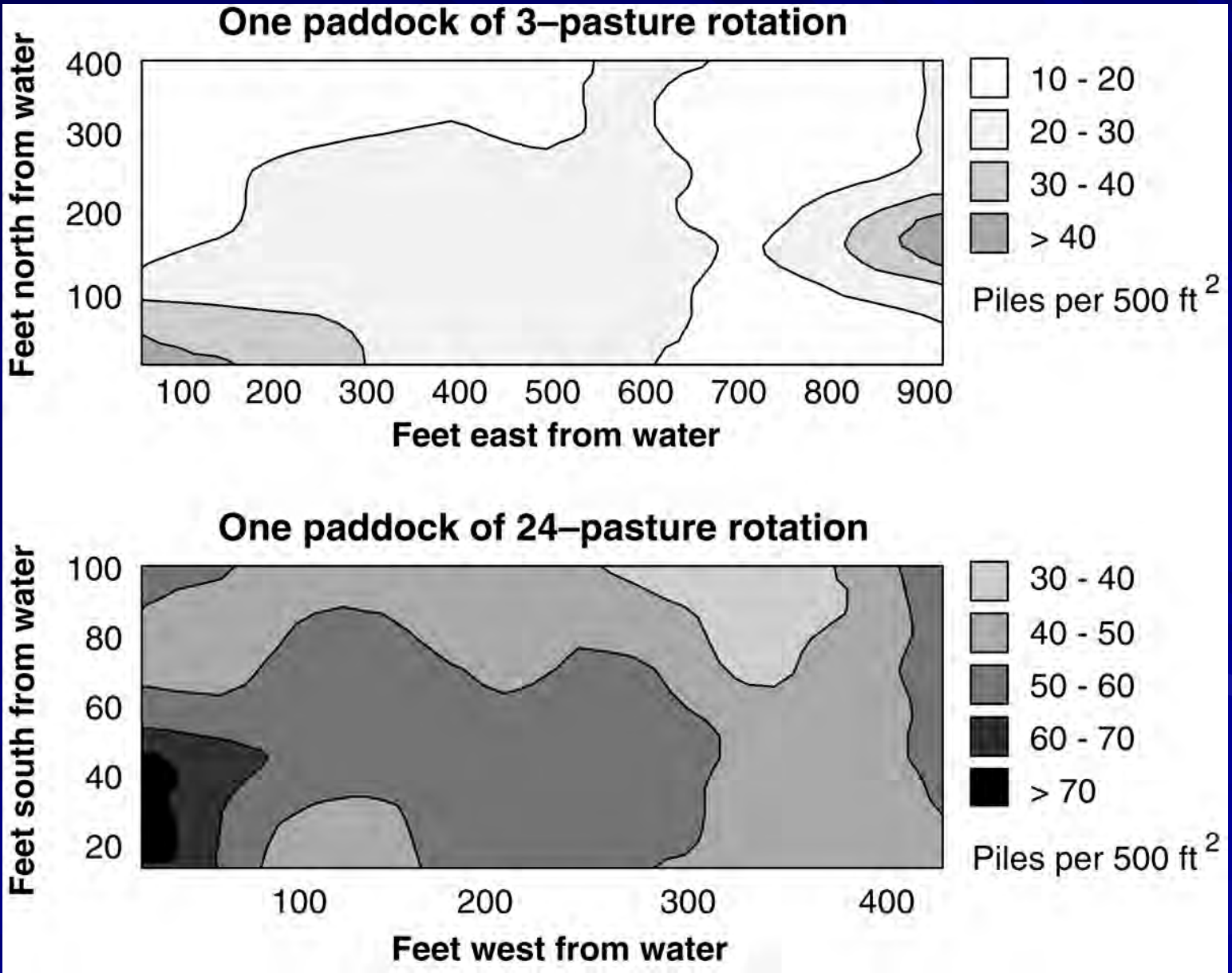


Indicator: Soil Temperature



1. At 70 °F, 100% of Soil moisture is used for growth.
2. At 100 °F, 85% of Soil moisture is lost and 15% is used for growth.
3. At 115 °F, microbes begin to breakdown, and
4. At 140 °F they die.

Even Manure Distribution

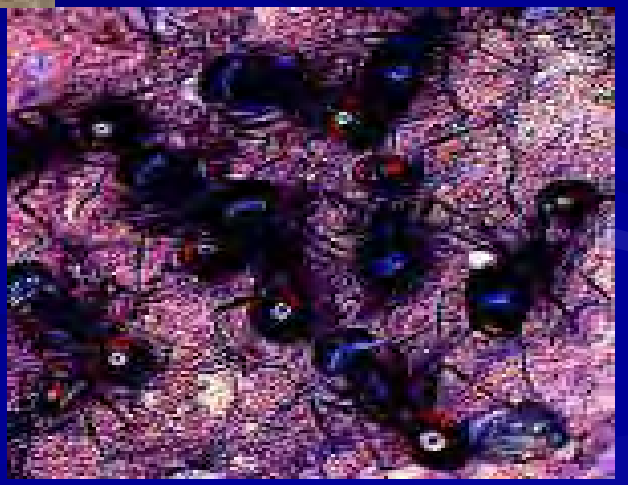


Manure Distribution

Rotation Frequency	Years to Get 1 Pile/sq. yard
Continuous	27
14 day	8
4 day	4 – 5
2 day	2
1 time a day	**1**

Indicators of Improved Soil Health

Insects/Arthropods




Pollinator
Insects

Earthworms

Dung Beetles

Dung Beetles

I Tunnelers

II Dwellers

III Rollers or Tumblers

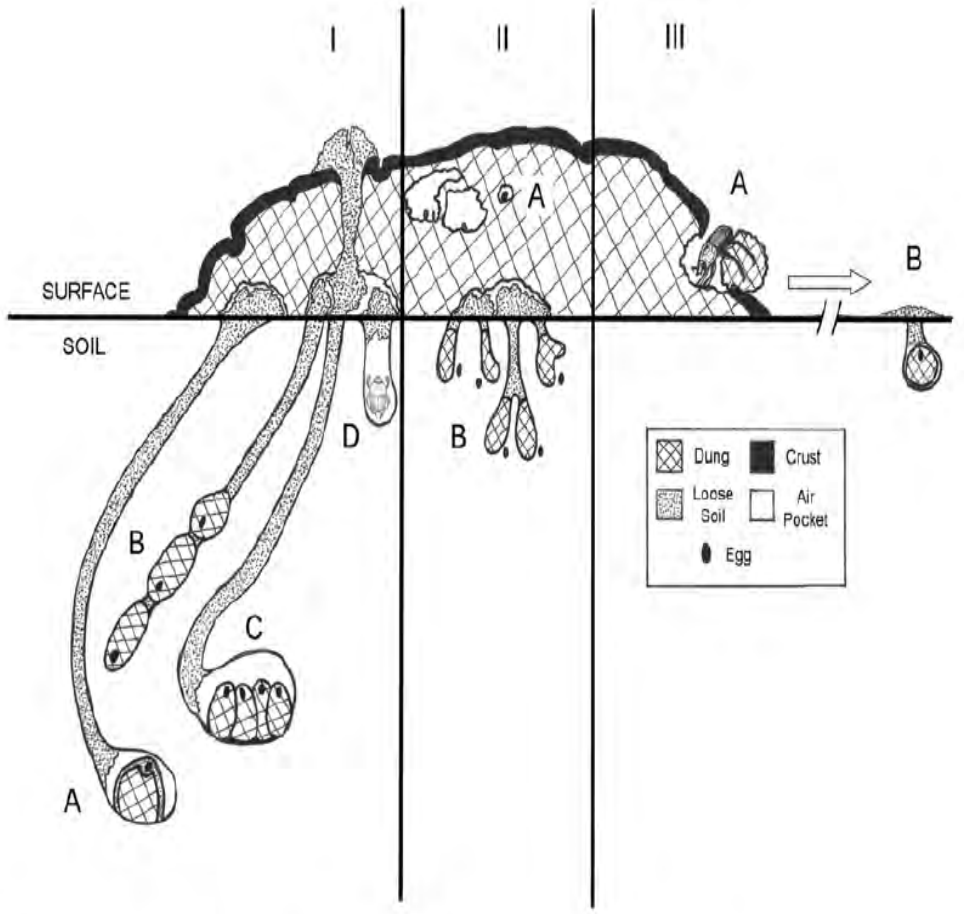


Figure 1. Cross section through dung pat depicting three nesting types:

Tunnelers I-A. *Phanaeus vindex* tunnel with single, soil-coated brood ball in single chamber; B. *Onthophagus* species tunnel with multiple brood masses; C. *Copris minutus* multiple brood balls; D. beetle excavating new tunnel (note subsurface soil is pushed through the dung pat crust)

Dwellers II-A. *Aphodius pseudolividus* eggs are laid singly or in groups inside dung pat; B. *Aphodius erraticus* bury dung under pat with eggs laid beside brood masses.

Rollers III-A. *Canthon pilularius* adult carving out dung into a ball; B. ball rolled a distance away from pat and buried shallowly.

Figure 3. Picture Guide to Dung Beetles Associated with NC Pastures
Males are indicated by the symbol ♂ and females ♀
Photographs by Matt Bertone

Aphodius distinctus
Size: 1/8-3/16"

Aphodius erraticus
Size: 1/4-3/8"

Aphodius fimetarius
Size: 1/4-3/8"

Aphodius pseudolividus
Size: 1/8-3/16"

Geotrupes blackburnii
Size: 3/8-3/4"

Onthophagus gazella (♀)
Size: 3/8-1/2"

Onthophagus gazella (♀)
Size: 3/8-1/2"

Onthophagus gazella (♂)
Size: 3/8-1/2"

Onthophagus gazella (♂)
Size: 3/8-1/2"

Onthophagus hecate (♀)
Size: 1/4-3/8"

Onthophagus hecate (♂)
Size: 1/4-3/8"

Onthophagus hecate (♂)
Size: 1/4-3/8"

Onthopagus pennsylvanicus
Size: 1/8-1/4"

Onthophagus taurus (♀)
Size: 1/4-3/8"

Onthophagus taurus (♂)
Size: 1/4-3/8"

Onthophagus taurus (♂)
Size: 1/4-3/8"

Phanaeus vindex (♀)
Size: 3/8-7/8"

Phanaeus vindex (♂)
Size: 3/8-7/8"

Phanaeus vindex (♂)
Size: 3/8-7/8"

Canthon pilularius
Size: 1/2-5/8"

Dichotomius carolinus
Size: 3/4 – 1¼"

Pronunciation guide: There are no common names of these beetles. To make their names easier to understand, a pronunciation guide is provided.

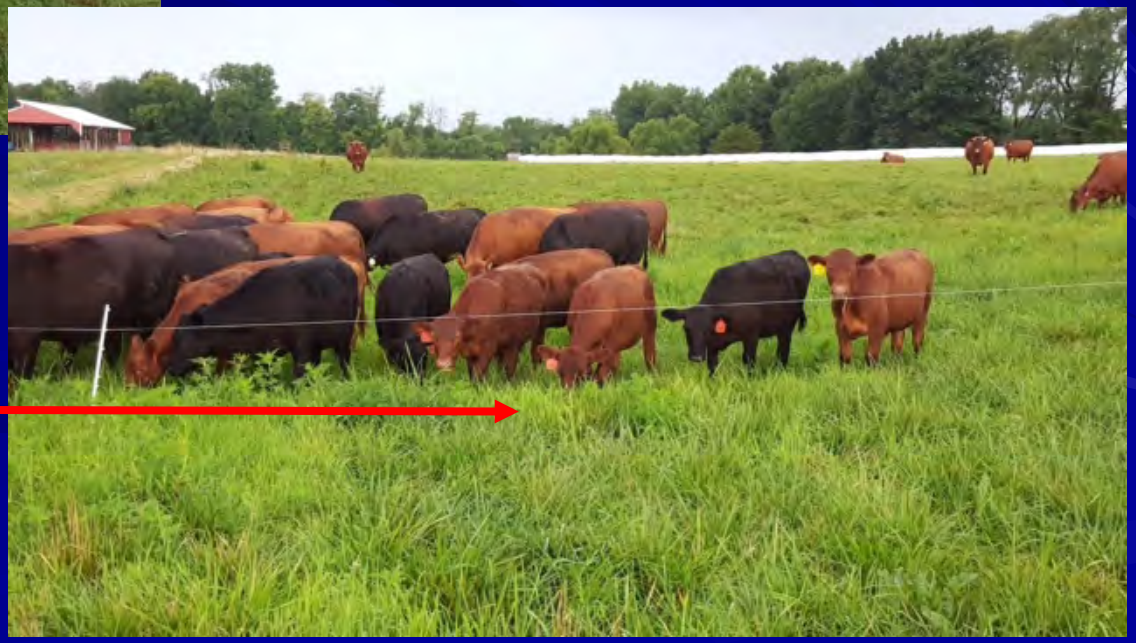
Aphodius distinctus: A-fo-di-us dis-tink-tuss
Aphodius erraticus: A-fo-di-us e-rat-i-kus
Aphodius fimetarius: A-fo-di-us fim-a-tary-us
Aphodius granarius: A-fo-di-us gran-air-e-us
Aphodius pseudolividus: A-fo-di-us sue-doe-liv-i-dus
Canthon pilularius: Kan-thon pie-loo-lary-us
Copris minutus: Koe-pris mi-nu-tus
Dichotomius carolinus: Dik-o-tomee-us carolin-us
Geotrupes blackburnii: Geo-troop-eze black-burny-eye
Onthophagus gazella: On-tho-fa-gus ga-zell-a
Onthophagus hecate: On-tho-fa-gus heck-ate
Onthophagus pennsylvanicus: On-tho-fa-gus pen-sill-van-i-kus
Onthophagus taurus: On-tho-fa-gus tore-us
Phanaeus vindex: Fan-ny-us vin-dex (Rainbow beetle)

Increased Soil Aggregation

Illinois Grazing Trial

6 inches rain in two days.

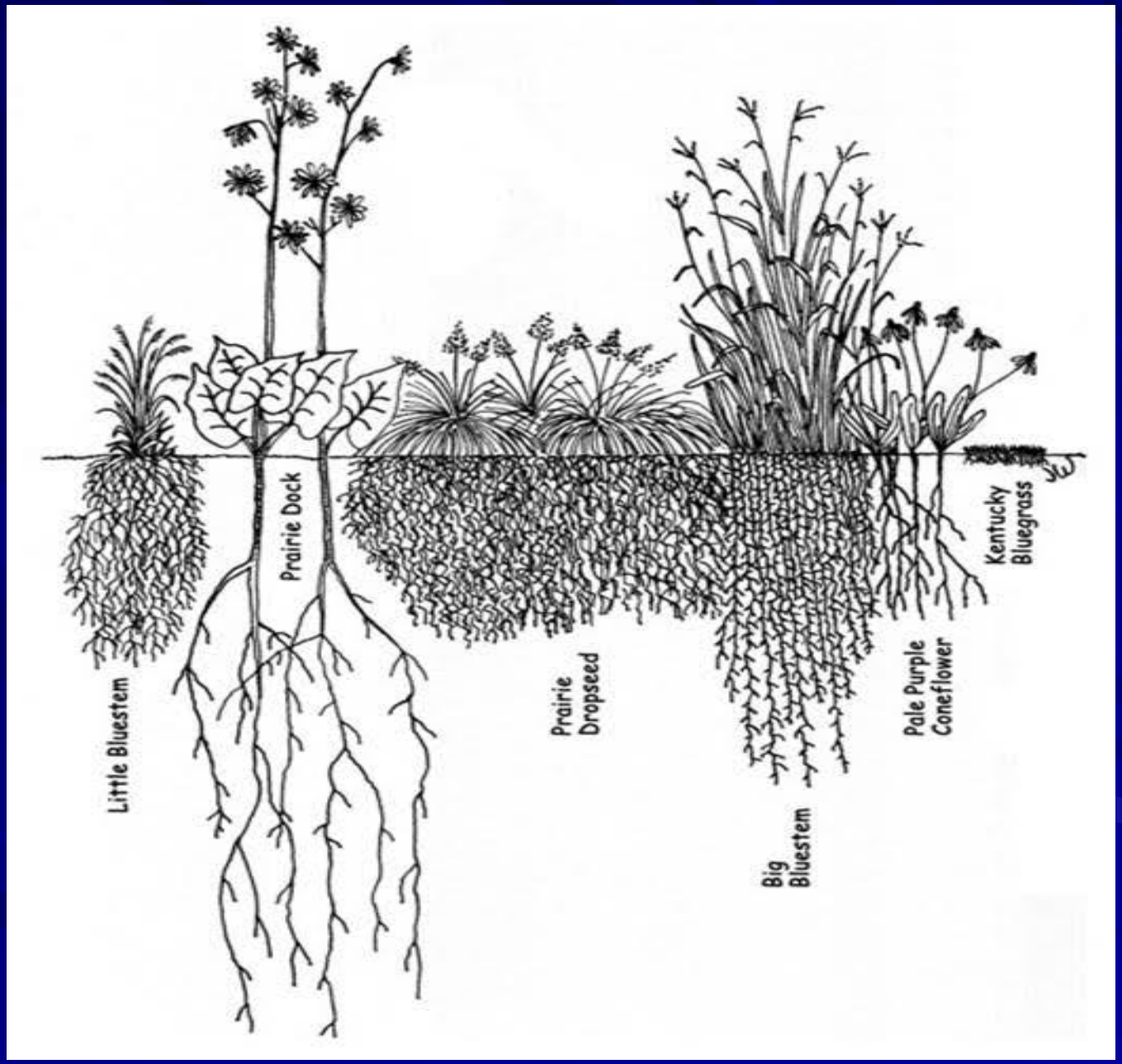
2 inches rain night before




Diversity Is Key

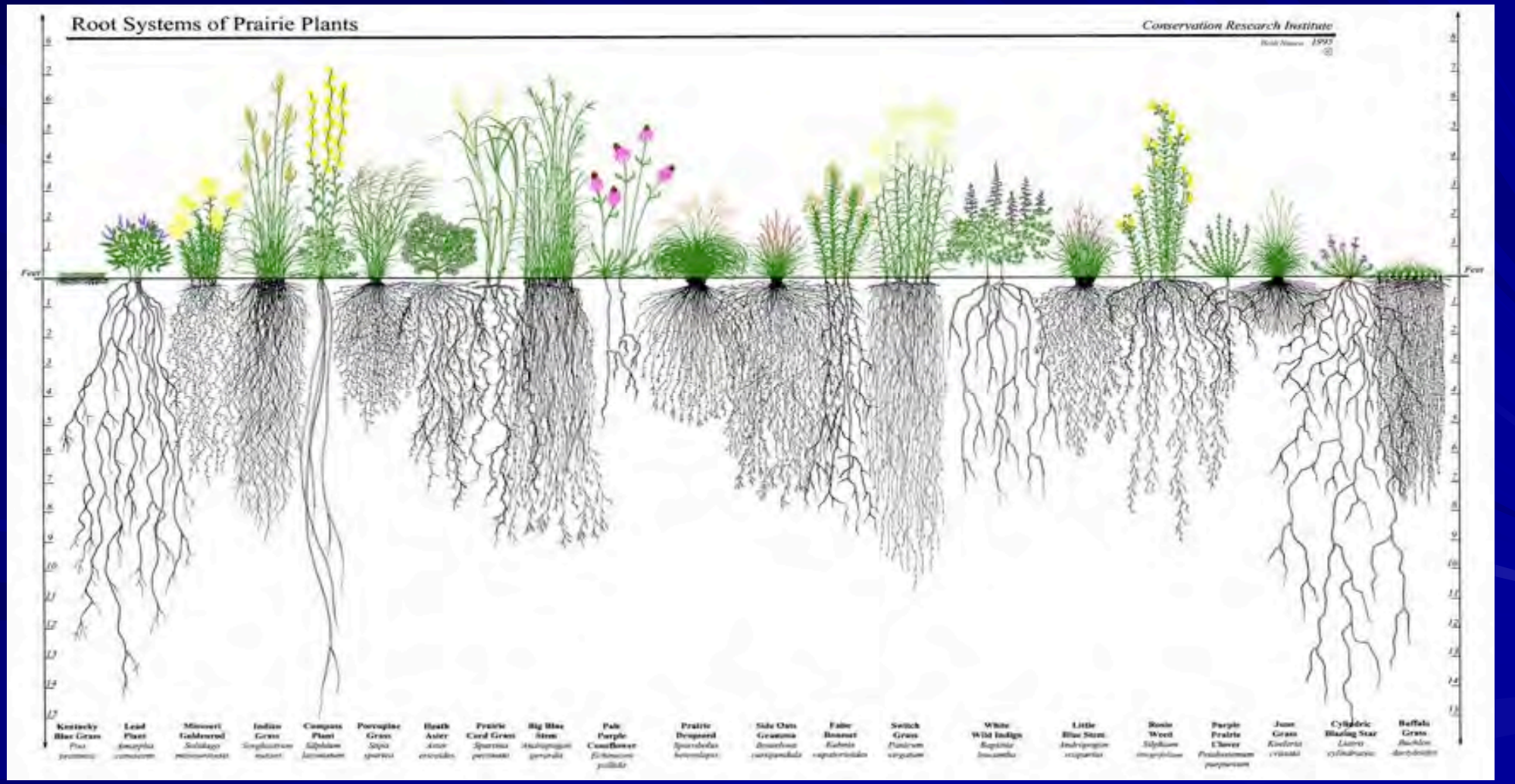
Penn State Trial

- Compared 2-seed perennial mix vs. 5-seed mix
  - 2-seed – Orchardgrass & white clover
  - 5-seed – Orchardgrass, white clover, fescue, alfalfa, chicory
  - 9 year trial
  - Grazed treatment & control equally
  - Advantages for 5-seed mix
    - 31% more forage DM production
    - SOC down to 39 inches
      - 1.8 tons/ha in 5-seed
      - 0.5 tons/ha in 2-seed


Little Bluestem
Prairie Dock
Prairie Dropseed
Big Bluestem
Pale Purple Coneflower
Kentucky Bluegrass

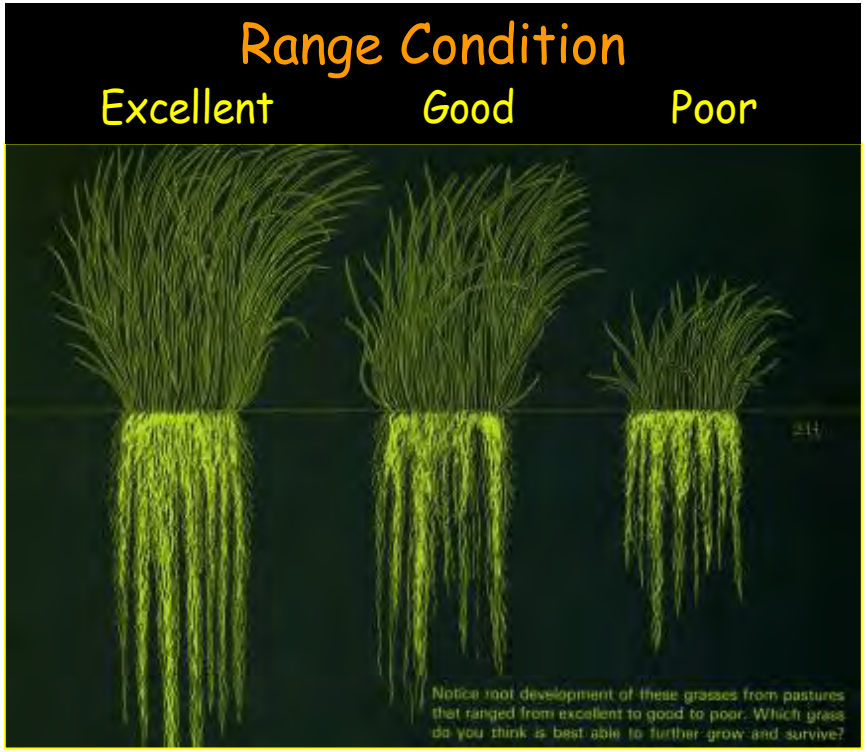
Where Do Majority of Soil Microbes Live & Function?

Approximately 2/3 Of Your OM Increase Will Come From Roots!

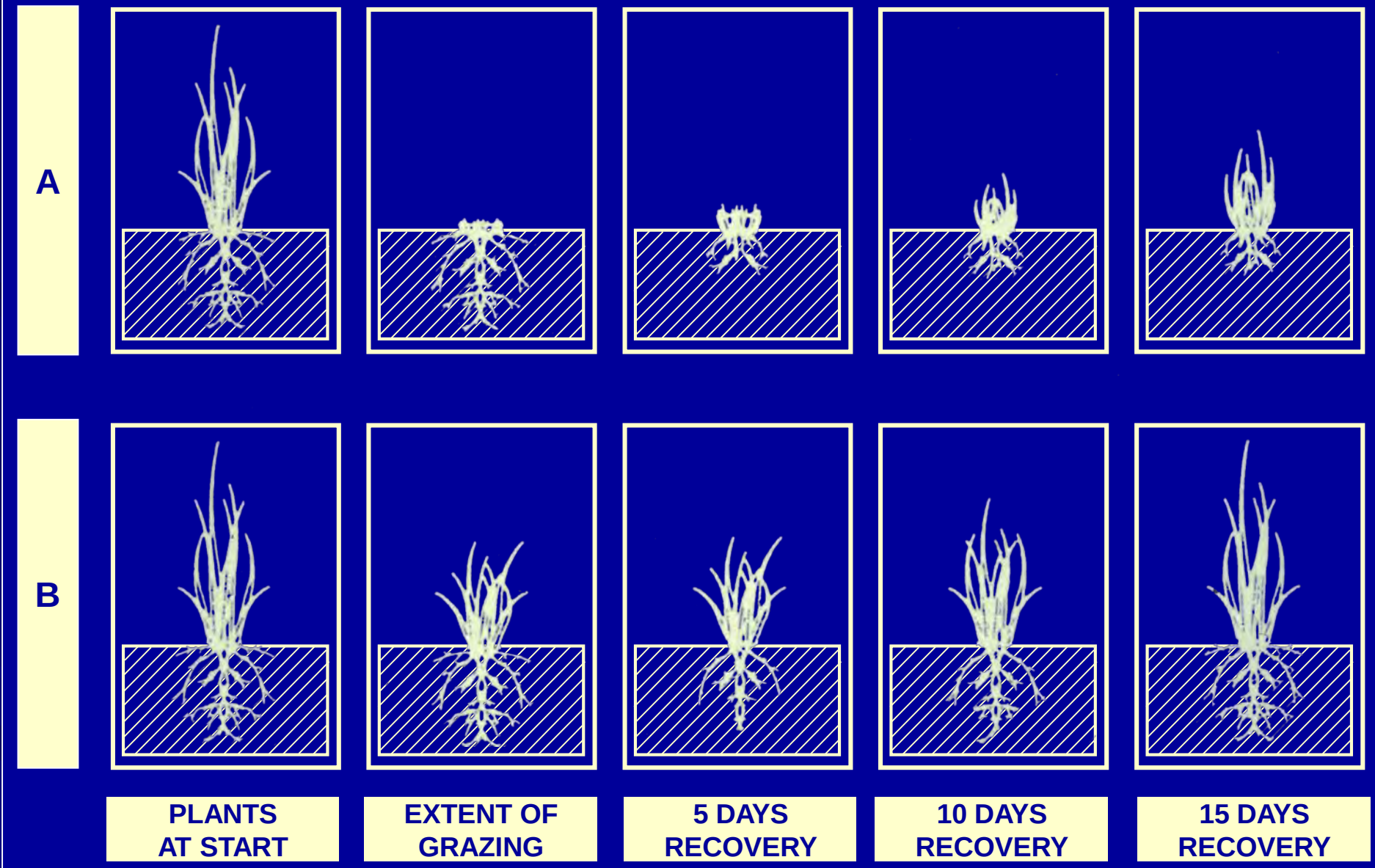


Decrease drought impacts

% Leaf Volume Removed	% Root Growth Stoppage
10%	0%
20%	0%
30%	0%
40%	0%
50%	2-4%
60%	50%
70%	78%
80%	100%
90%	100%



Courtesy: R. Teague, TAMU

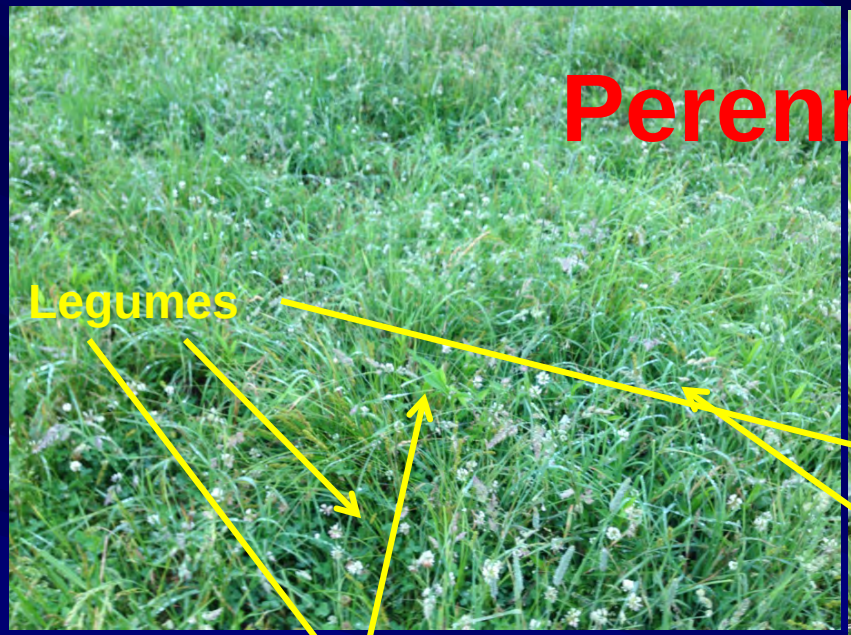

A
B
PLANTS AT START
EXTENT OF GRAZING
5 DAYS RECOVERY
10 DAYS RECOVERY
15 DAYS RECOVERY

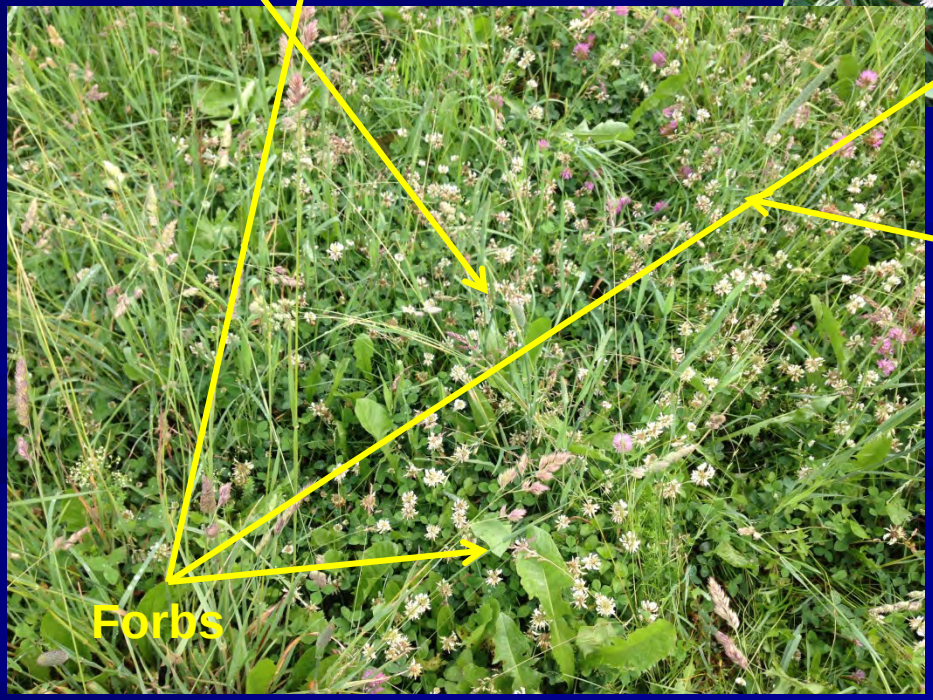
Desired Mix

- Principle of Three
  - Grasses
  - Legumes
  - Forbs

  - Strive for minimum of three grasses, three legumes, and three forbs in mix, whether perennial or annual.

Perennial Pastures





Grasses

Warm Season Annuals

Cool Season Annuals

Why Complexity & Diversity?

- Compounding & Cascading Effects
  - Always occur – Positive or negative?
  - Secondary & Tertiary compounds
    - Dr. Fred Provenza & Others
  - Diversity in microbial species
  - Diversity in macroorganisms
  - Exponential rather than linear
- "*No effect or impact is singular*"

Perennial Mix

- Bromegrass, Orchardgrass, MeadowFescue, Tall Fescue, Bluegrass, Reeds Canary, Timothy, Natives, ….
- White Clover, Red Clover, Trefoil, Hairy vetch, Milk vetch, lespedezas, Sweet Clover, Tick Clover, Alfalfa, Sainfoin….
- Chicory, Plantains (Narrrow & Broadleaf), Yarrow, Sheep’s parsley, Burette, Dandelion, Docks, ….

Principle of Disruption

Flexibility is Key

- Do NOT do things the same way every time!
- AMP/AHSD is NOT a system.
  - Alter stocking densities
  - Do not move through rotations in same pattern
  - Alter grazing heights
  - Alter rest periods
  - Alter species order
  - Alter time of season/year