Adaptive Grazing and Relationship to Soil Health

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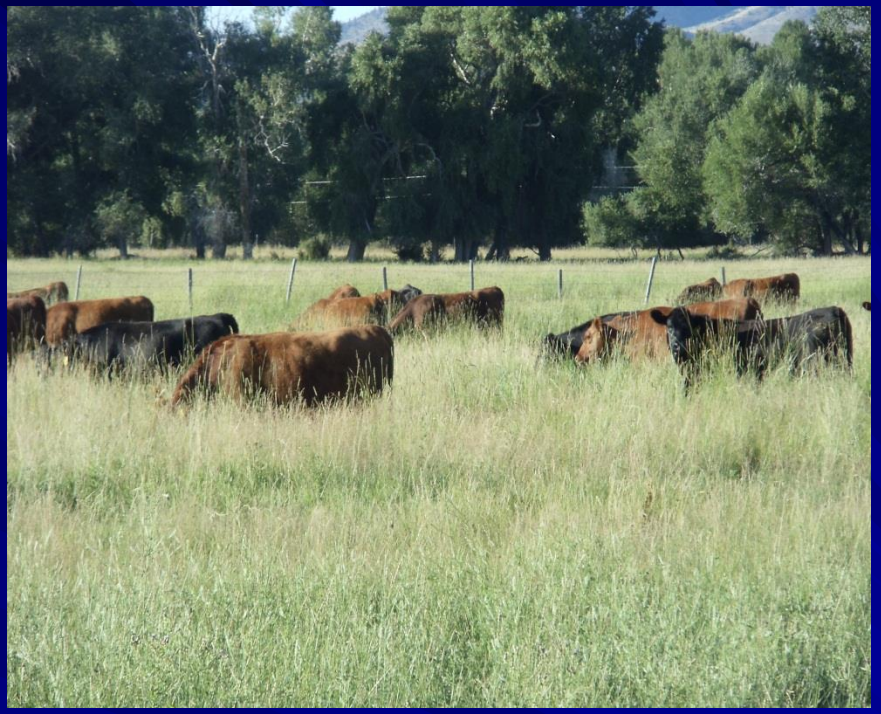



105

Three Principles

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

Principle of Compounding

- Never singular effects or impact
- Never Neutral – Always either positive or negative
- Everything we do creates a series of compounding & cascading events
- Also creates epigenetic effects

Principle of Diversity

- Want highly diverse and complex pastures and annual mixes – not monocultures.
- Grasses, Legumes, Forbs
- Primary nutrients, PLUS secondary & tertiary compounds.
- Creates series of positive compounding effects and beneftis.

Principle of Disruption

- Nature has tremendous resilience and responds well to challenges.
- Planned, purposeful disruptions.
- Creates host of positive compounding effects.

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

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

Mob Grazing High Carbon Biennials

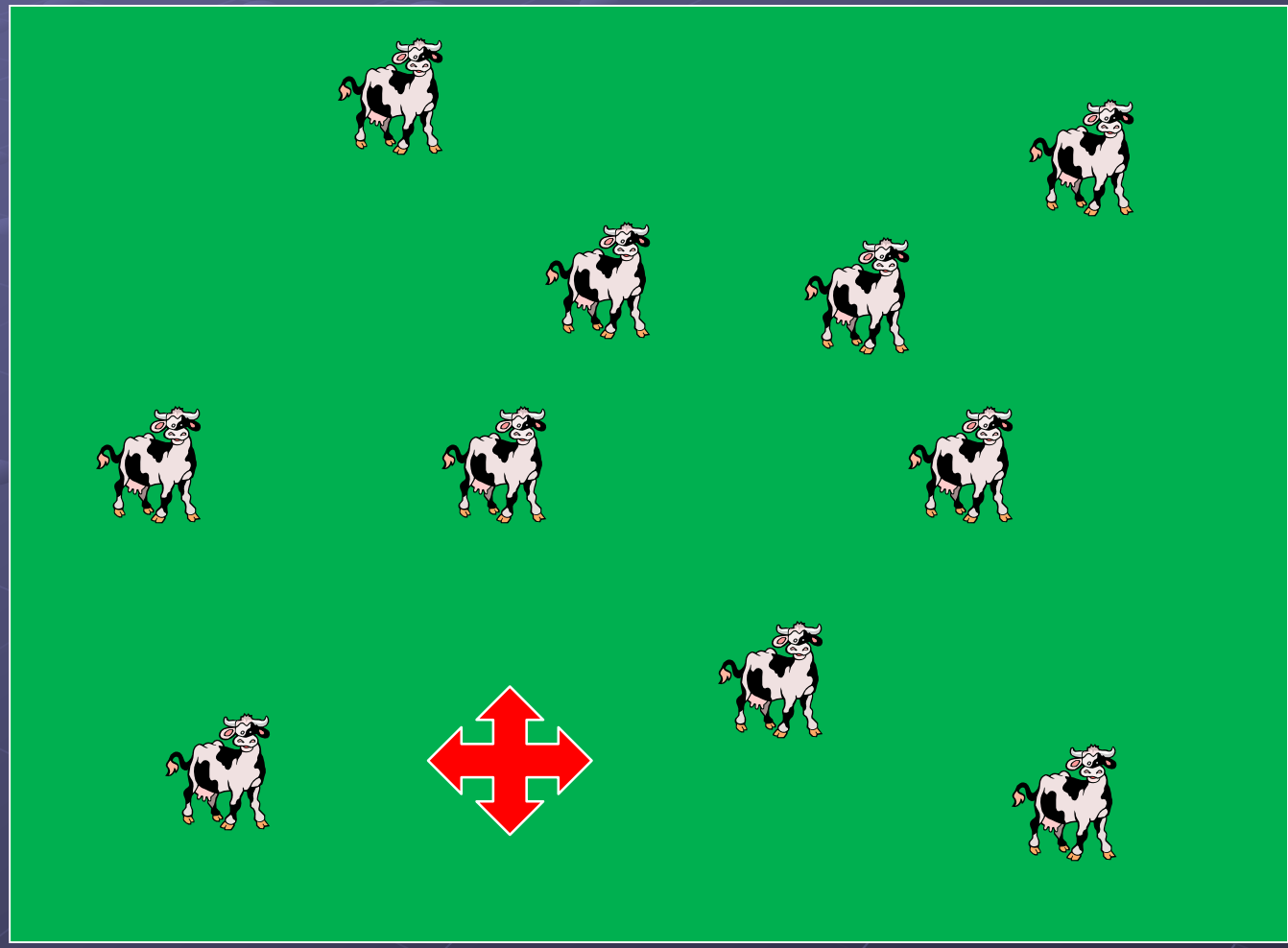
Moving Cattle

Carbon!

Stocking rate and stock density with continuous grazing

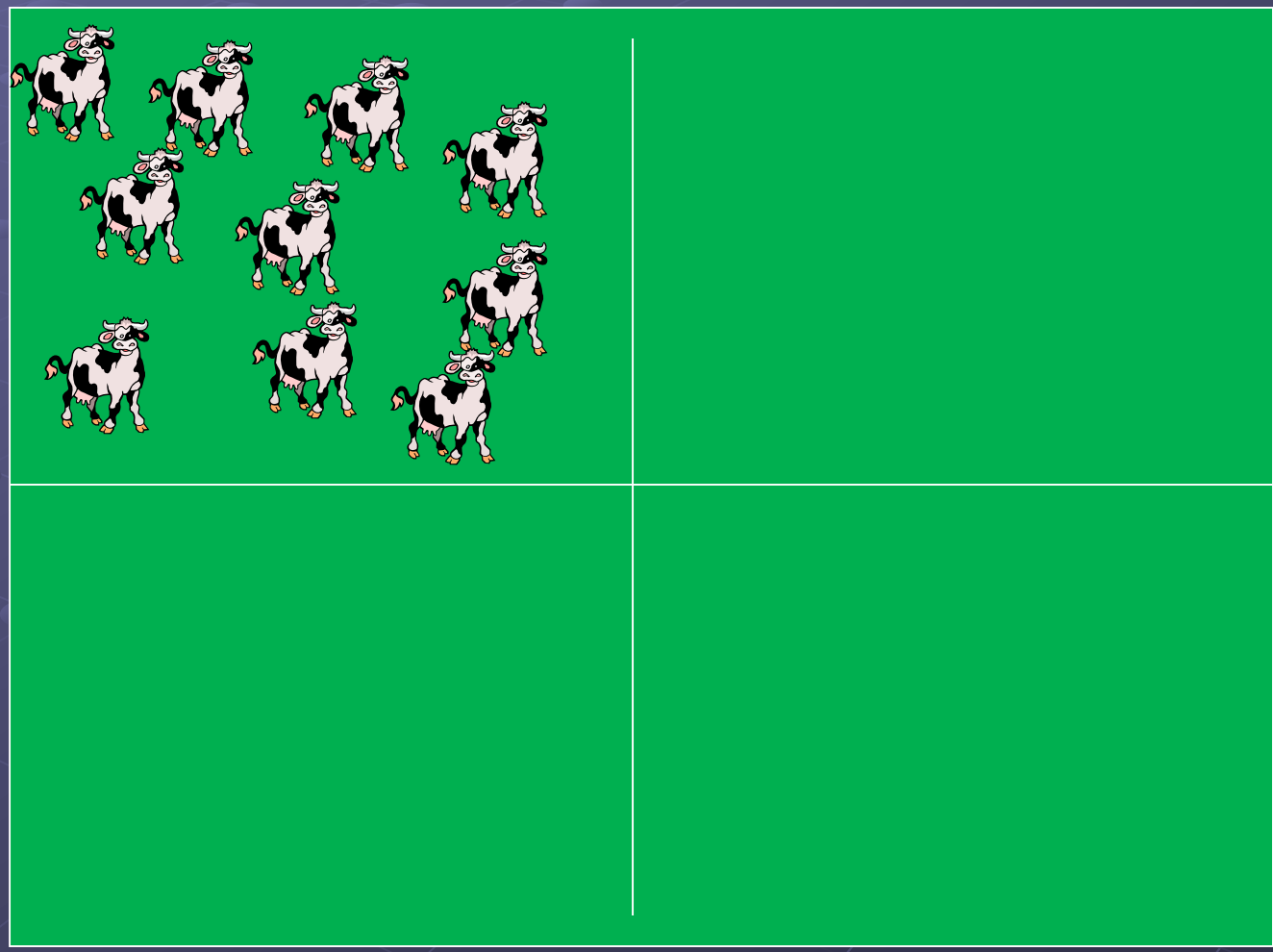
- Ten head on ten acres
- Stocking rate = 1 hd/acre
- With continuous grazing:

  stock density = stocking rate
- Both are still 1200 lb/acre



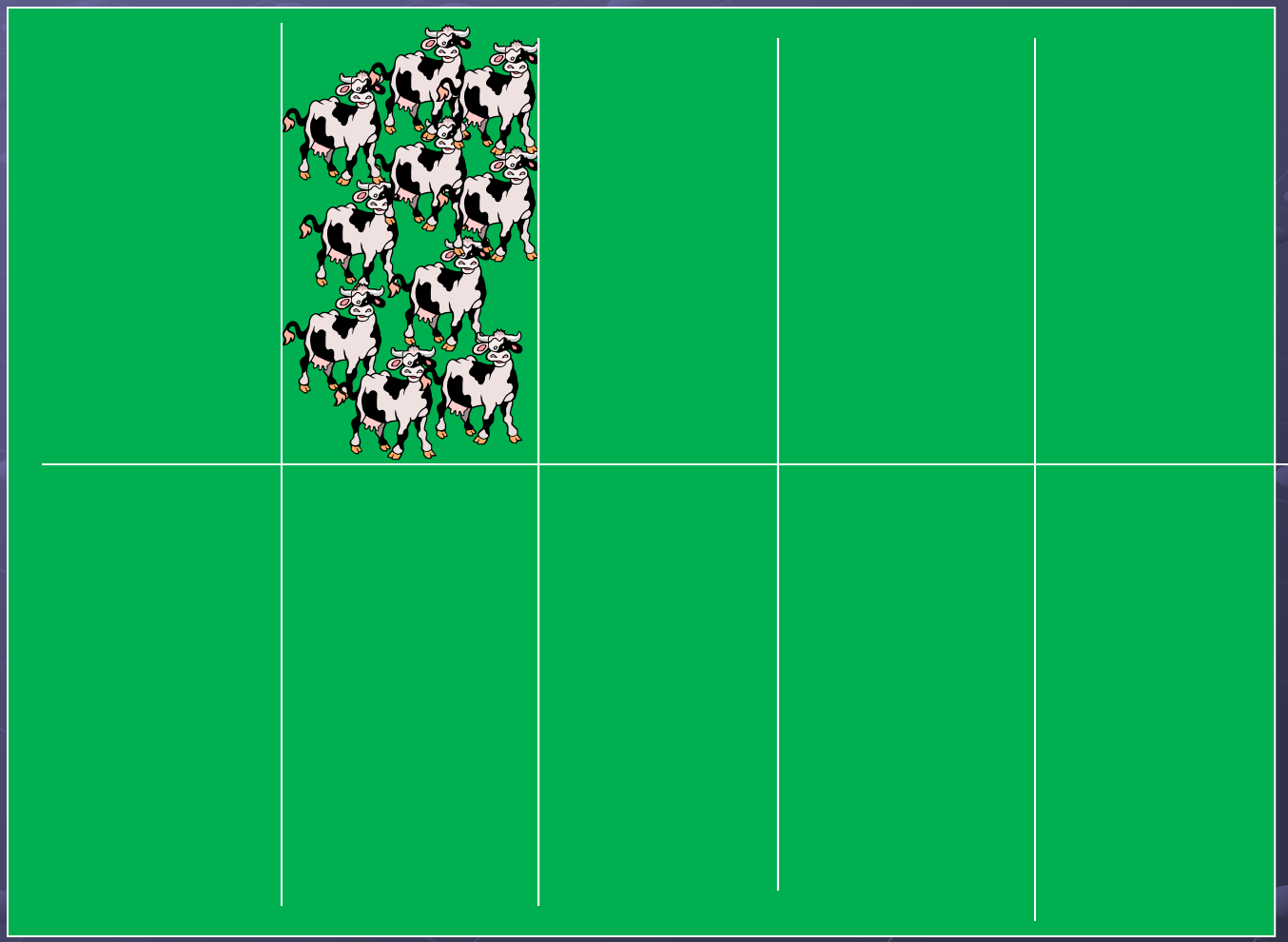
Pasture subdivision and stock density

- With pasture subdivision stocking rate may not change but stock density does !
- Stock density is 10 hd/2.5 acres or 4800 lb/acre



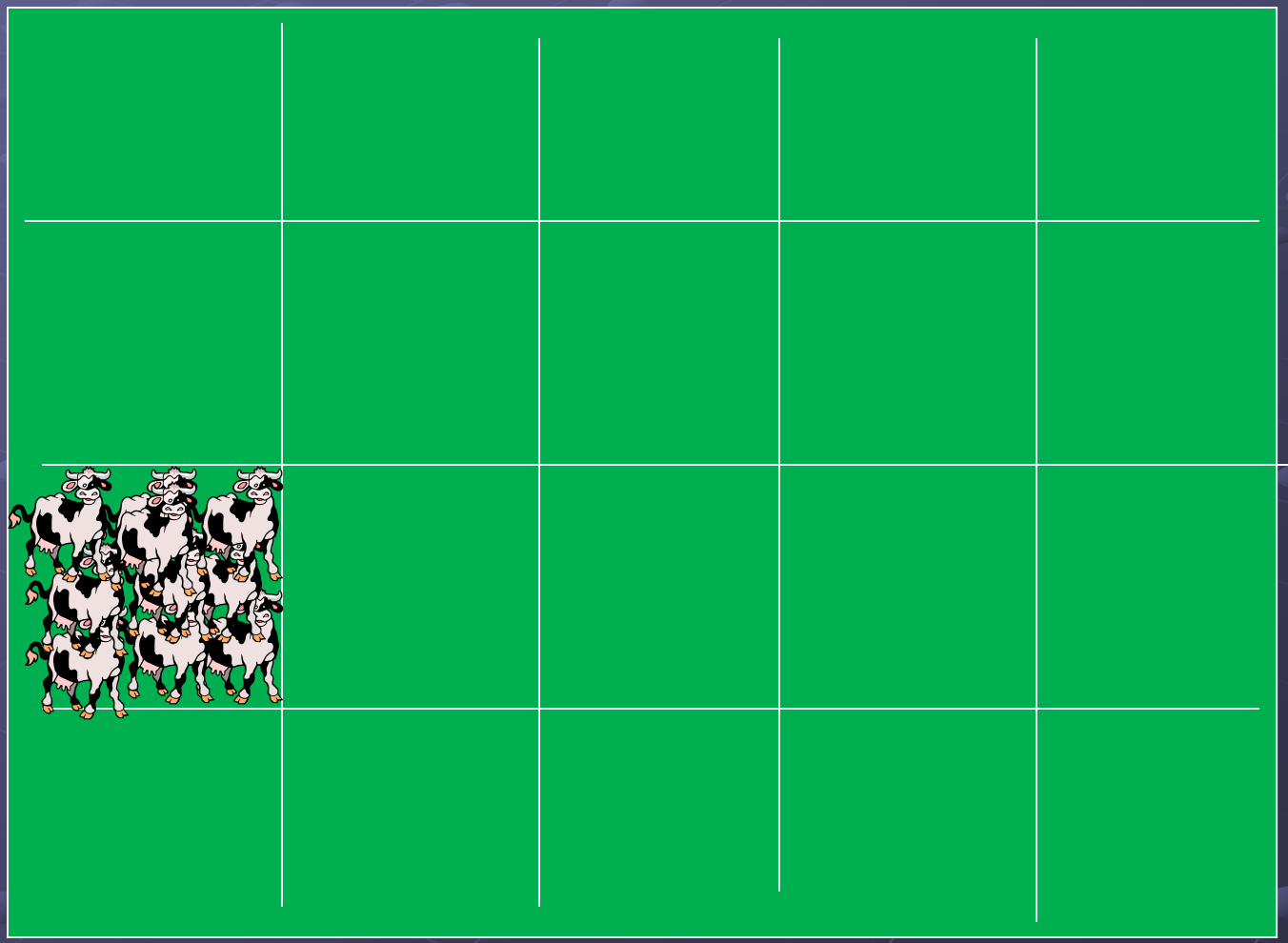
Pasture subdivision and stock density

- Each level of subdivision results in higher stock density
- Stock density is now 12,000 lb/acre



Pasture subdivision and stock density

- Stock density is now 24,000 lb/acre
- You've got it, right?



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”**
- www.soilcarboncowboys.com

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
- https://www.no-tillfarmer.com/topics/65

Additional Resources

- https://www.no-tillfarmer.com/articles/6809-evaluating-herbicide-carryover-on-cover-crops-deu
- www.pasturemap.com
- www.vence.io

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

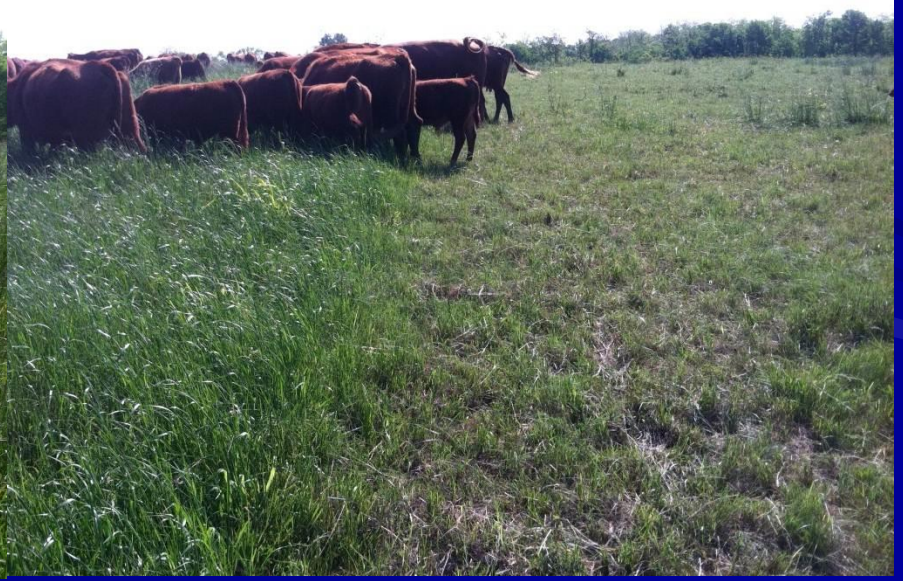
- Bale Grazing 1st winter.
- High Stock Density/Short Duration Grazing.
- Long rest periods.
- Strategic use of microbial quorum sensing.

Year 1 Grazing Season

Grazing Weeds

Year 2 Grazing Season

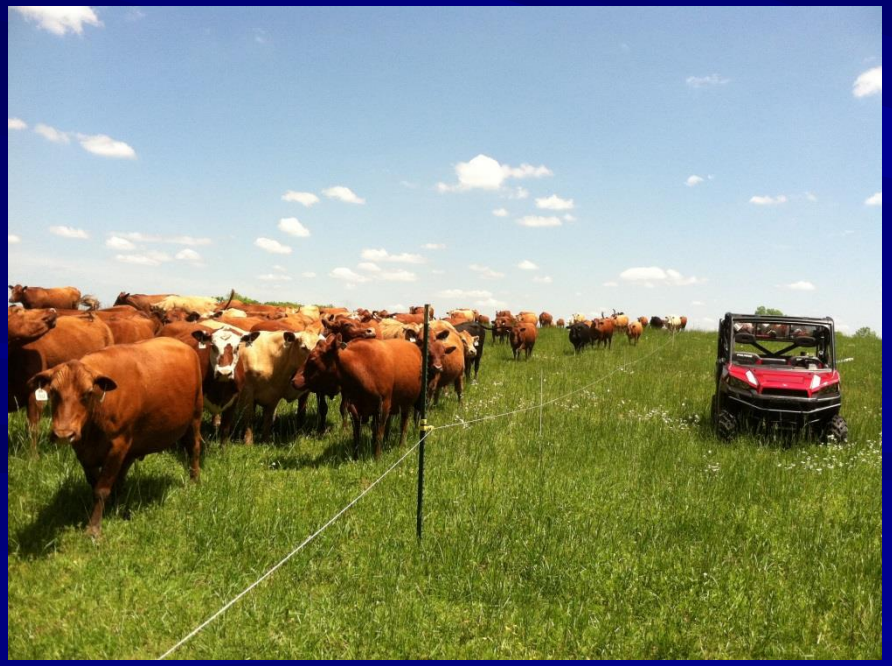
Year 3 Grazing Season

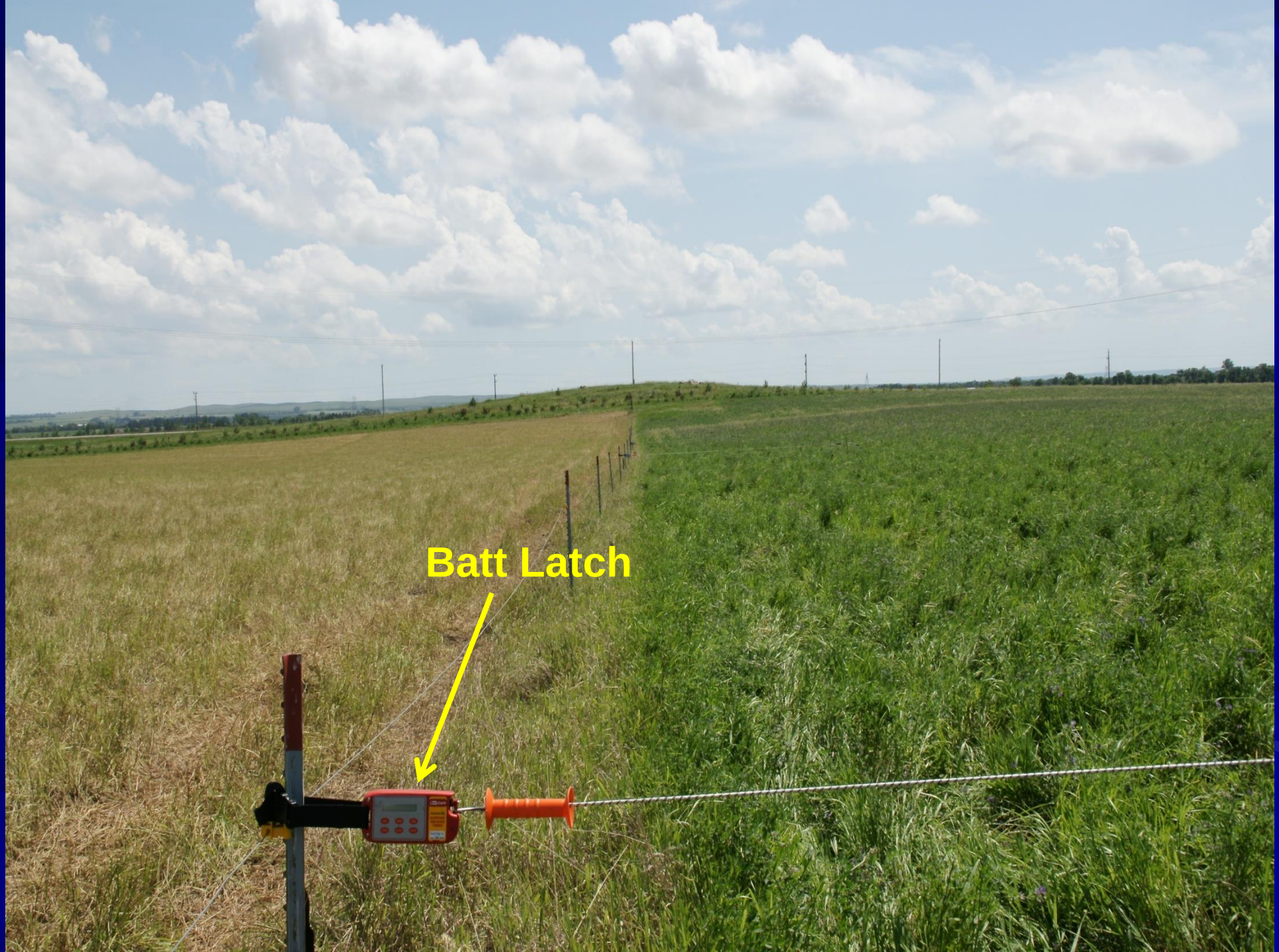


Year 4 Grazing Season

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

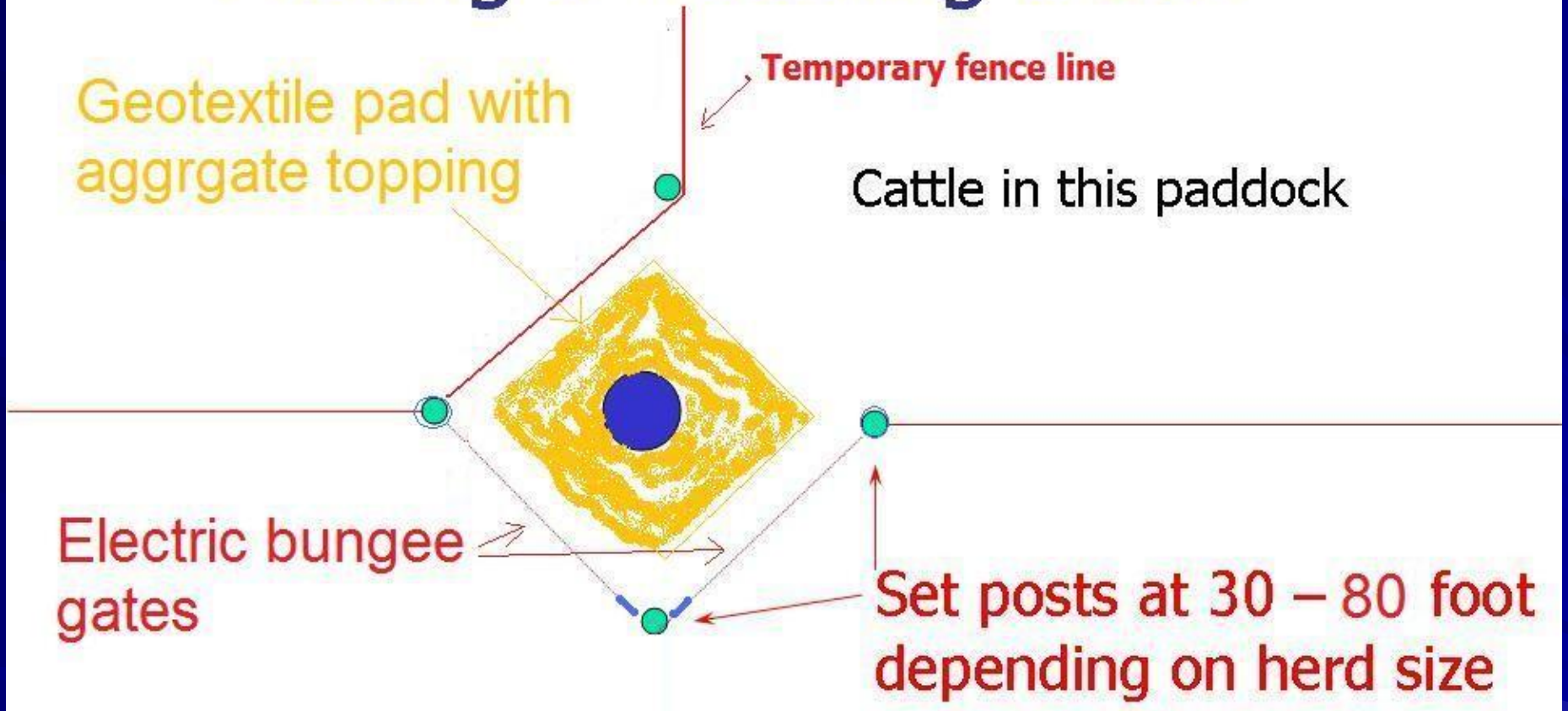

11:33 AM
SET CLOCK
START TIME
HOW LONG
HOW OFTEN
OFF
AUTO
FOR RAIN DELAY PRESS +
MANUAL

Multi-Paddock Construction for Multiple Daily Moves

Allen's Fencing Rig

Keeping Cattle Out Of Ponds

Making a watering block



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….

10 Inches Rain – Hurricane Joquin – Oct. 2016 - SC

Stoney Creek Farm

Grant, Dawn & Karlie Breitkreutz

*Cow-Calf Producer – Rotational Grazing

*Cover Crops for fertility, grazing, forage


Sadly, this has become more common during the spring in our area.

Single-Species Cover

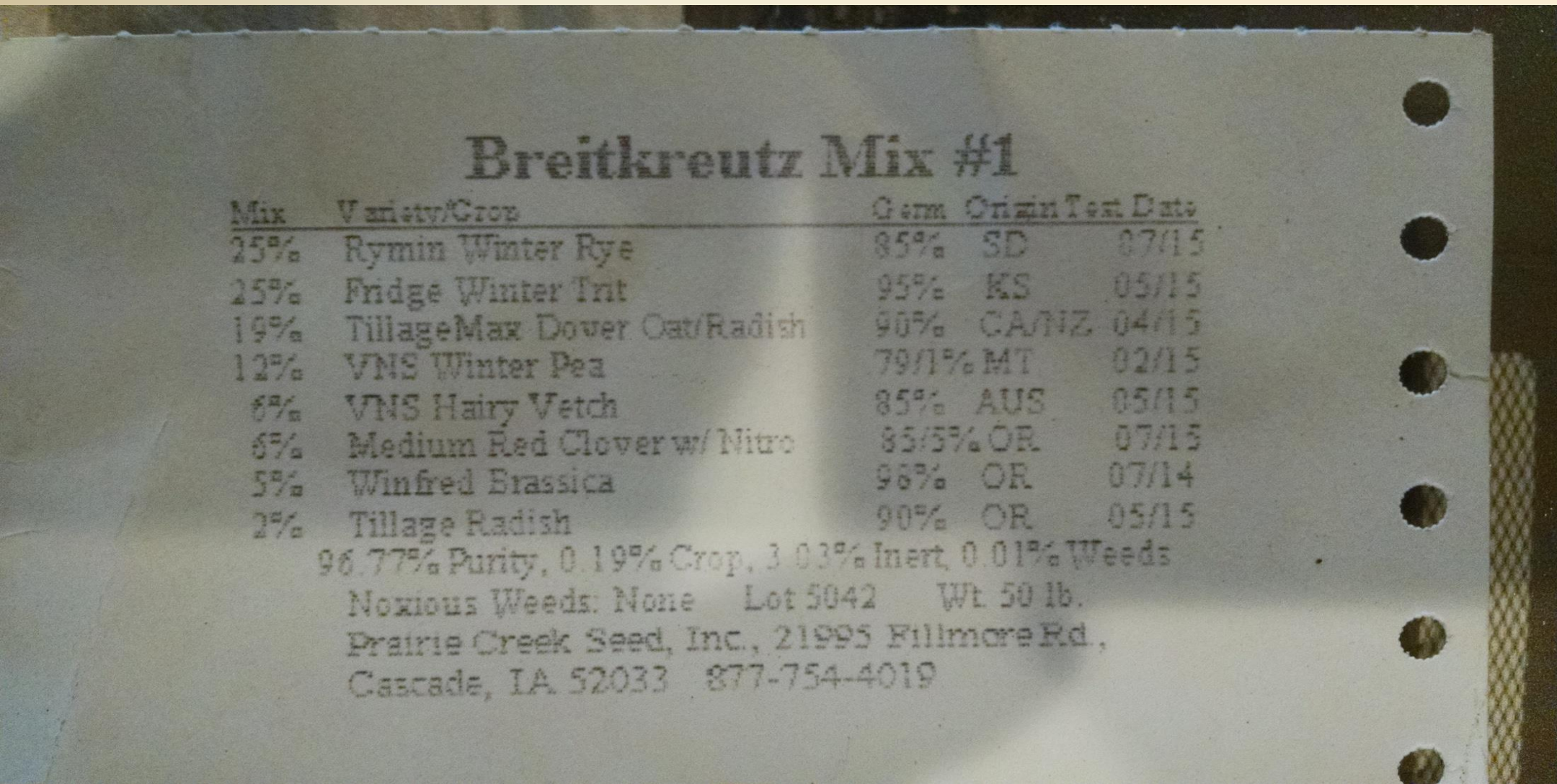
- 1 out of 3 was a success

- 2 out of 3 were a BIG failure for multiple reasons.

- **Lack of moisture**
- **Financial- Rented ground, incorrect seed, herbicide residuals & ineffective**

- In a dry year, the more species planted, the more likely some- thing will germinate & grow.

Cover crop mix following wheat harvest.



Breitkreutz Mix #1

Mix	Variety/Crop	Germ	Origin	Test Date
25%	Rymin Winter Rye	85%	SD	07/15
25%	Fridge Winter Trit	95%	KS	05/15
19%	TillageMax Dover Oat/Radish	90%	CA/NZ	04/15
12%	VNS Winter Pea	79/1%	MT	02/15
6%	VNS Hairy Vetch	85%	AUS	05/15
6%	Medium Red Clover w/ Nitro	85/5%	OR	07/15
5%	Winfred Brassica	96%	OR	07/14
2%	Tillage Radish	90%	OR	05/15

96.77% Purity, 0.19% Crop, 3.03% Inert, 0.01% Weeds

Noxious Weeds: None Lot 5042 Wt. 50 lb.

Prairie Creek Seed, Inc., 21995 Fillmore Rd.,

Cascade, IA 52033 877-754-4019

September 16, 2015, after wheat harvested & straw baled.

October 30, 2015, same field.


Ungrazed cover crop
03/12/2015

We were challenged to adapt a standard corn planter to no-till our corn crop.

Corn planter set up for no-till.

We adapted our no-till drill to interseed cover crop into corn.

Freshly seeded cover into standing corn and surviving cover from fall.

September 11th, chopping corn silage.

Approved cover crop seeded in corn crop on DNR-owned land as part of the cooperative farming agreement.
Picture taken November 8th.

Study field root pit October 7th

Live roots
3 ½ feet
in soil
March 2016

Soil from our field.

Soil from a tilled field.

Increased Soil Aggregation

Dollars & “Sense”

Wheat field cover cost: $37.25/acre
Wheat field feed cost: $.70/cow/day
Weight gained: 130-150# over 43 days
Corn field:
Flown-on seed cost: $66.52/acre
Inter-seeding cost: $26.45/acre
Study Field cover cost: $37/acre
Cover crop feed cost: $.46/lb. of gain
Weight gained: 3.4 lbs/day bred heifers
2.4 lbs/day calves

Wheat "Sense"

Expense		Return	
Seeding/acre	$20	Cow Feed/acre	$110
Seed	$38	Straw/acre	$ 35
Total	$58		$145

Net Gain=$87

Delayed Gains/Savings for Following Crop Year

Purchased Fertilizer	$39/ac
Purchased Herbicide	$11-$20/ac
Purchased Seed	$53/ac
Total	$103/acre

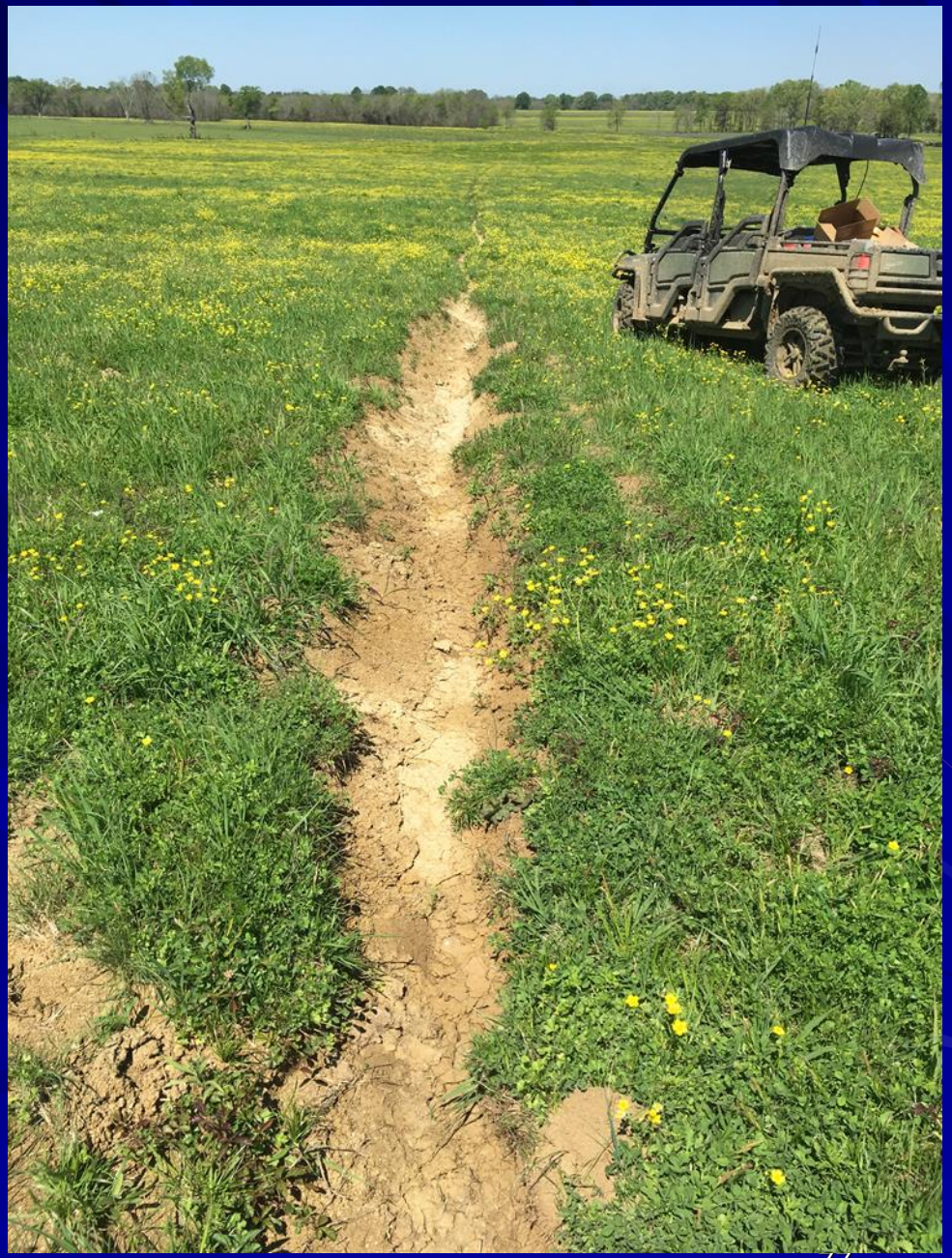
Total Net Gain=$190/acre

One of the best rewards for our efforts!

Alabama

Starting Point

- 120+ head Piney Woods cows
- Overstocked & Overgrazed
- Basically monoculture pastures
- Feeding 150 days annually
- Very poor soil health parameters
- Limited birds, pollinators, wildlife



After Two Years

Results

- Added 400 more cows.
- Eliminated fertilizer.
- Reduced hay feeding from 150+ days to under 30 days.
- Significantly more diversity, earthworms, pollinators, bird species, wildlife.
- Water infiltration rates increased more than 400%.

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.

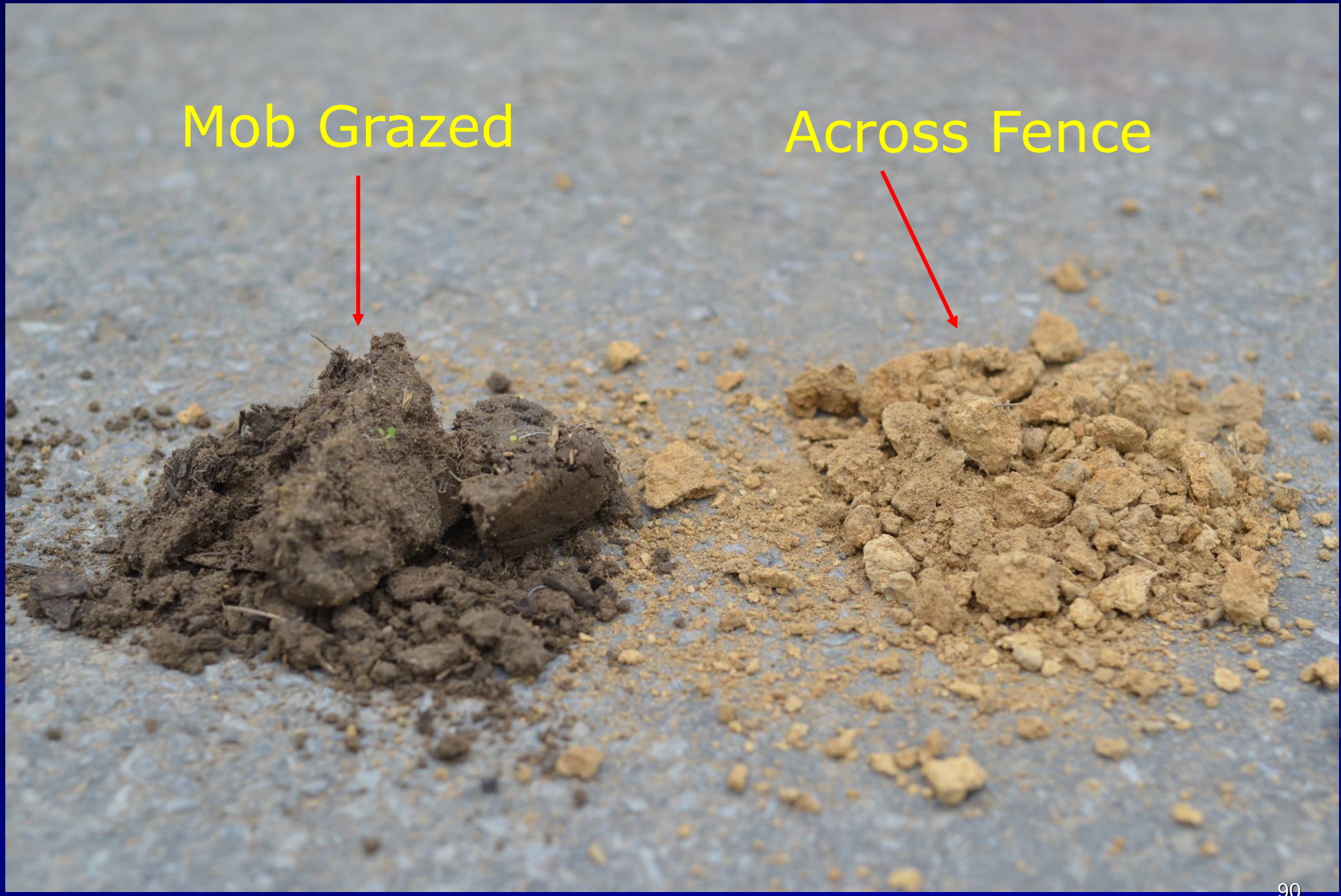
Chad Bitler, M.S.
Agriculture Resource Coordinator (ARC)
Email – cbitler@green-acres.org
Direct – (513) 898-3159

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

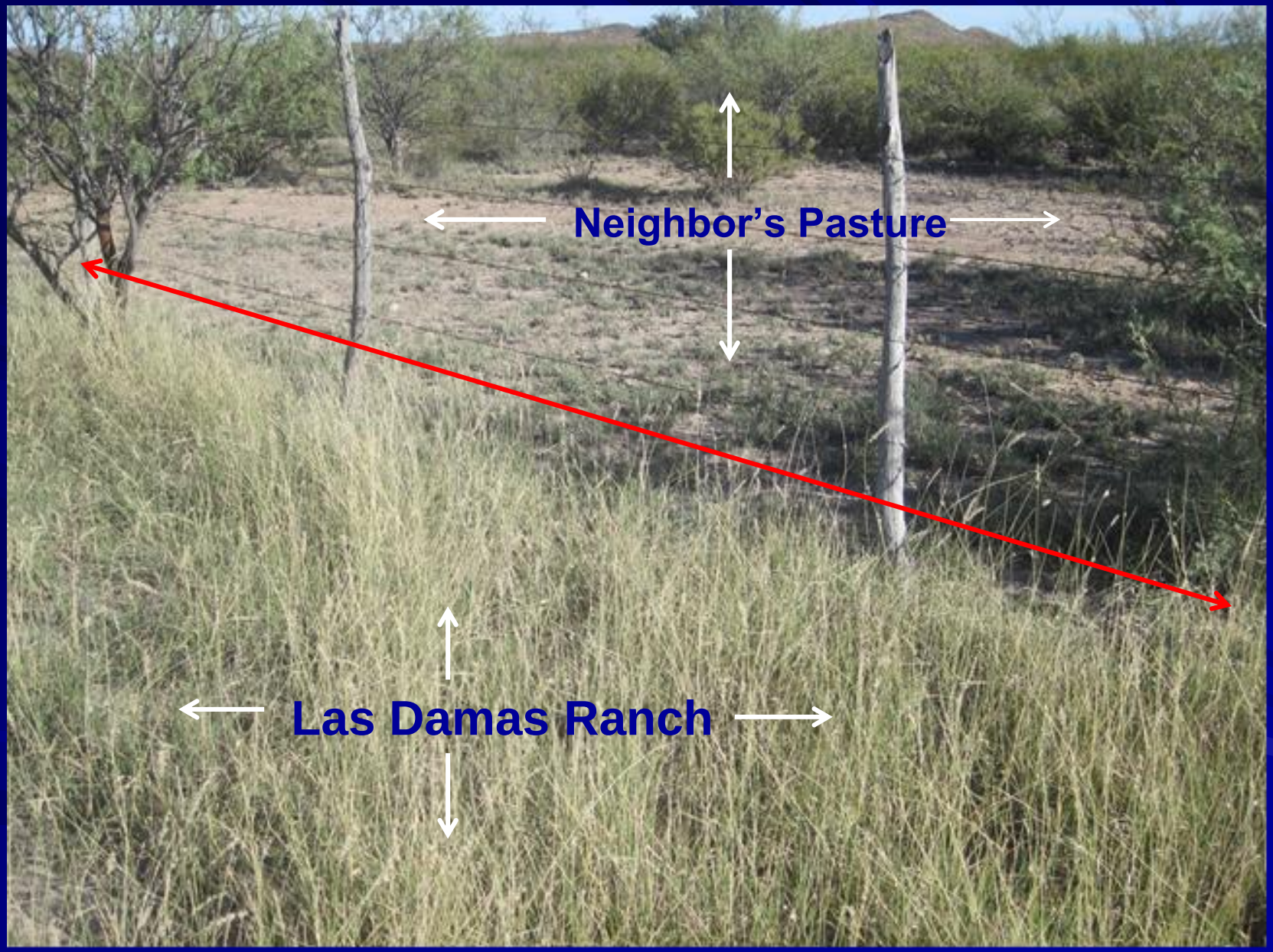
North Dakota

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 & Results

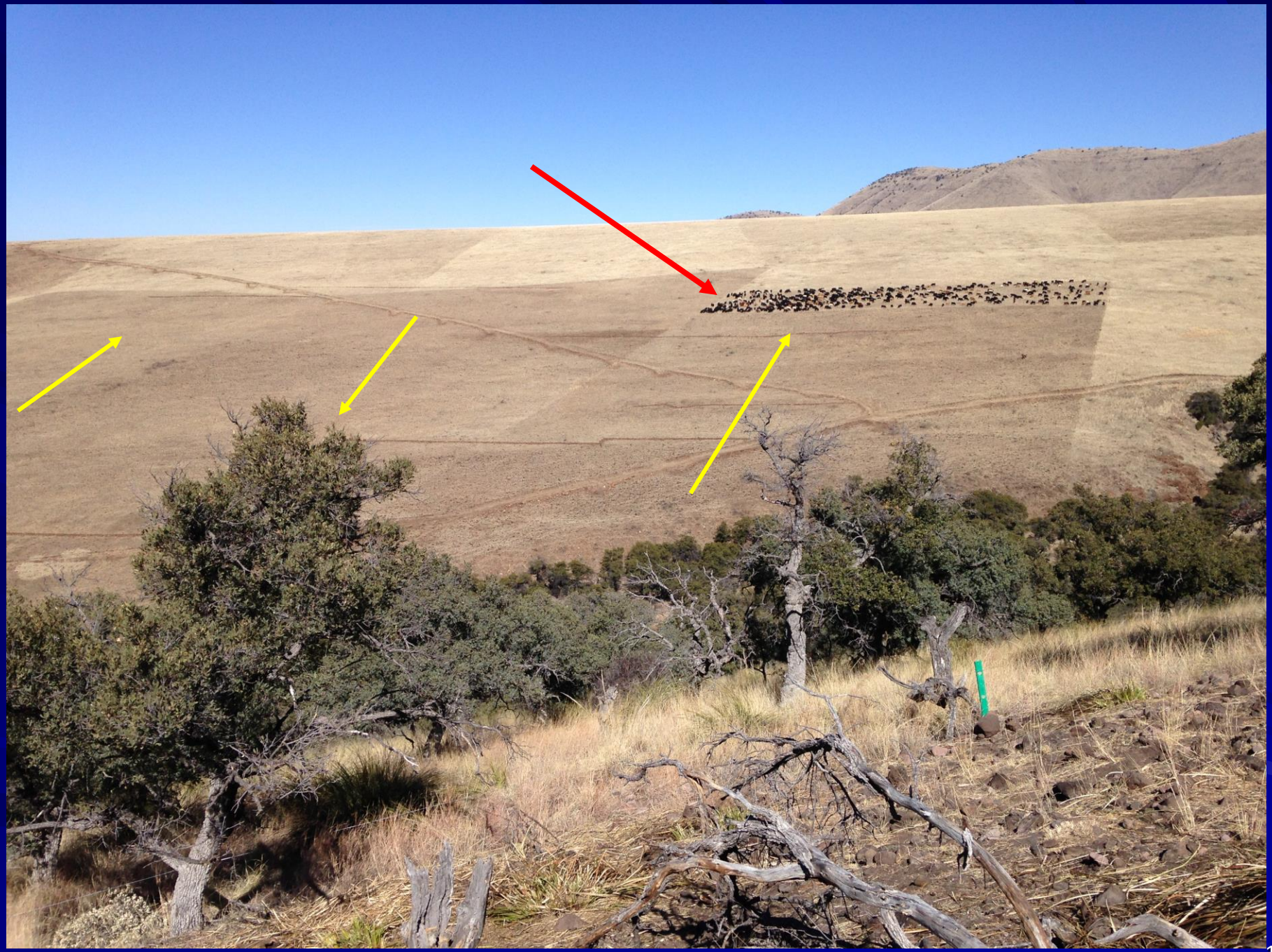
- Typical 11 inch rainfall region.
  - Last 4 years – **10”, 9”, 8”, 5” inches**.
- Started with a monoculture of tobosagrass
  - Now = More than **4 dozen** species…..
- Run 1 cow/calf per **40 acres**.
- FREE ACRES!!!
- Neighbor ranch runs 1 cow/calf per **200 acres**.

Results

- Since 2006 cattle sales have increased 2.5 times.
- Hay expenses reduced by one half.
- Net profits are 4 times greater.
- Pounds of calf produced per hectare has increased 3.7 times.

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

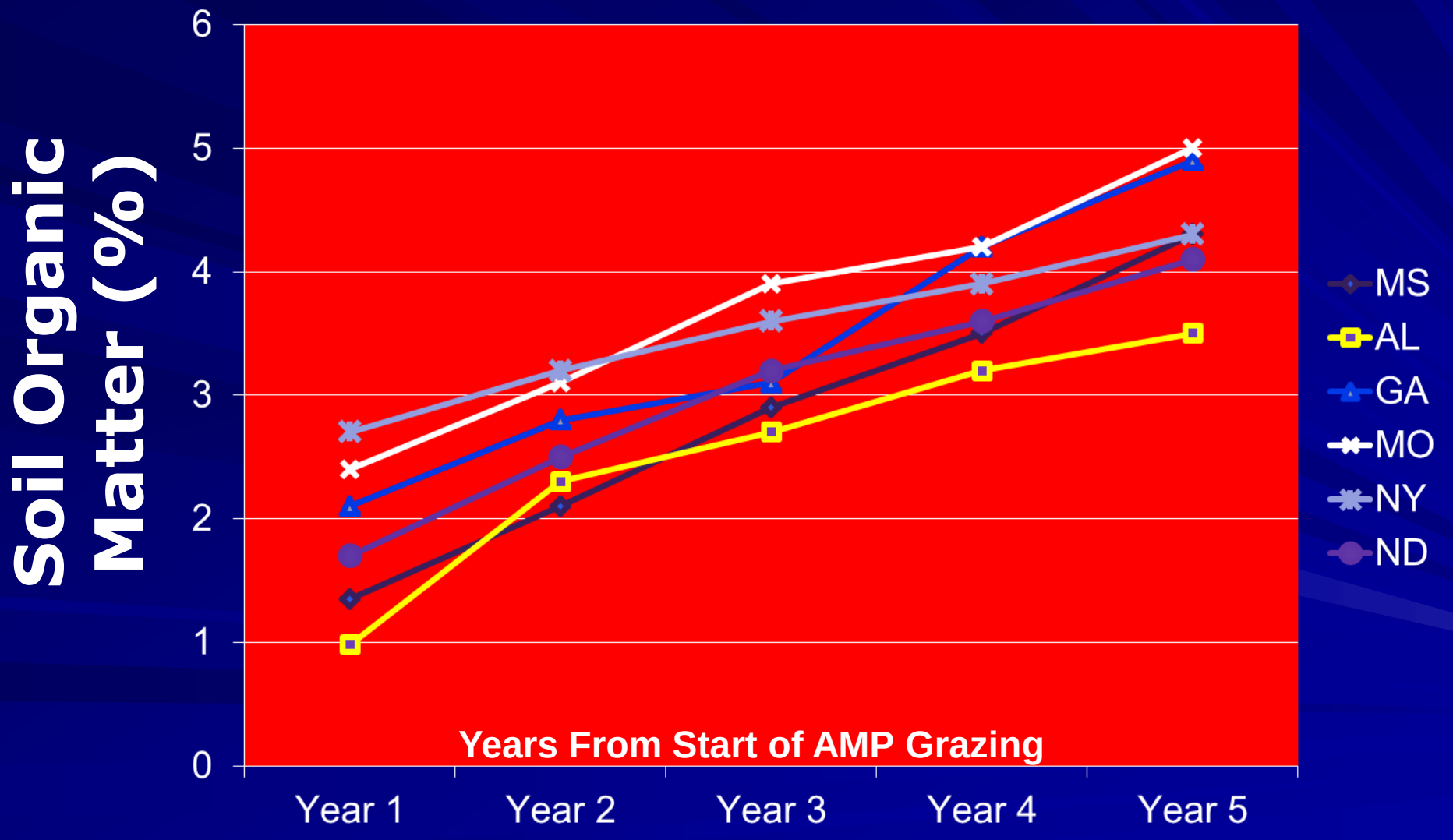
Horizon	AHSD	CG - Rotation	CG – Cont.
1	4.26	3.28	2.72
2	3.22	3.76	2.74
3	3.10	2.06	0.80
4	2.98	2.04	1.08
5	2.80	0.76	0.80
6	1.98	0.82	0.68

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

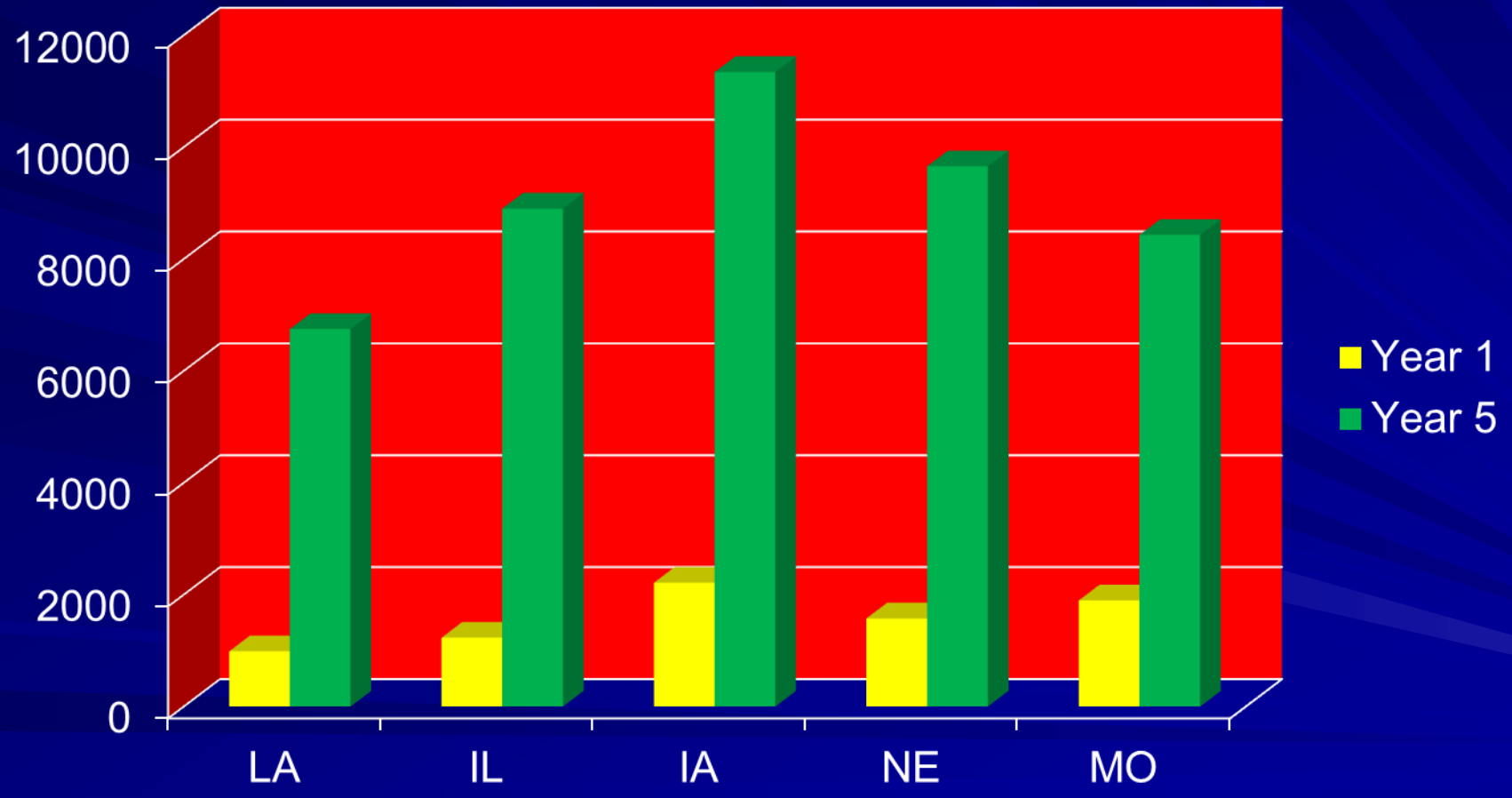
Improvement in Soil Organic Matter Using AMP Grazing



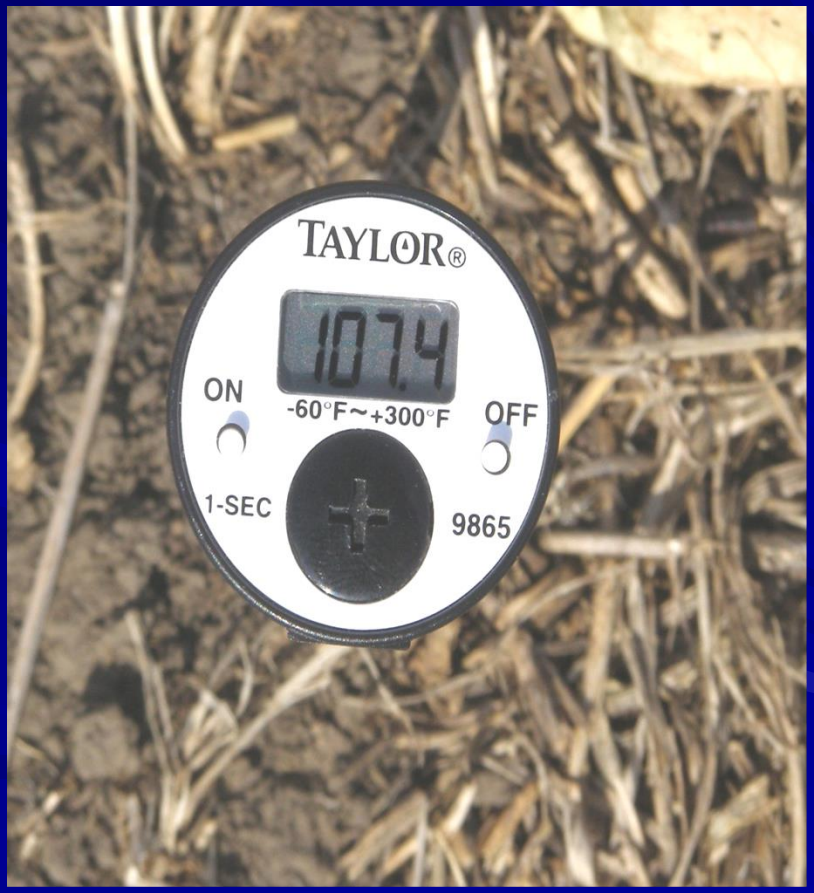
Source: Grass Fed Insights, LLC

Rebuilds Soil Microbial Biomass and Restores Microbial Balance

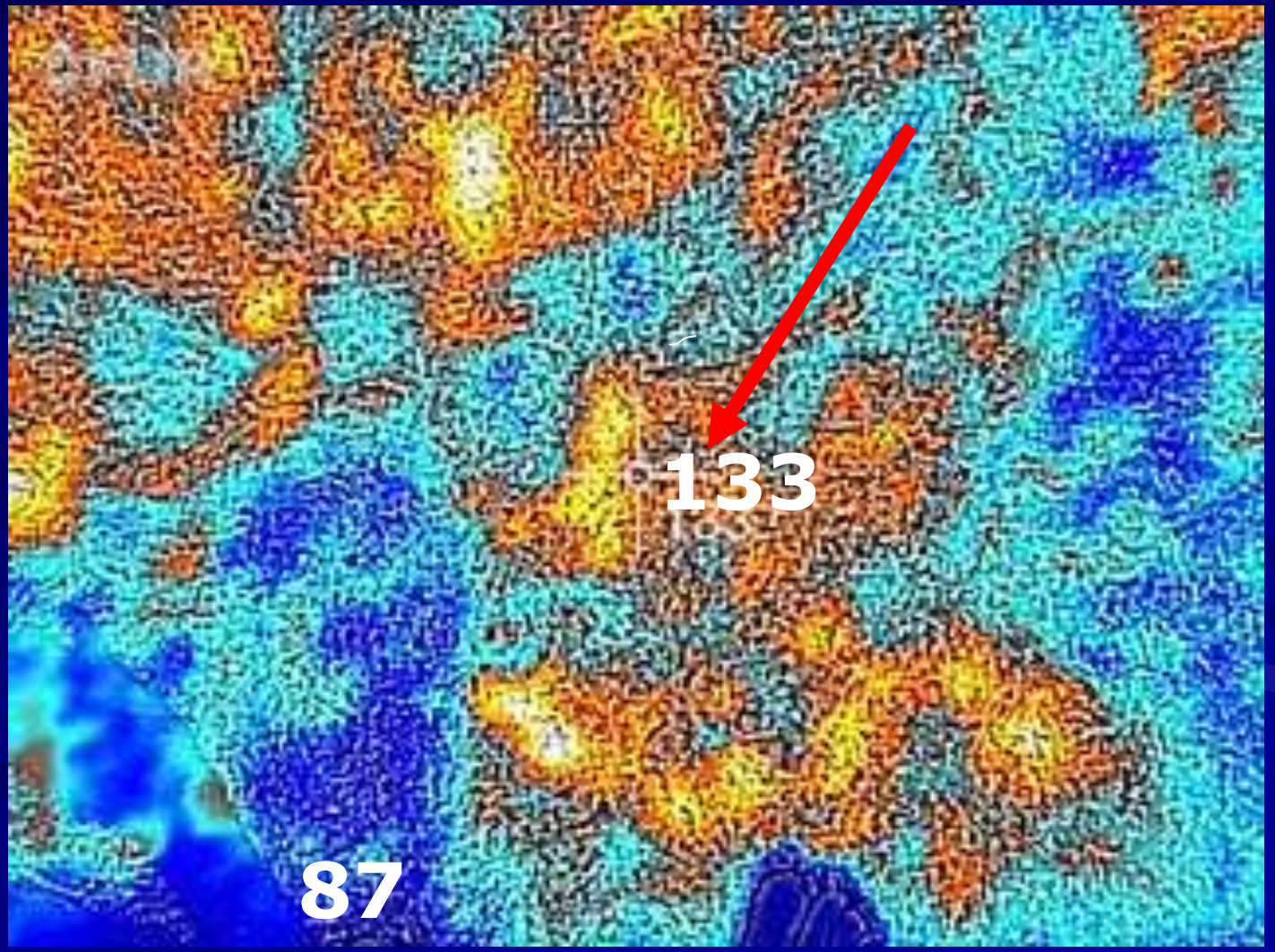
Building Microbial Biomass
(ng/g of Soil)



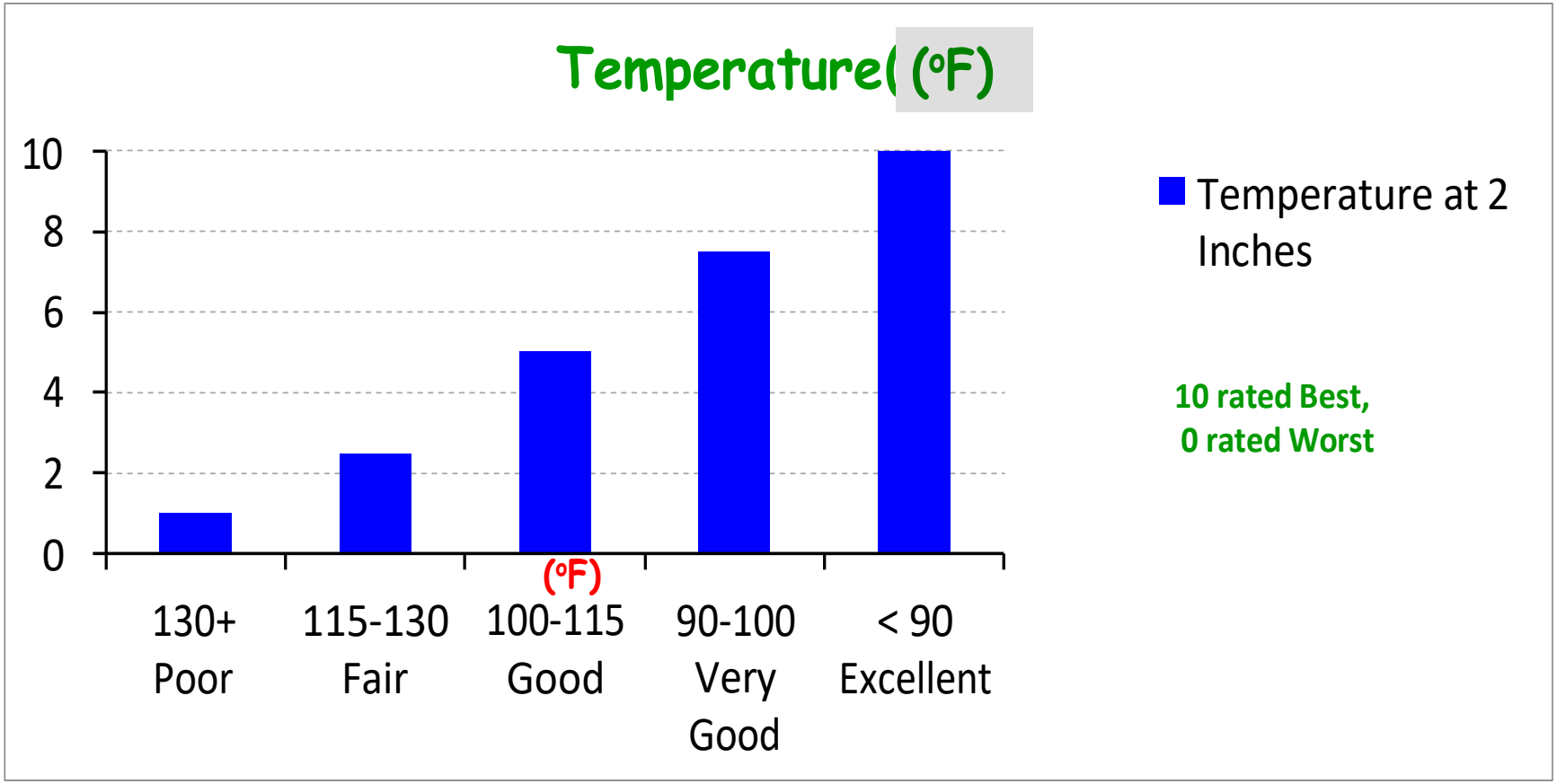
Protect Soil Temperatures



FLIR – Air Temp 96º

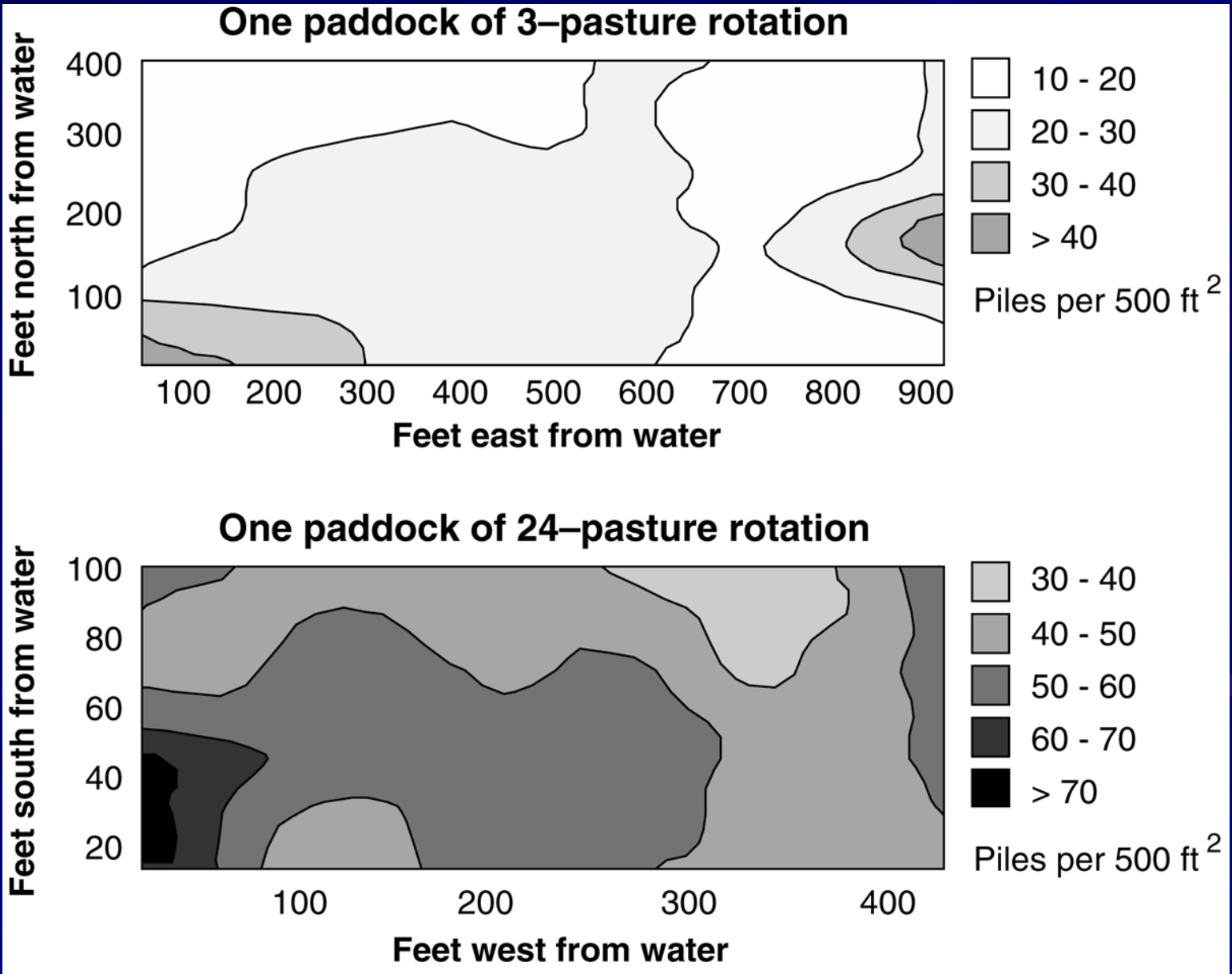


Indicator: Soil Temperature



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**

Cattle Manure Fertilizer Value is:

In Units of nitrogen (N), Phosphorus (P), and Potassium(K):

84N – 54P – 189K per year or **0.23N-0.15P-0.52K** per cow/day

So, How long does it take to fertilize a pasture using AMP Grazing?

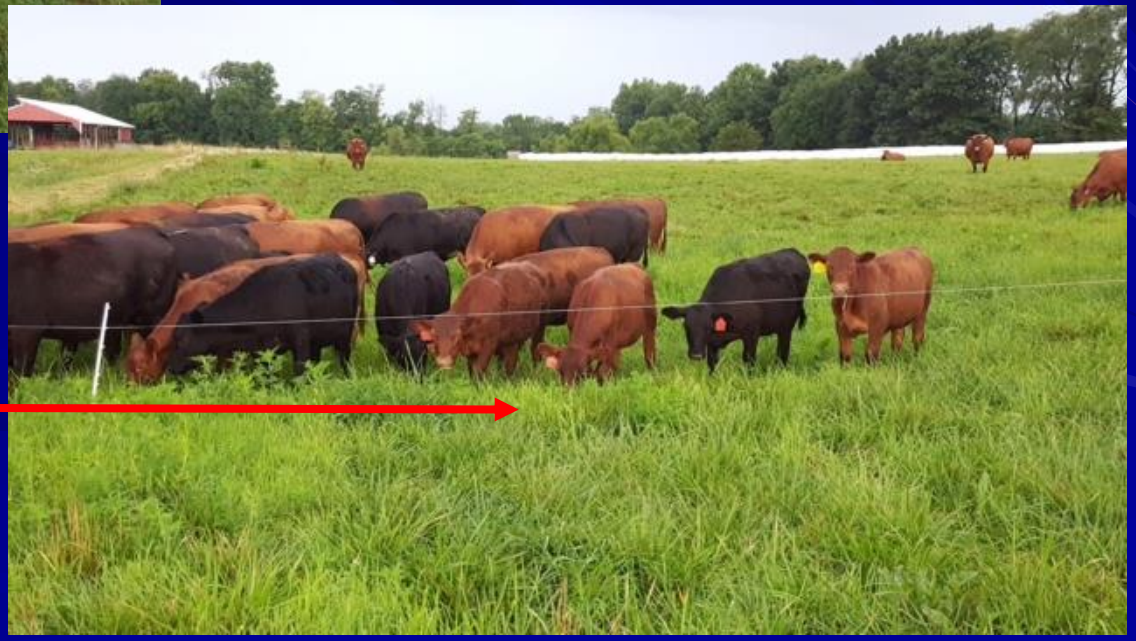
100 cows x's **1,000 lbs**/hd x's **1 day** grazing/**1 acre** = **23N-15P-52K/ac**

3 Days Grazing/Acre = 69N-45P-156K/ac

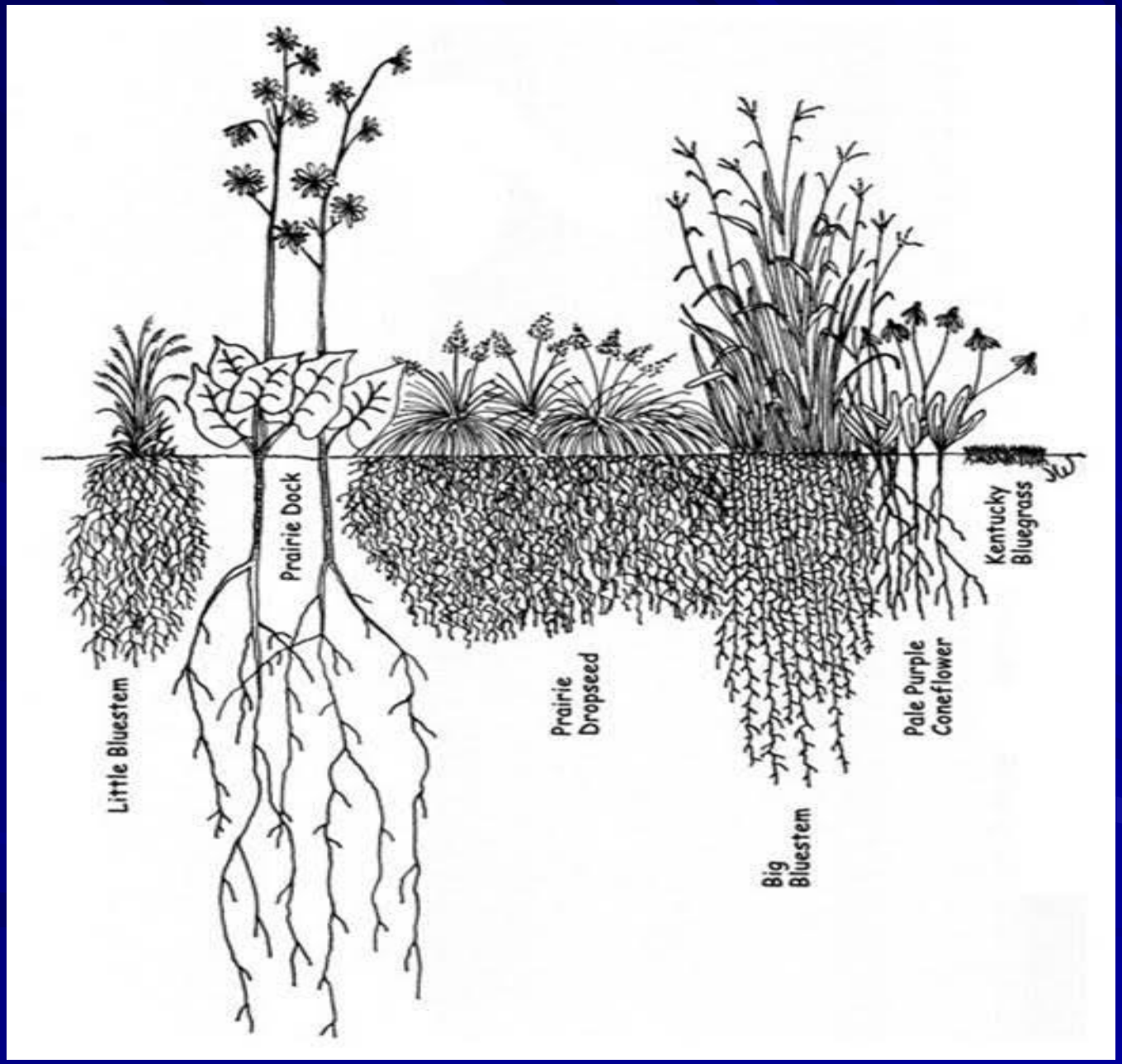
Illinois Grazing Trial

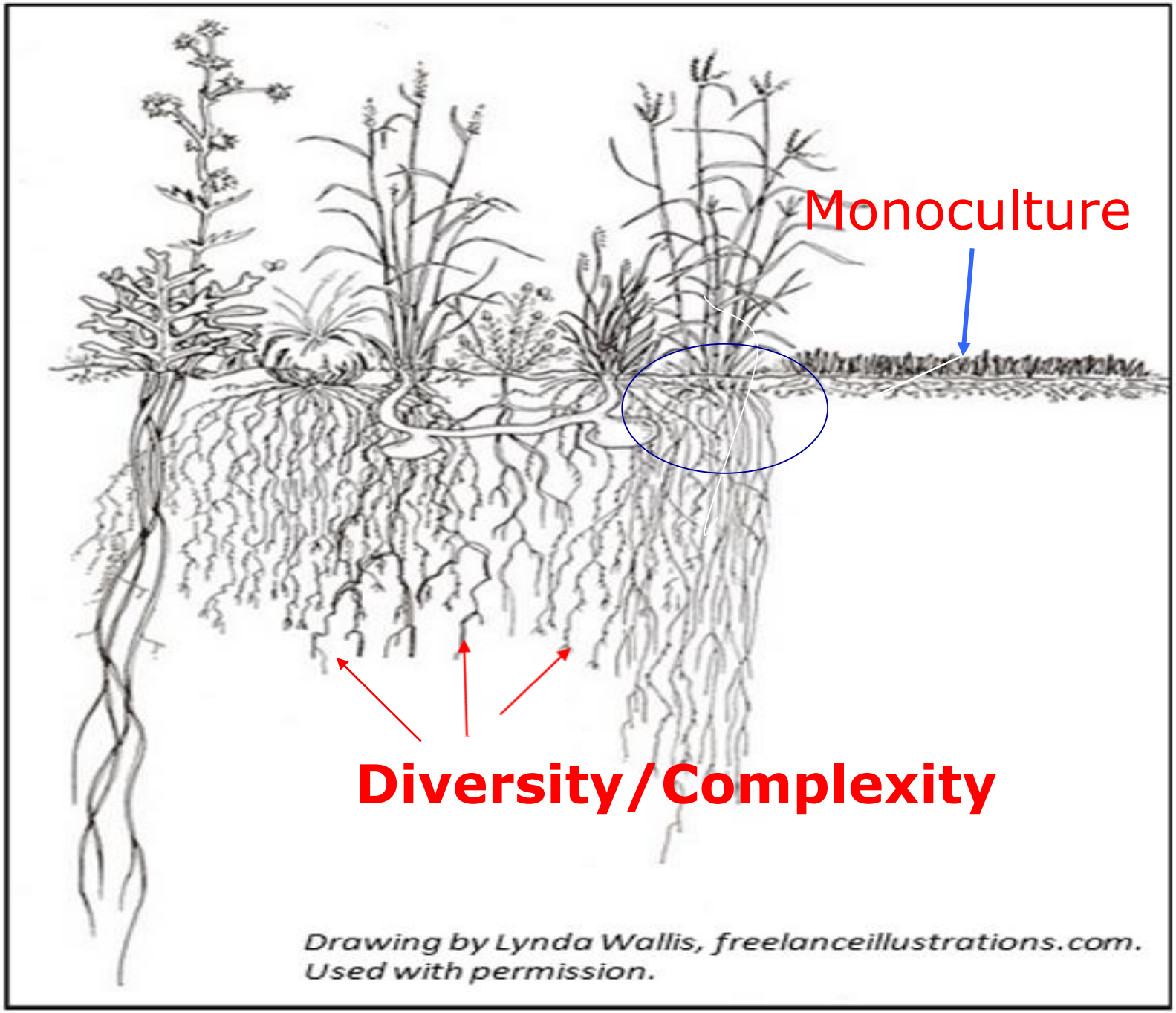
6 inches rain in two days.

2 inches rain night before



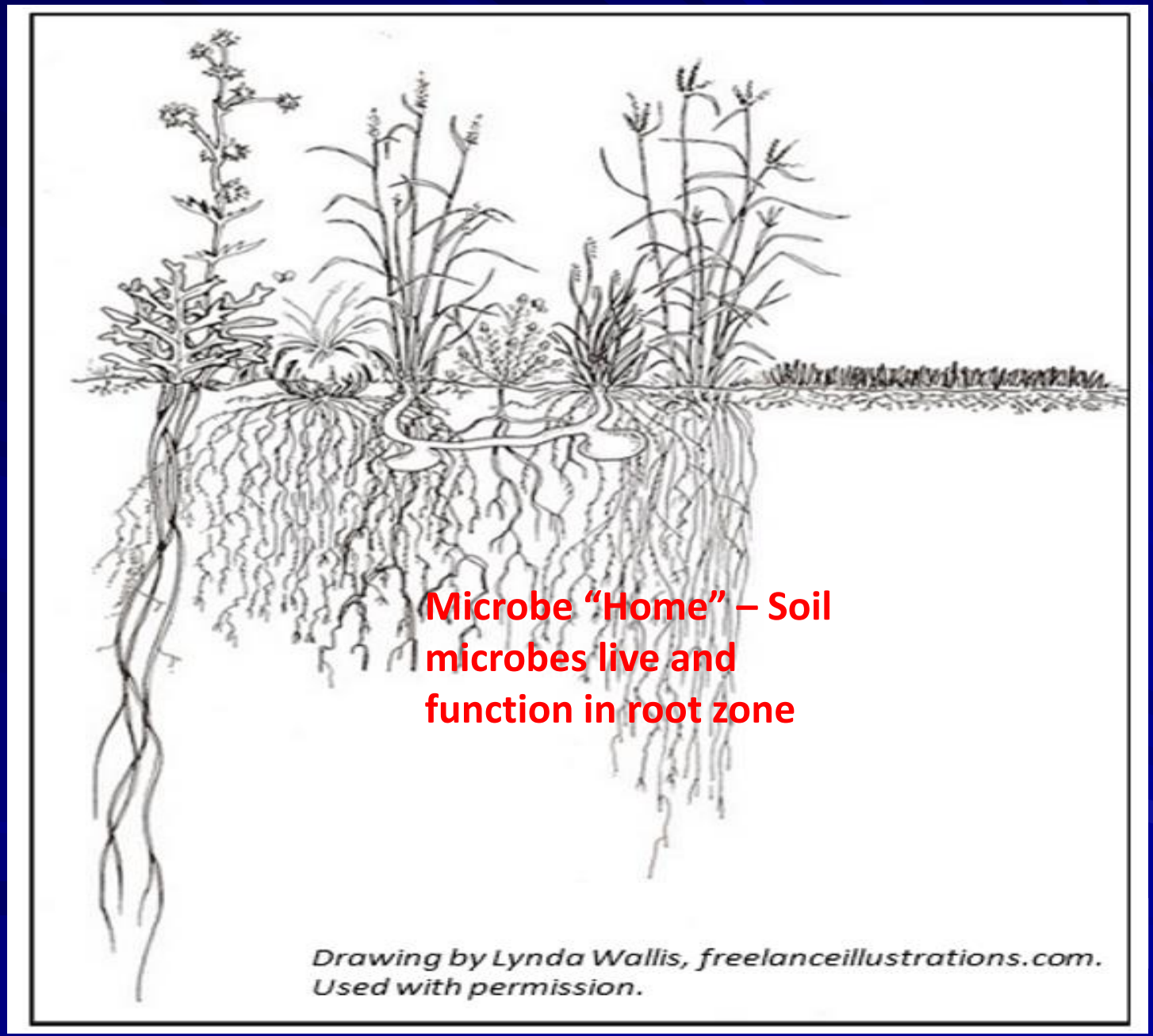

Diversity Is Key


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

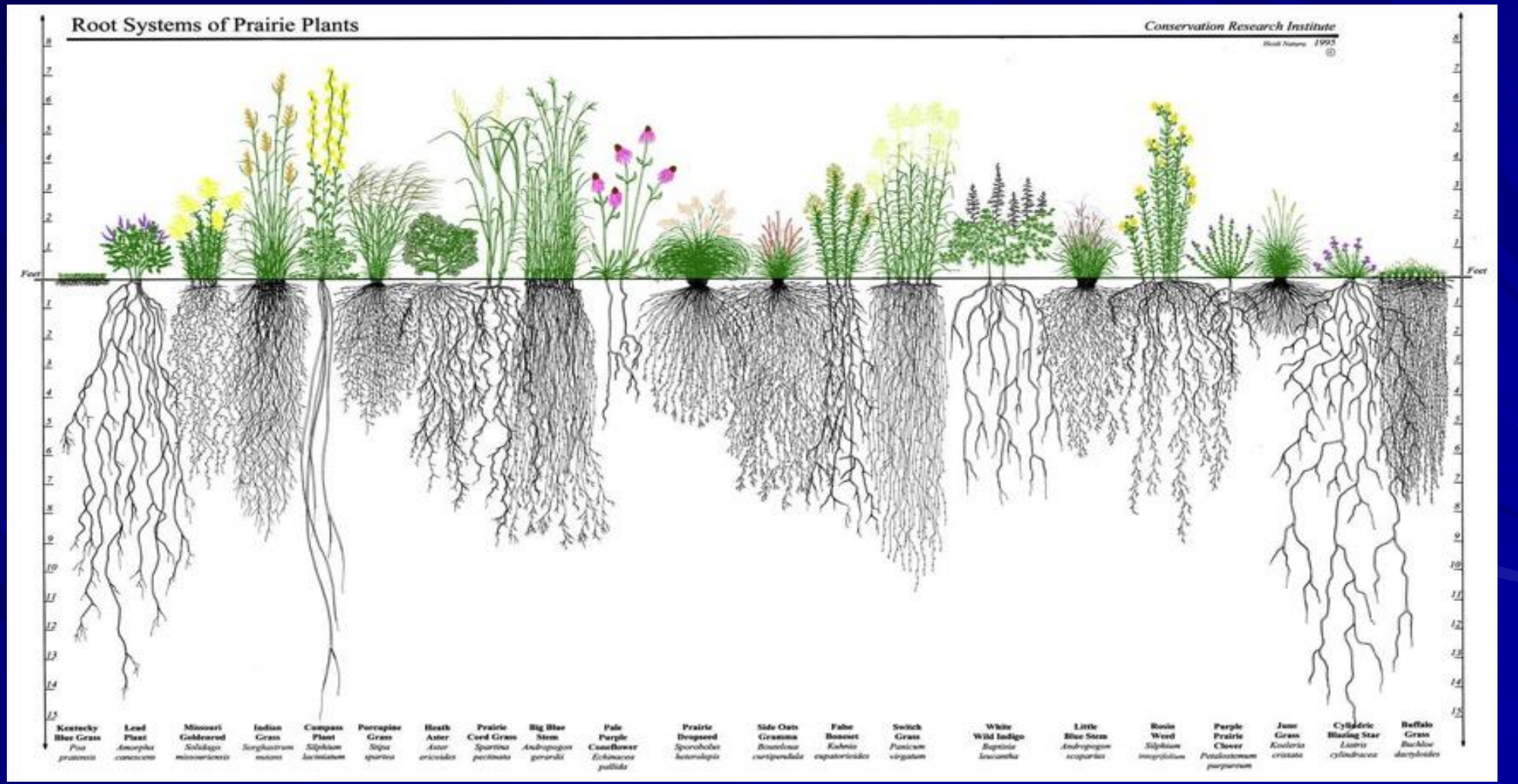

Monoculture
Diversity/Complexity
Drawing by Lynda Wallis, freelanceillustrations.com.
Used with permission.

rce:
ams

Where Do Majority of Soil Microbes Live & Function?

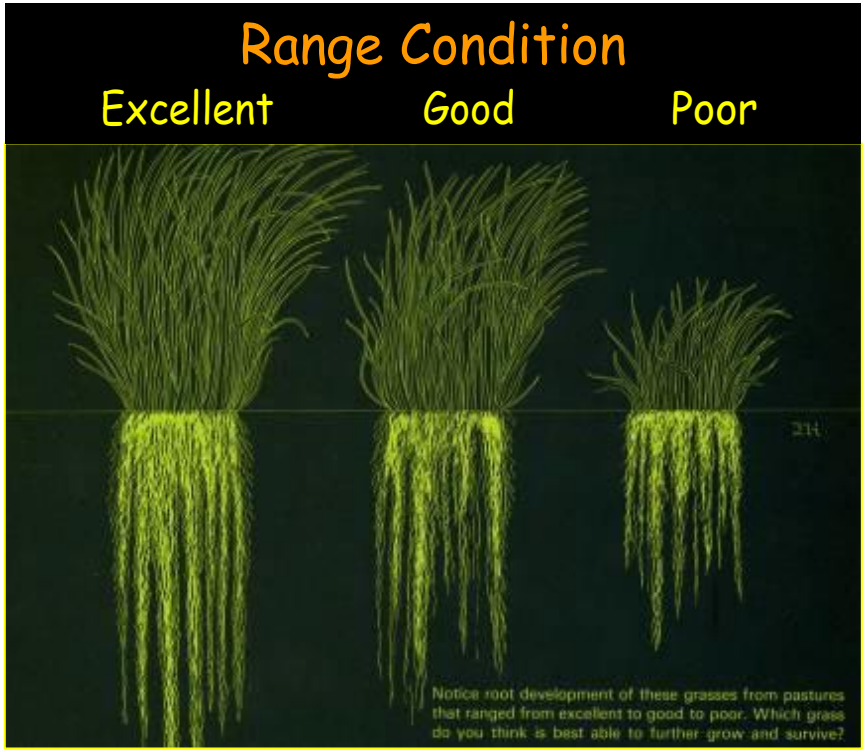

Microbe “Home” – Soil microbes live and function in root zone
Drawing by Lynda Wallis, freelanceillustrations.com.
Used with permission.

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

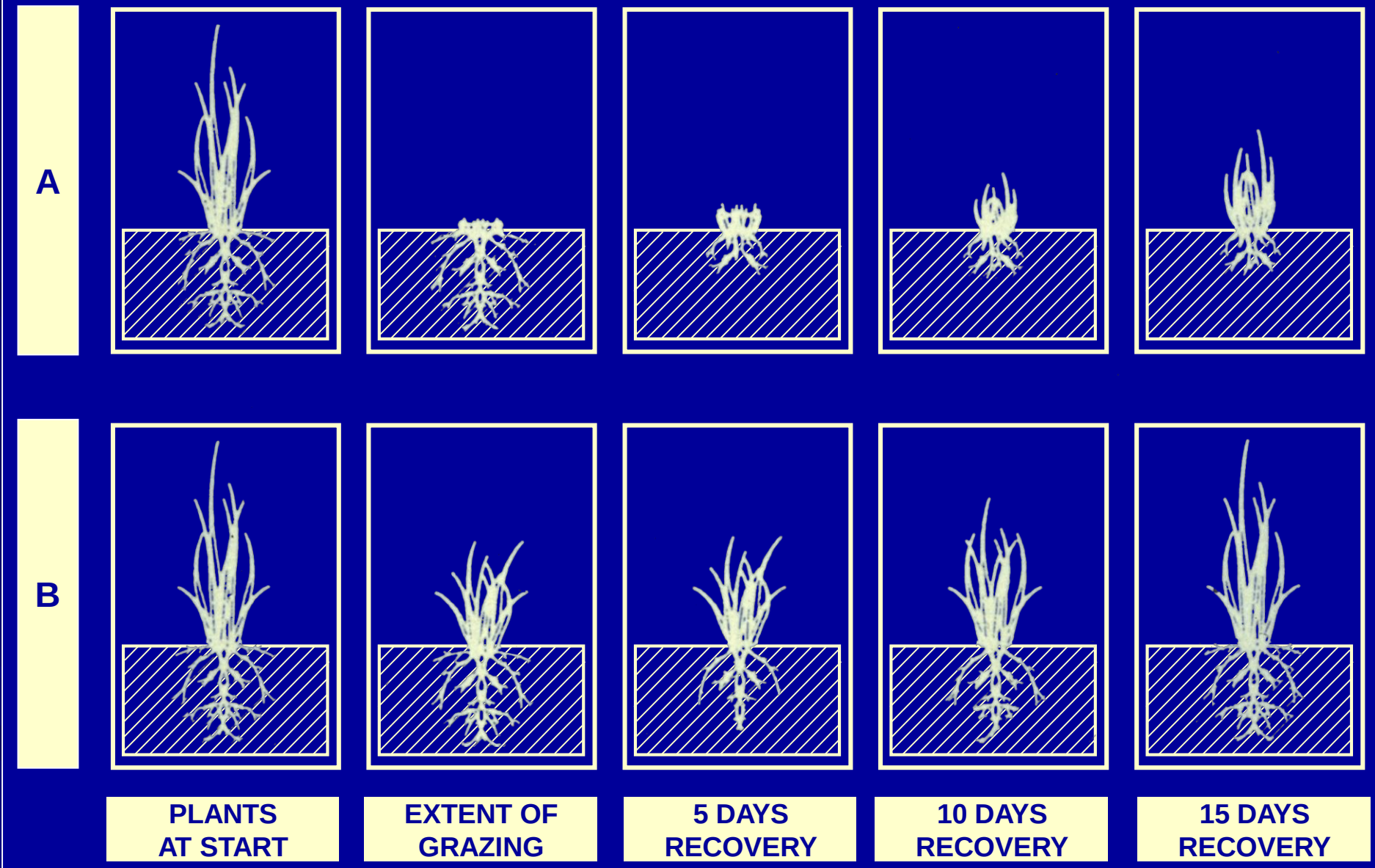


Decrease drought impacts

% 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

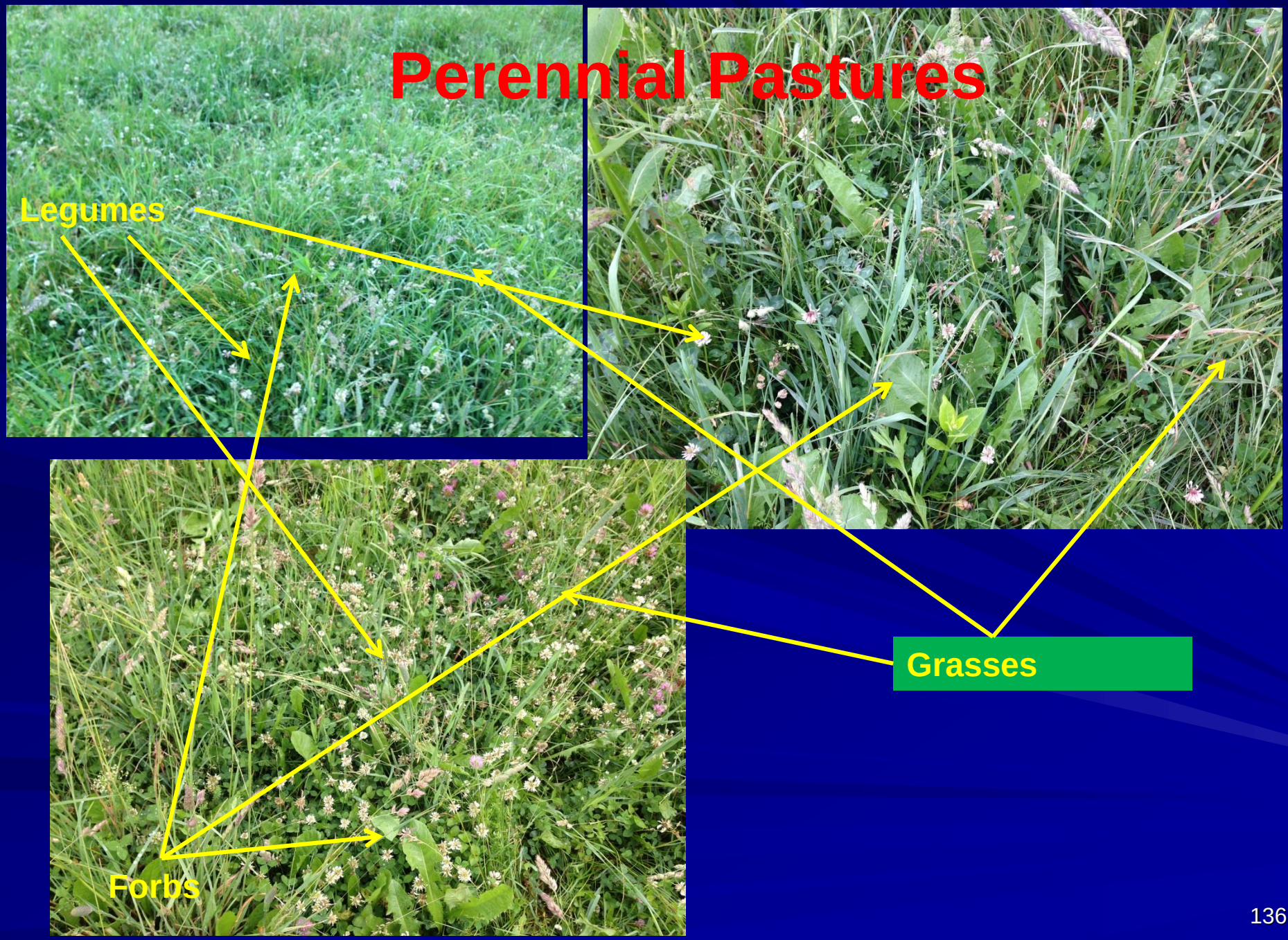

A
B
PLANTS AT START
EXTENT OF GRAZING
5 DAYS RECOVERY
10 DAYS RECOVERY
15 DAYS RECOVERY

Desired Mix

- Rule of Three
  - Grasses
  - Legumes
  - Forbs

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

Perennial Pastures



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, ….

Winter Forage Management

Bale Grazing in Nova Scotia

Winter Stockpile Grazing

Value of Winter Stockpile

Variable	Suggested Value	Sample Value
TDN	>60	65
NFD_d	60-70	62
NE_L	0.65 – 0.70	0.68
RFQ	140-170	179

Millet: 9% CP 50% TDN

Sorghum/Sudan: 12% CP 72% TDN


Hairy Vetch: 18% CP 70% TDN


Radish: 14% CP 70% TDN

BRIX

- Higher Brix – Result of improving SOM and soil microbial populations.

BRIX

- Dissolved plant solids include sugars (such a sucrose and fructans), minerals, amino acids, proteins, lipids and pectins.

- Higher Brix – Result of improving SOM and soil microbial populations.

Simple To Measure

- Can use either Optical or Digital Refractometer.

Digital

Optical

Measuring Brix – Sample Prep

Measuring Brix - Refractometer

Why High Brix in Forages?

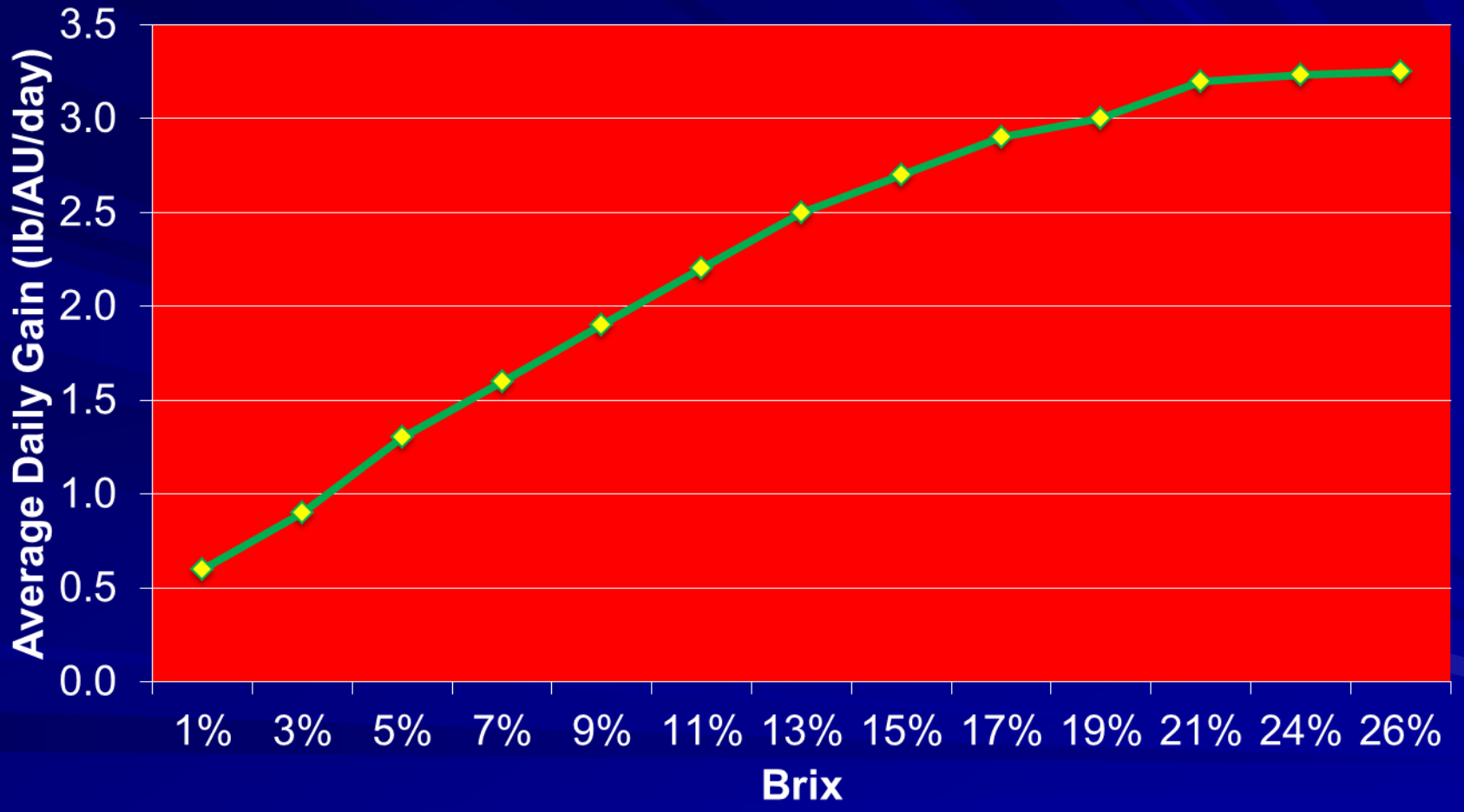
- Research shows
  - increase animal gains
  - Increase Milk/components
- High Brix Forages are:
  - More drought resistant
  - Freeze tolerant,
  - More resistant to plant disease and pests

- References:
- (Moorby, 2001).
- (Moller, 1996).
- (Downing & Gamroth, 2007; Miller, et al, 1999).
- (Allison, 2007).
- (McKenzie, 2007).

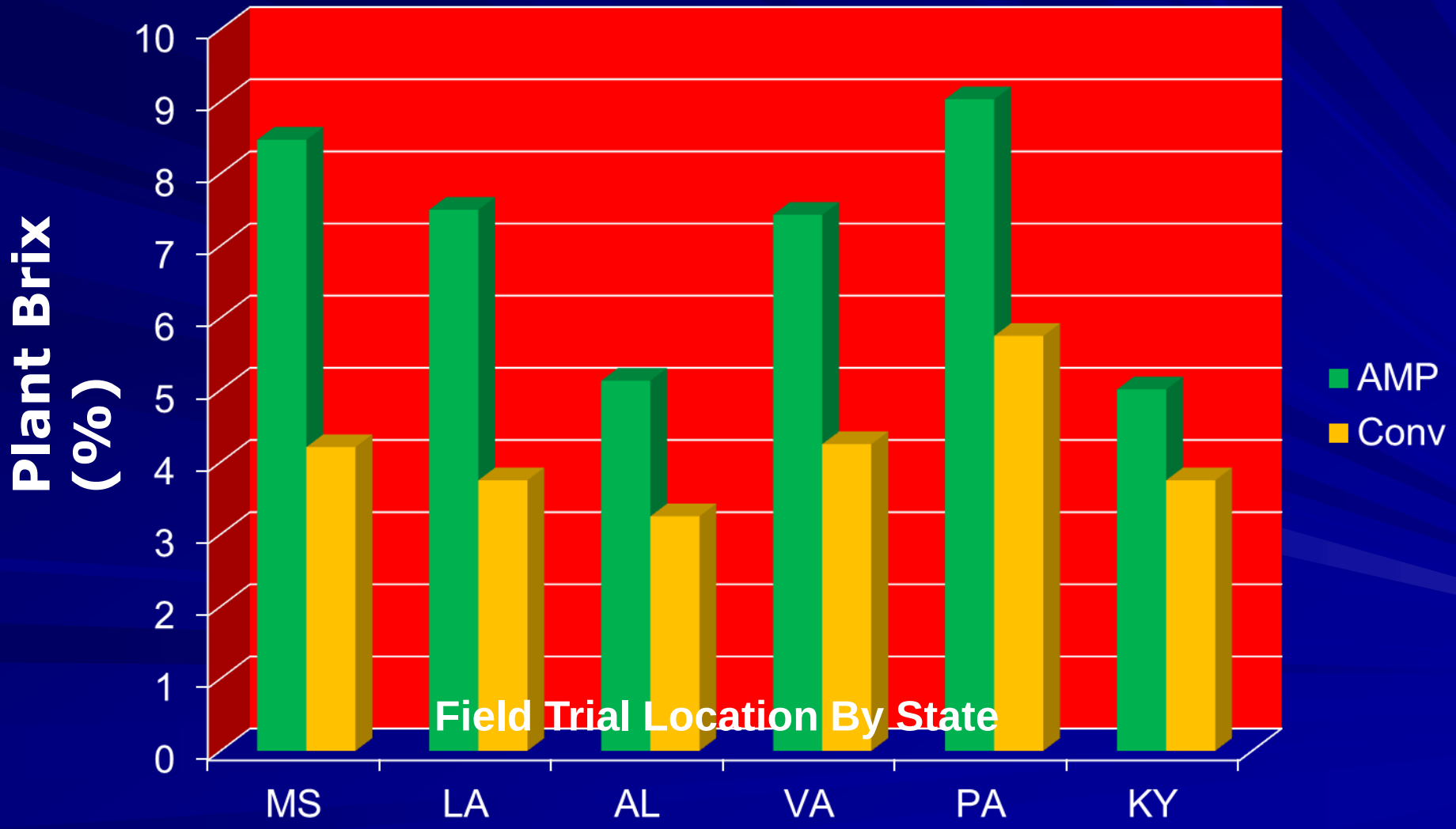
- Brix 5.0% or less = ADG in low 1's.
- Brix 8-12% = ADG in low to mid-2's.
- Brix 12 – 15% = ADG in mid-high 2's.
- Brix > 15% = ADG in high 2's to 3's.
- Every 1.0% increase in Brix adds 0.1 to 0.3 ADG.
- Going from 3% to 6% Brix in dairy pastures adds between 10-20% milk production.

Brix Advantage

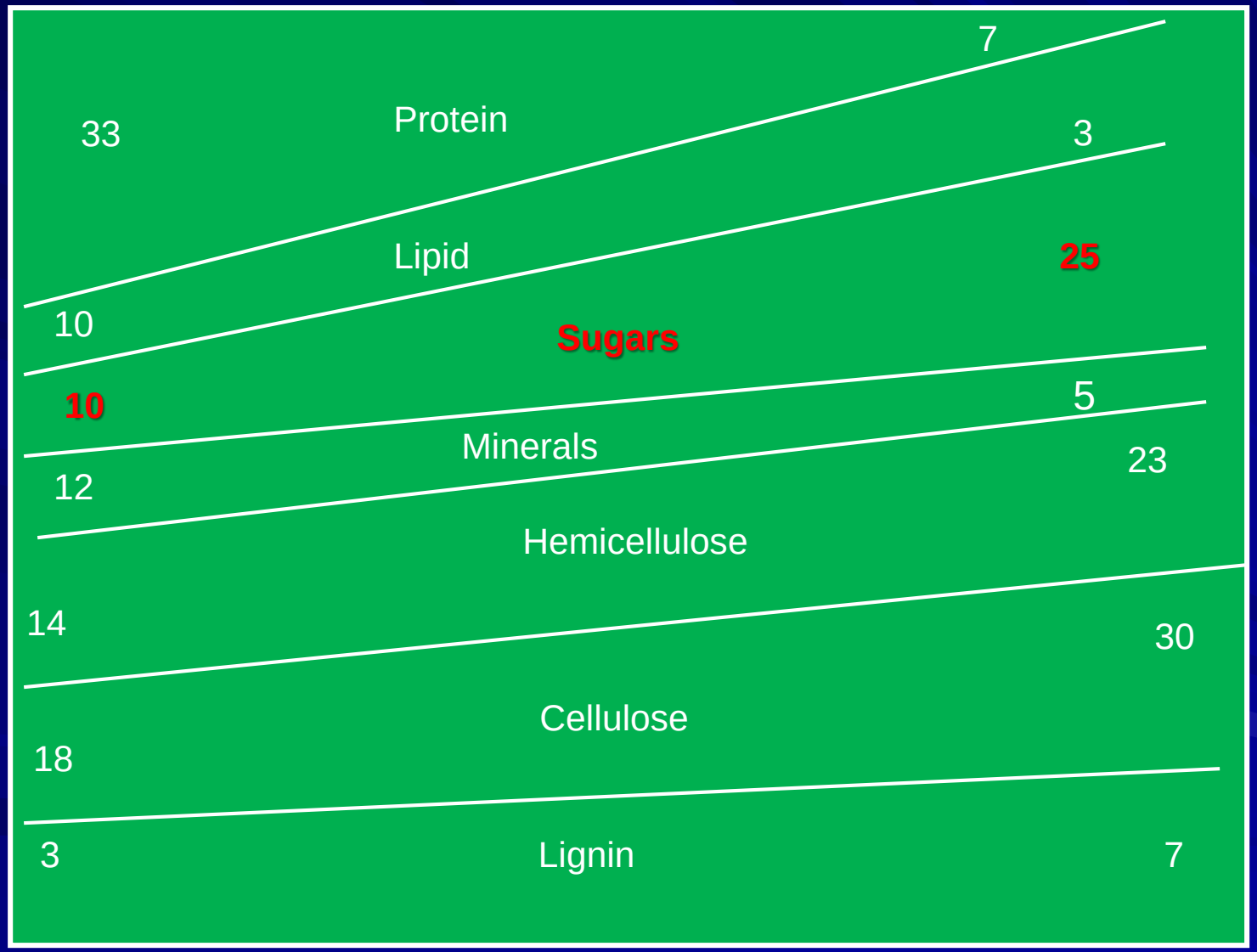
Impact of forage quality on ADG



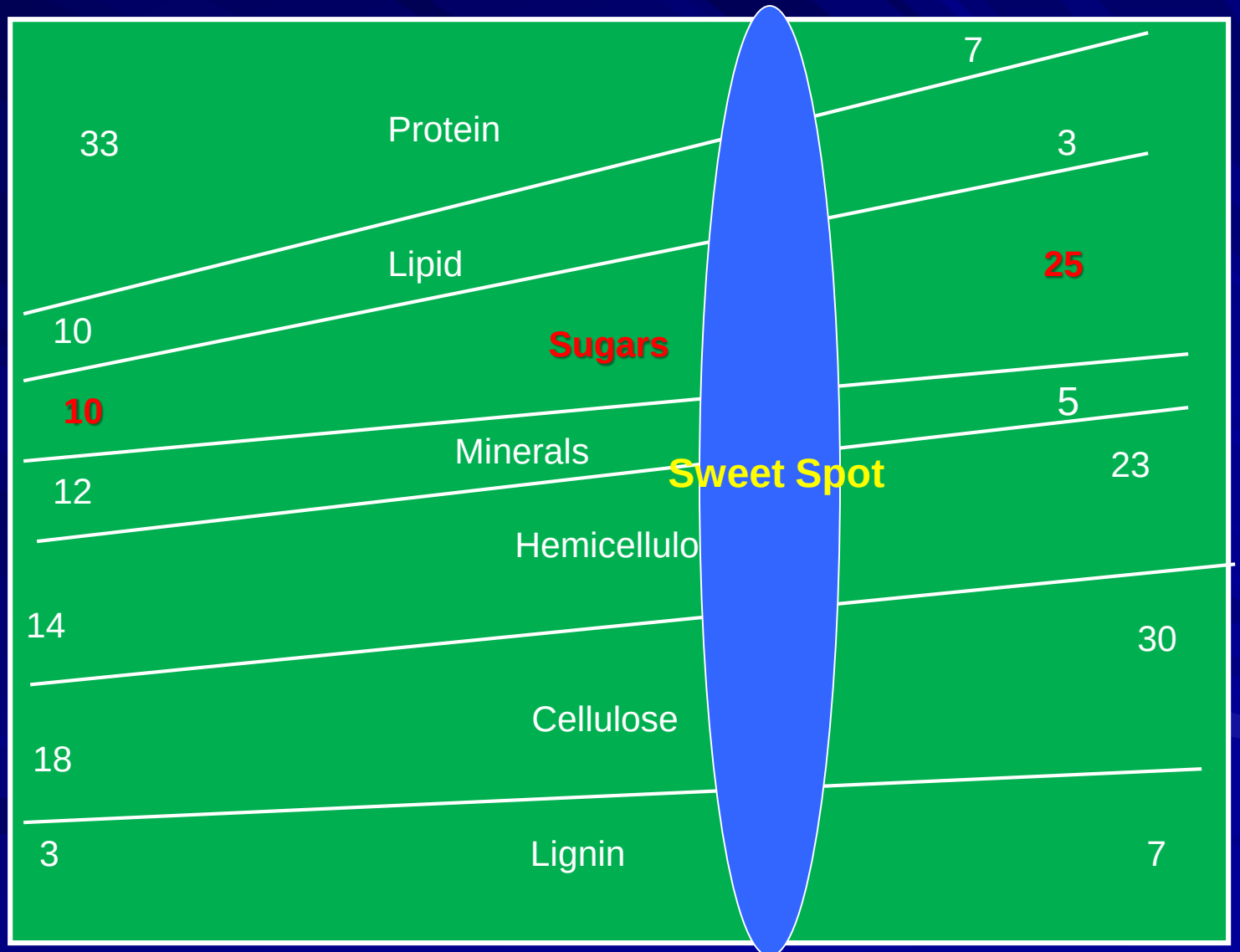
Single Season Forage Brix Impact: AMP Grazing Vs. Conventional Grazing



Effects of Stage of Maturity on Pasture Composition



Effects of Stage of Maturity on Pasture Composition



Too Big to Ignore

- Two Keys to Better Gains:
  - Stage of maturity of forage when grazed
  - Timing of daily moves

  - Paying attention will result in ADG improvements of **0.25 to 0.5 lbs/hd/day**.

Important Grazing Tips

- Know DM availability and allow 3.0% - 3.5% DM per head daily.
- Take no more than 30%- 50% available DM in a single grazing.
- Move forward rapidly to not allow too many bites of the same plant.
- Know the brix content.
- Turn into new paddocks in early to mid-afternoon (peak brix or plant sugars).
- Stage of forage maturity critical – Mid-stage to slightly beyond…

Future of Agriculture

- More Stacked Enterprises
  - Multispecies livestock
  - Beekeeping, beneficial insect raising
  - Integration of higher value crops
    - Specialty grains
    - Fruits and nuts
    - Vegetable and herbs
  - Recreational & entertainment
  - On Farm restaurants, cooking & canning schools, etc….

Stock Density Calculations

- If you have 3000 lbs per acre of available forage DM and want to utilize 50% and leave 50% trample:

- 3000 x 50% = 1500 lbs DM available for 24 hour period.

Stock Density Calculations

- Assume 100 head of 1200 lb lactating beef cows.
- Assume 3.5% DM consumption needed daily.
- 1200 x 3.5% = 42 lbs forage DM/hd/day.
- 100 x 42 = 4200 lbs DM needed daily for herd.

Stock Density Calculations

- If you have 1500 lbs DM available per acre and need 4200 lbs DM daily, then average paddock size:

- 4200/1500 = 2.8 acres needed per day.
- Total Pounds = 1200 x 100 = 120,000 lbs
- Stock Density/Acre = 120,000 lbs/2.8 = 42,857 lbs/acre.

Stock Density Calculations

No. Moves Per Day	Stock Density Per Acre (lbs/ac)	Paddock Size (acres)
1	42,857	2.8
2	85,714	1.4
3	128,571	0.93
4	171,428	0.7
5	214,285	0.56
10	428,570	0.28