Grazing for Healthy Soils

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5 Principles of Building Soil Health

1. Armor the soil
2. Minimize soil disturbance
3. Increase plant diversity
4. Keep living roots in the ground all year
5. Utilize livestock grazing

Armor the Soil

- Bare Ground is enemy number 1
  - Increases soil temperature
  - Reduces biological activity
  - Reduces infiltration
  - Increases erosion
  - Reduces energy flow - photosynthesis

Soil Temperature

Soil Temperature

When soil temp reaches. . .

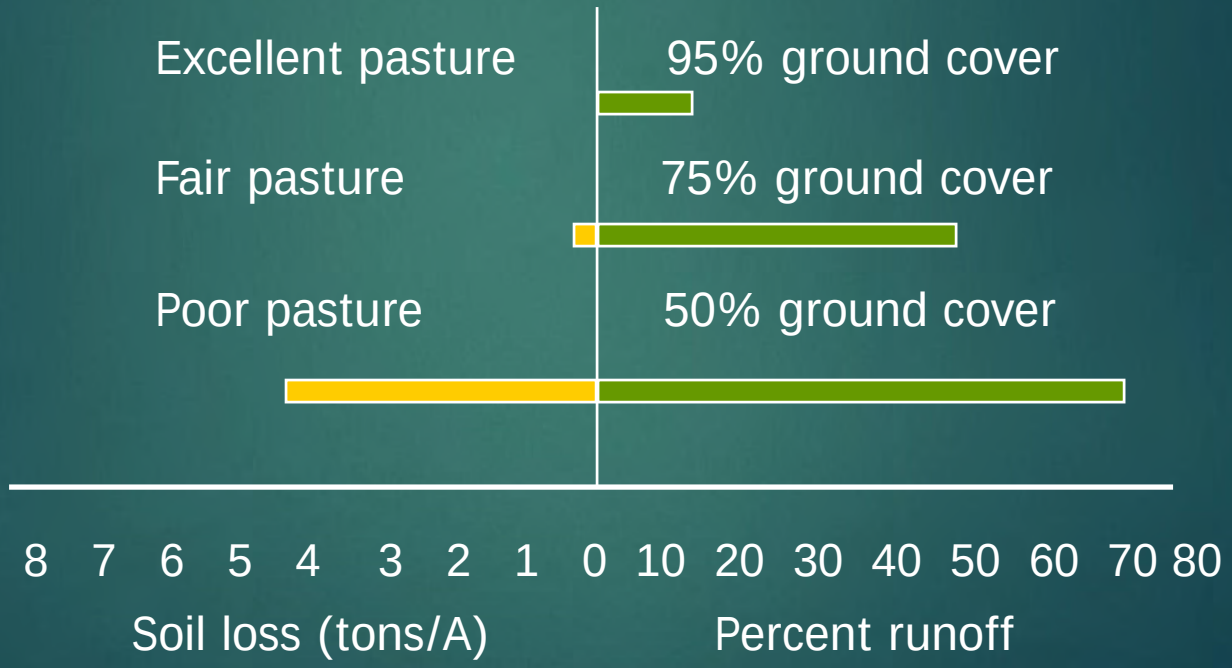
140° F	Soil bacteria die
130° F	100% moisture lost through evaporation & transpiration
100° F	15% moisture is used for growth 85% moisture lost through evaporation & transpiration
70° F	100% moisture is used for growth

J.J. Mc Entre, USDA SCS, Kerrville, TX, 1956

Infiltration and Runoff

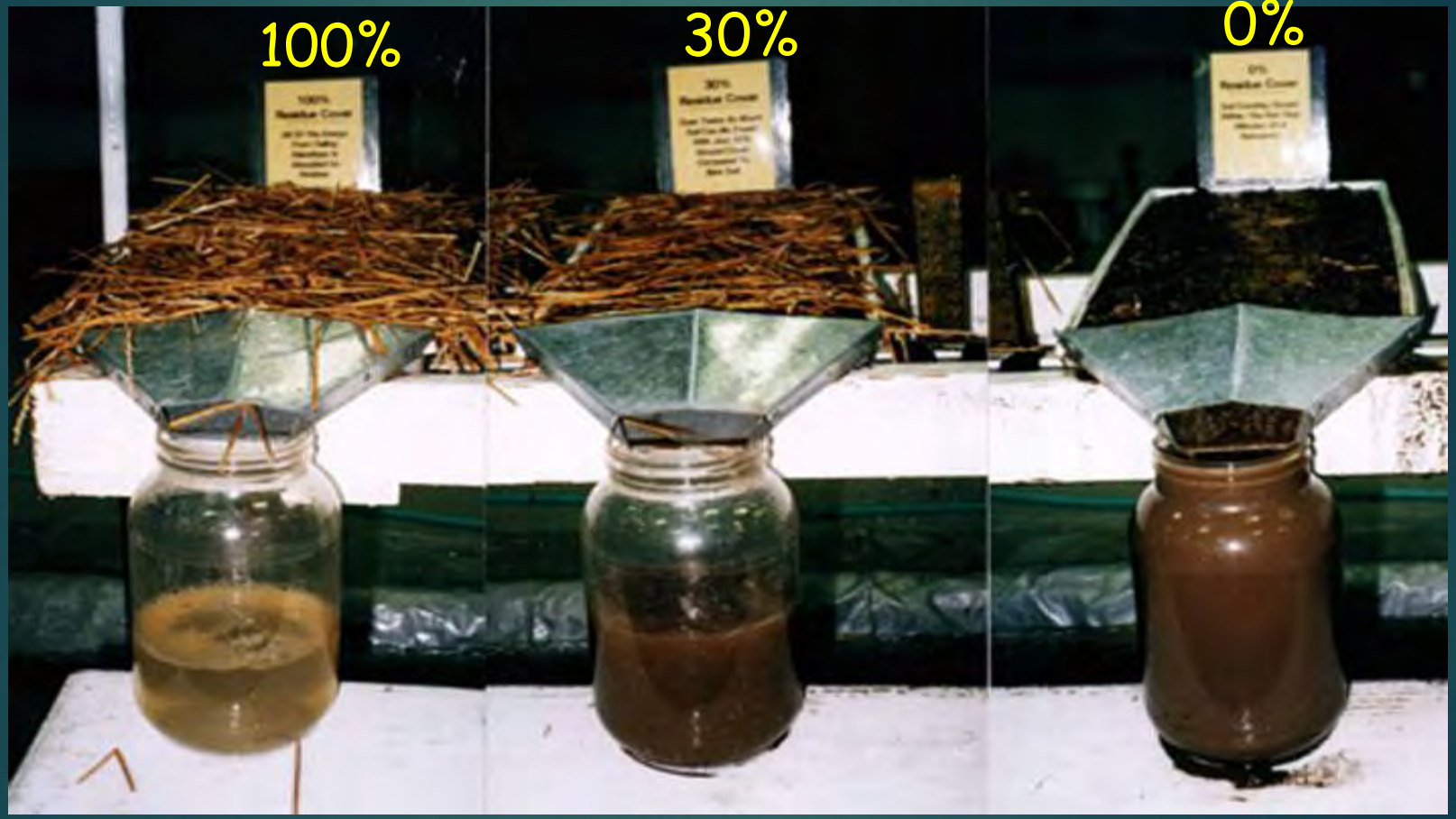
3 inches of rainfall in 90 minutes, 10% slope, silt loam soil

(University of Nebraska & USDA-SCS, 1937)

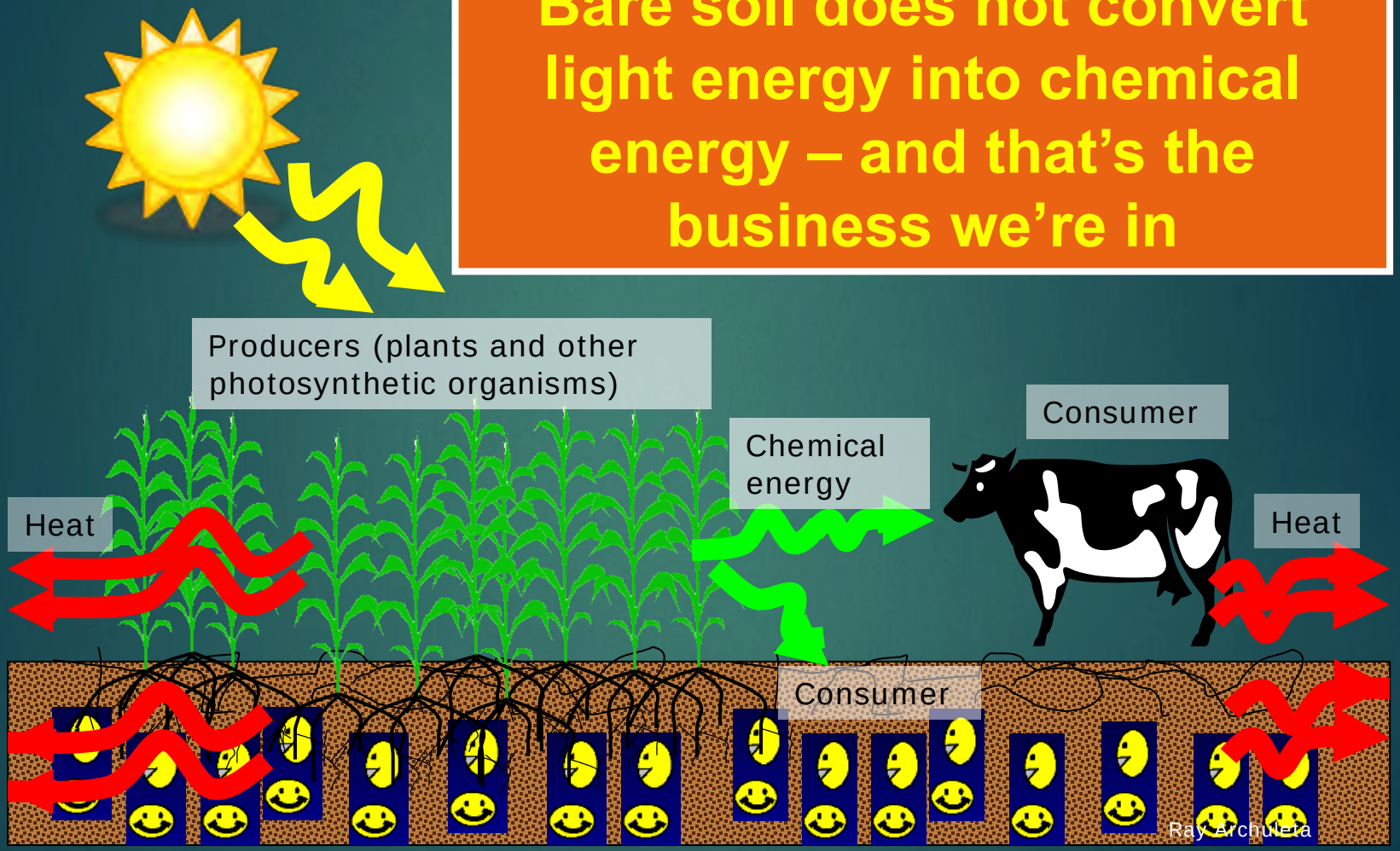


Rainfall simulator test run

Soil Cover %

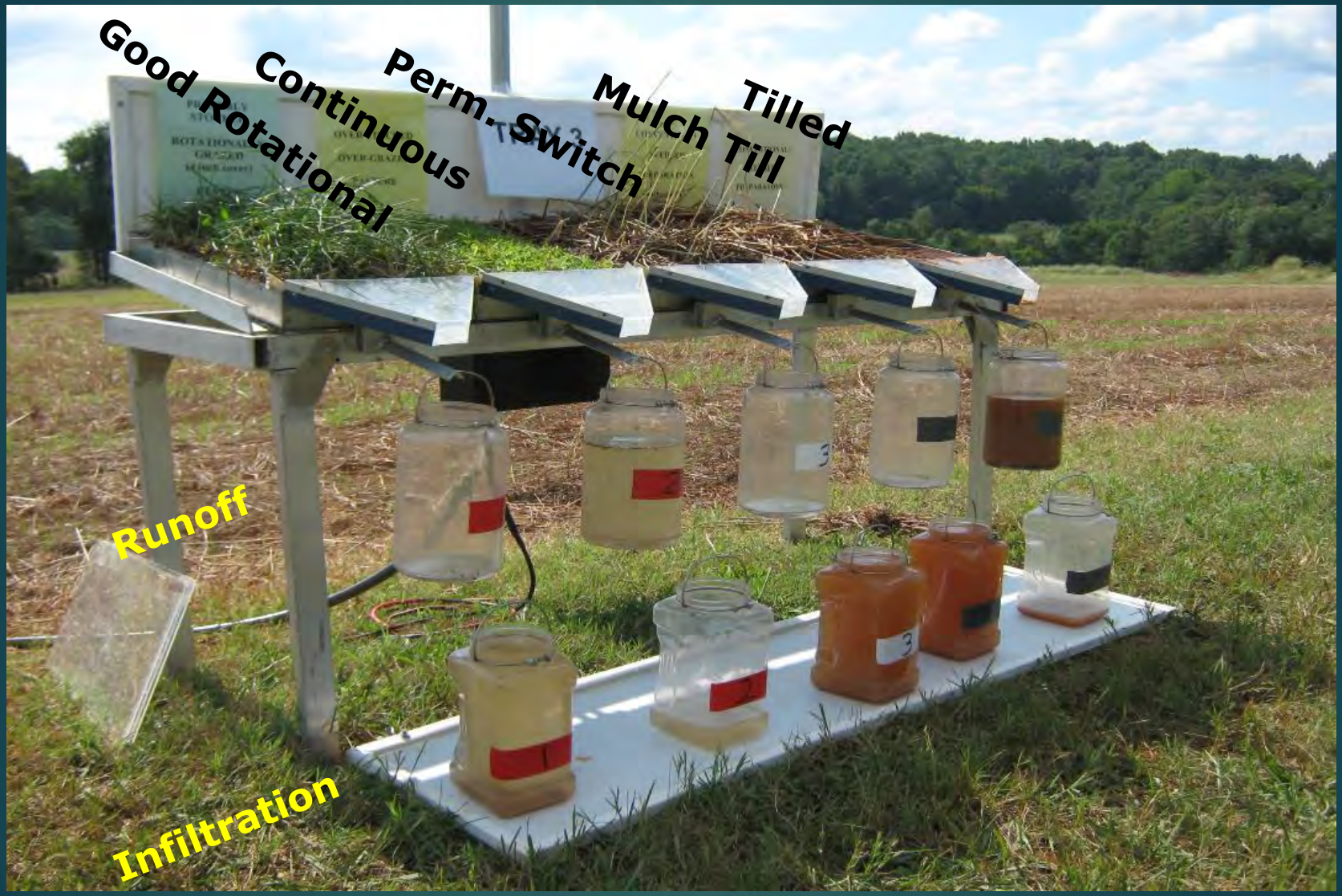


Bare soil does not convert light energy into chemical energy – and that's the business we're in



Minimize Soil Disturbance

- Tillage, Grazing and Haying are all disturbances
  - Overgrazing, plowing and continual haying
    - Result in more bare ground
    - Reduces root growth
    - Stimulates first responders – WEEDS
    - Destroys soil pores by shearing and compacting
    - Increases soil temperature
    - Diminishes the soil's ability to respire
    - Disrupts the habitat of soil microorganisms


Good Rotational
Continuous
Perm.-Switch
Mulch Till
Tilled
Runoff
Infiltration

Overgrazing: another source of disturbance

Chemical disturbances: excessive amounts or overuse of pesticides, fertilizers and manures

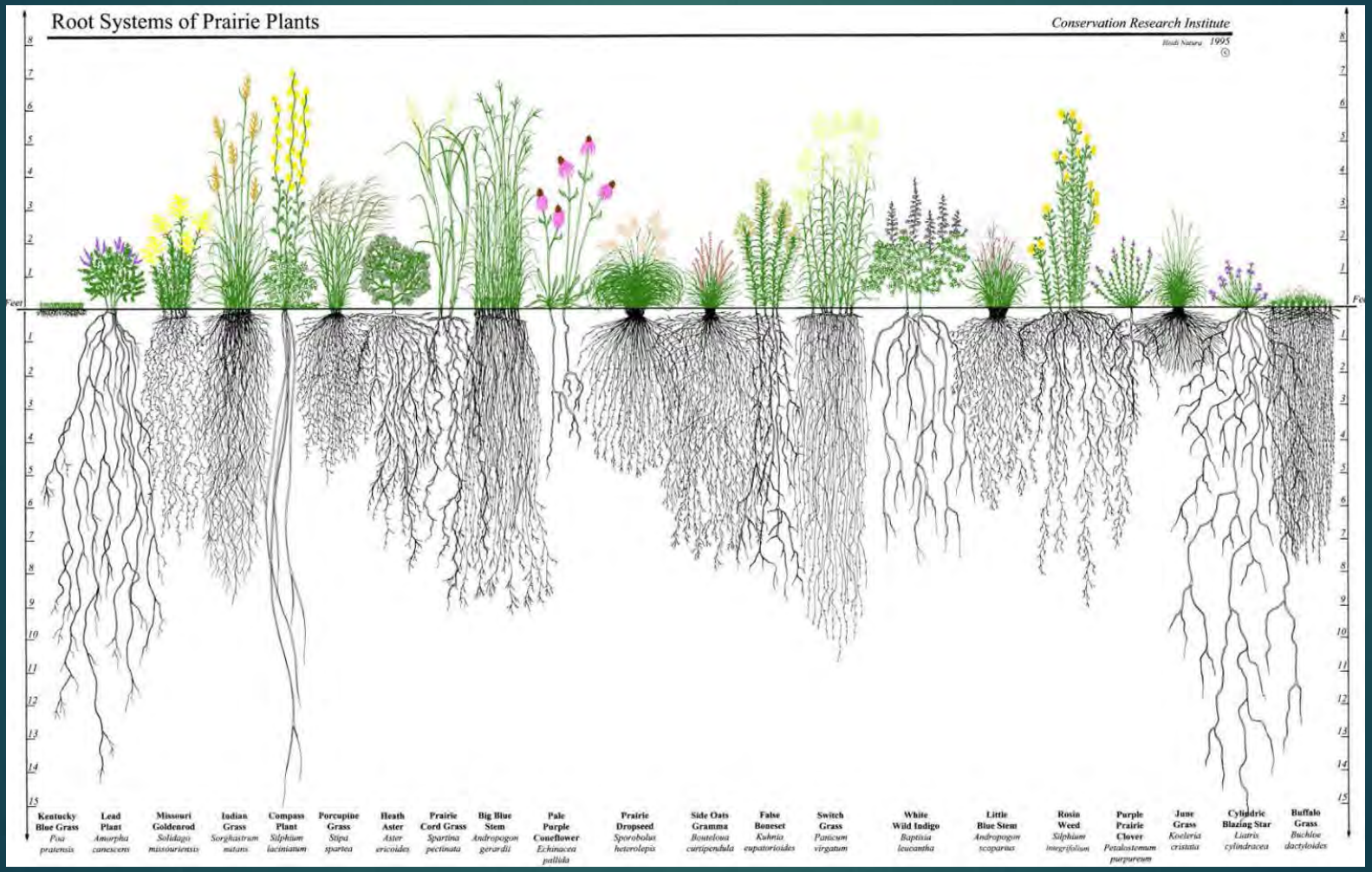
Increase Plant Diversity

- Allows for a more diverse root system
- Allows for a more diverse soil biology
- Captures more solar energy
- More productive
- Provides insurance against disease, pests, and weather

What does diversity really mean?

- Cool Season Grass
- Warm Season Grass
- Cool Season Broadleaf
- Warm Season Broadleaf

Plant Diversity

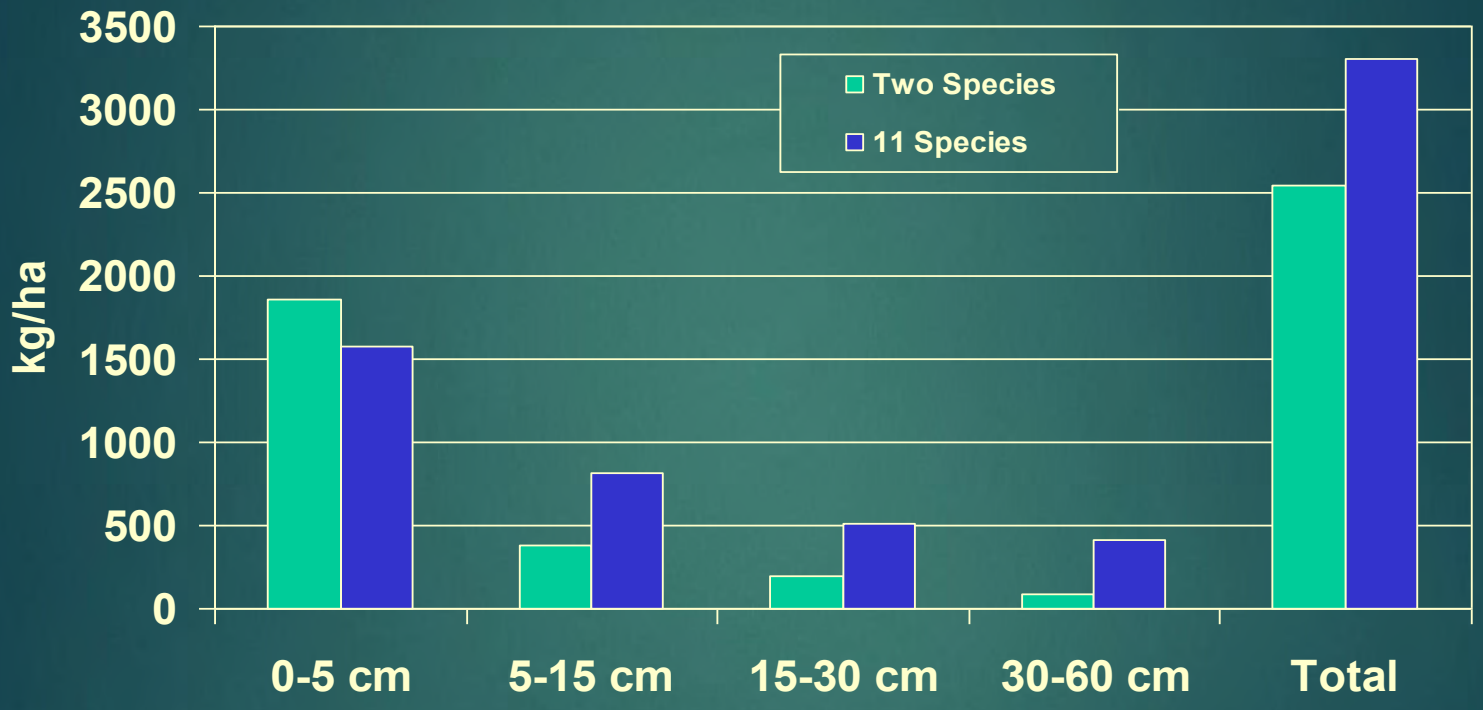


Soil Fertility

Depth	Ca	Mg	K	OM	pH(salt)
0-8	4560	484	234	3.5	6.1
8-13	2480	580	156	1	4.4
13-21	4600	1210	312	.86	4.3
21-28	4960	1355	312	.69	4.4
28-43	5120	1258	156	.34	4.9
43-51	6560	1452	78	.34	6
51-67	18360	871	78	0	7.6
67-74	17360	992	78	.17	7.6
74-78	15960	1065	78	0	7.7

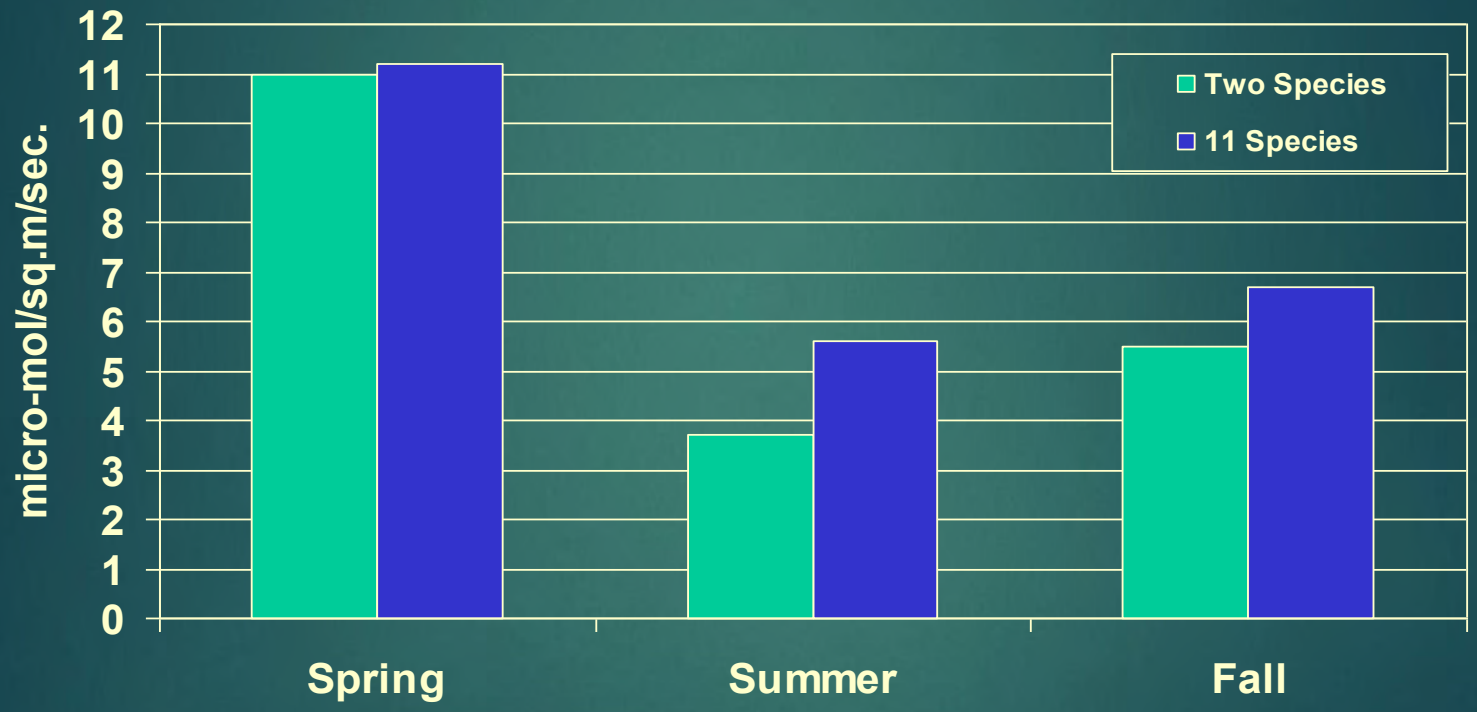
NRCS Pedon M0717103, Armstrong, Putnam County

Root mass of simple and complex mixtures



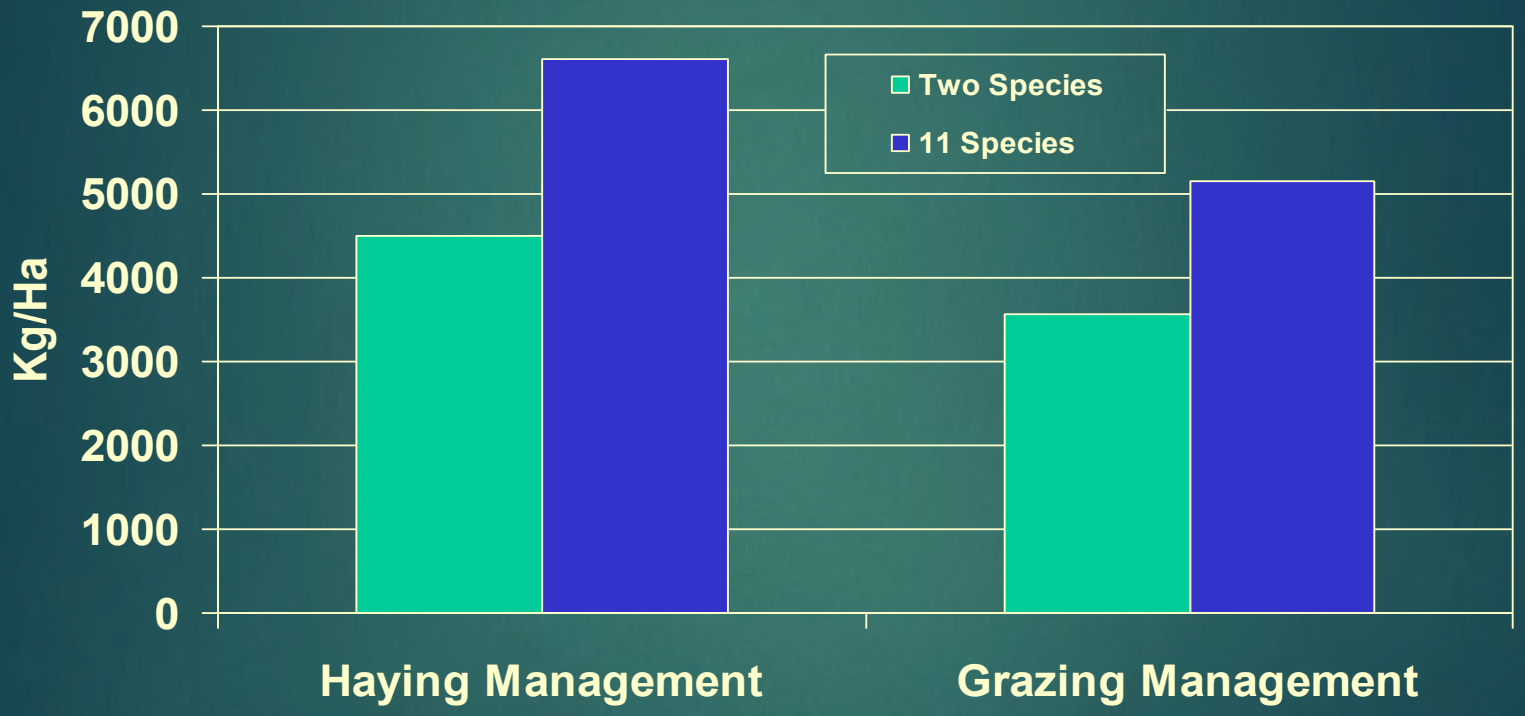
Data from Skinner et al. 2006 Agronomy J.

Photosynthesis in simple and complex mixtures



Data from Skinner et al. 2006 Agronomy J.

Forage Yield in simple and complex mixtures



Data from Skinner et al. 2006 Agronomy J.

Keep Living Roots in the Soil All Year

- Living roots provide a food source for beneficial bacteria
- Promotes the symbiotic relationship between plant roots and mycorrhizal fungi
- Soils are most productive when soil microbes have access to living plant roots
- Plant diversity keeps more living roots in the soil year round
- Grazing management affects root growth

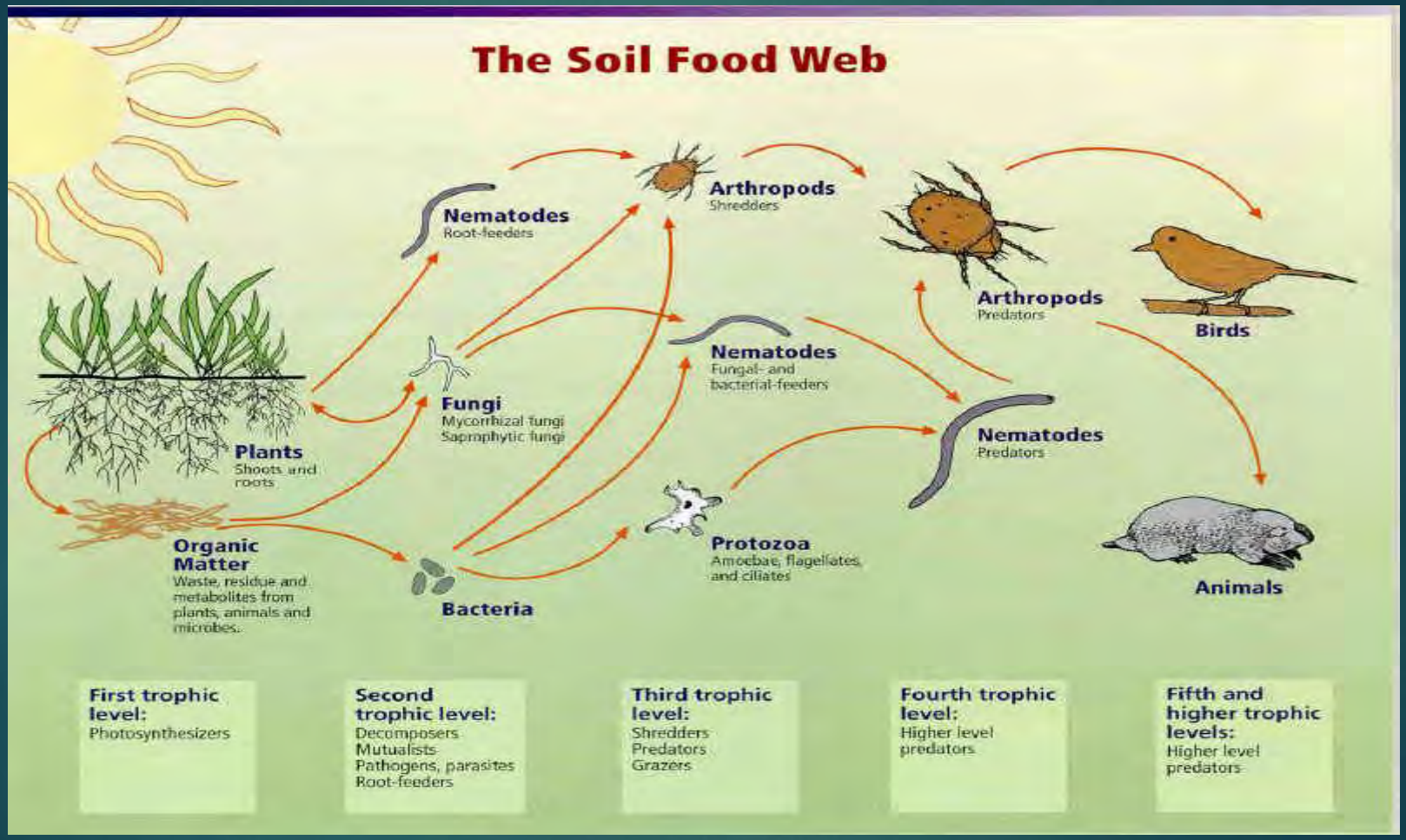
Leaf Removal Affects on Corresponding Root Growth

% Leaf Removed	% Root Growth Stopped
10	0
20	0
30	0
40	0
50	2 to 4
60	50
70	78
80	100
90	100

Depth of Rooting under Rotational Grazing and Continuous Grazing Systems

Bath County, Kentucky

Feed your Soil Livestock All Year Long



Soil Livestock

Type of Organism	number/acre	pounds/acre
Bacteria	800,000,000,000,000,000,000	2,600
Actinobacteria	20,000,000,000,000,000	1,300
Fungi	200,000,000,000,000	2,600
Algae	4,000,000,000	90
Protozoa	2,000,000,000,000	90
Nematodes	80,000,000	45
Earthworms	40,000	445
Insects /arthropods	8,160,000	830

Soil Food Web

8,000

Number one food source of most soil organisms is a living root.

Living roots release many types of organic materials into the rhizosphere around the surface of the root

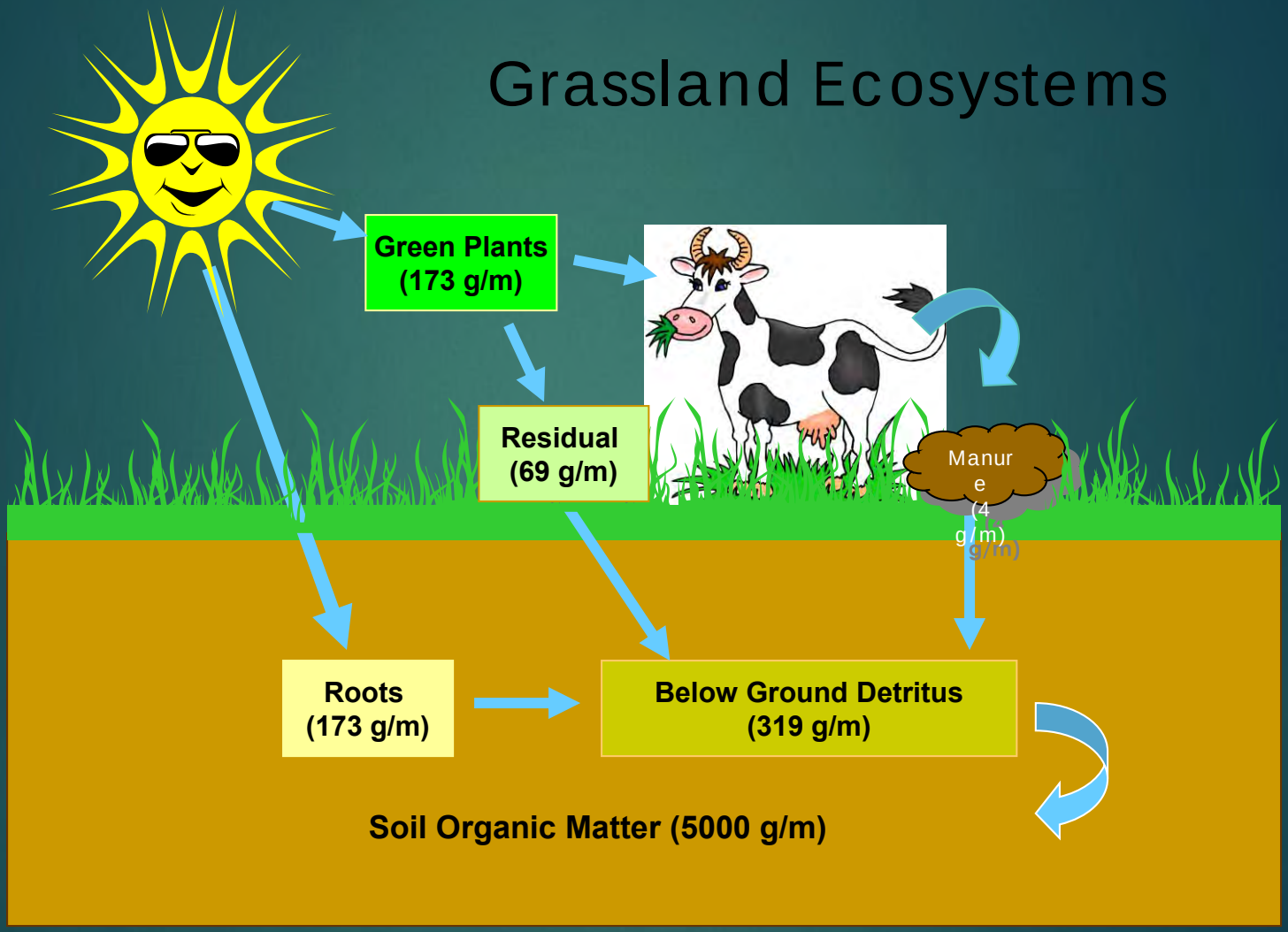
Utilize Livestock Grazing

- Grazing Management is the key to healthy soils on grassland
- Grazing Management Influences:
  - Vegetation cover
  - Species composition
  - Nutrient cycling
  - Soil organic matter
  - Soil biology
  - Soil compaction
  - Infiltration

Using your animals to manage the Pasture Ecosystem

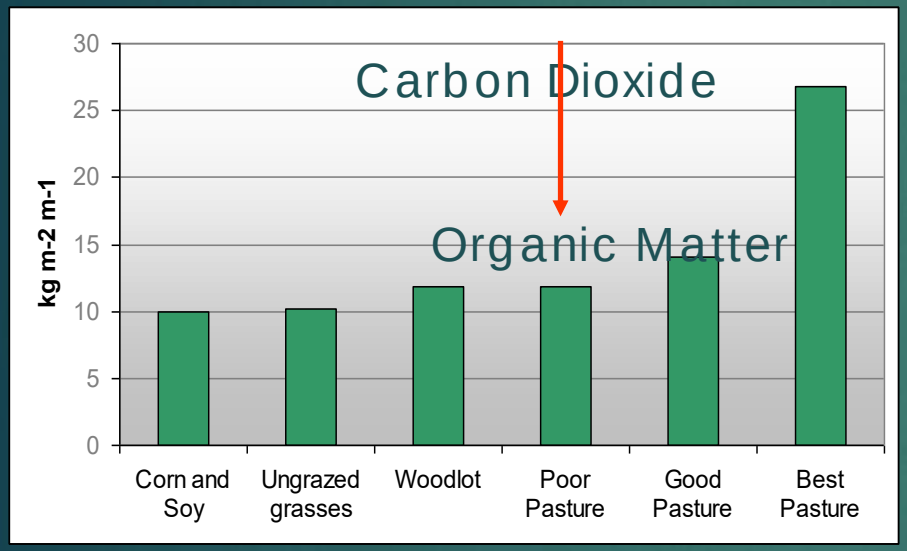
- Pasture species diversity
- Grazing management
  - Grazing Height
  - Residual Height
- Soil health, fertility & nutrient cycling

Grassland Ecosystems



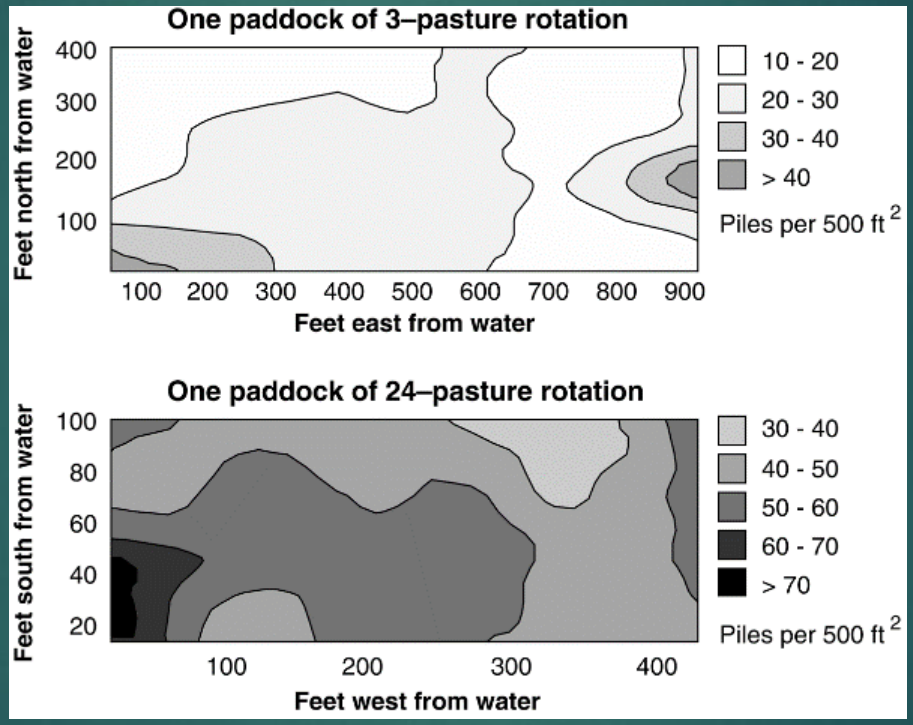
Manure is Food (energy)!

Grazed land stores more carbon.



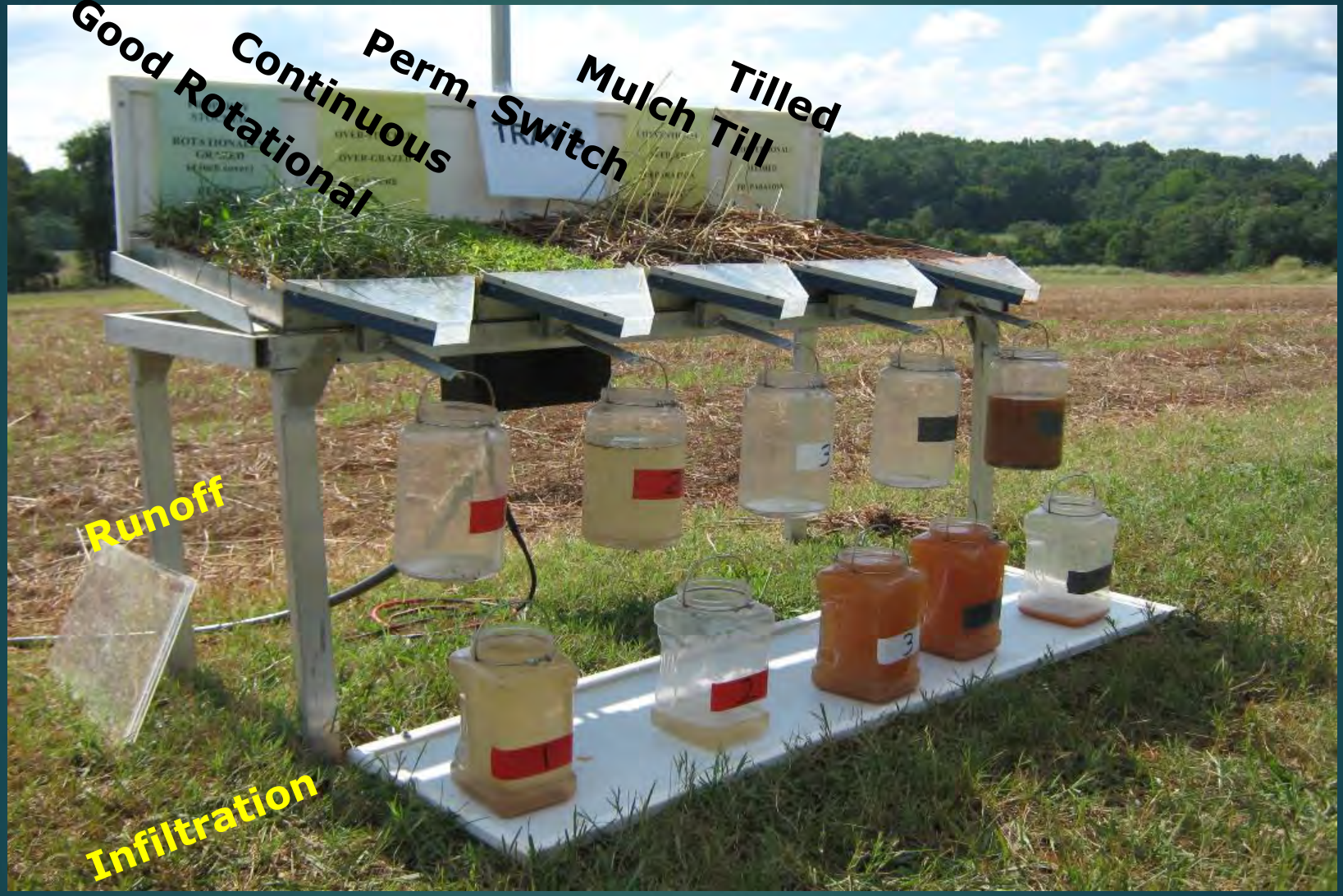
Iowa State University 2002

Improved Manure Distribution



Improved Manure **Distribution**

Roation Frequency	Years to get 1 pile / sq. yard
Continuous	27
14 day	8
4 day	4-5
2 day	2


Good Rotational
Continuous
Perm. Switch
Mulch Till
Tilled
Runoff
Infiltration

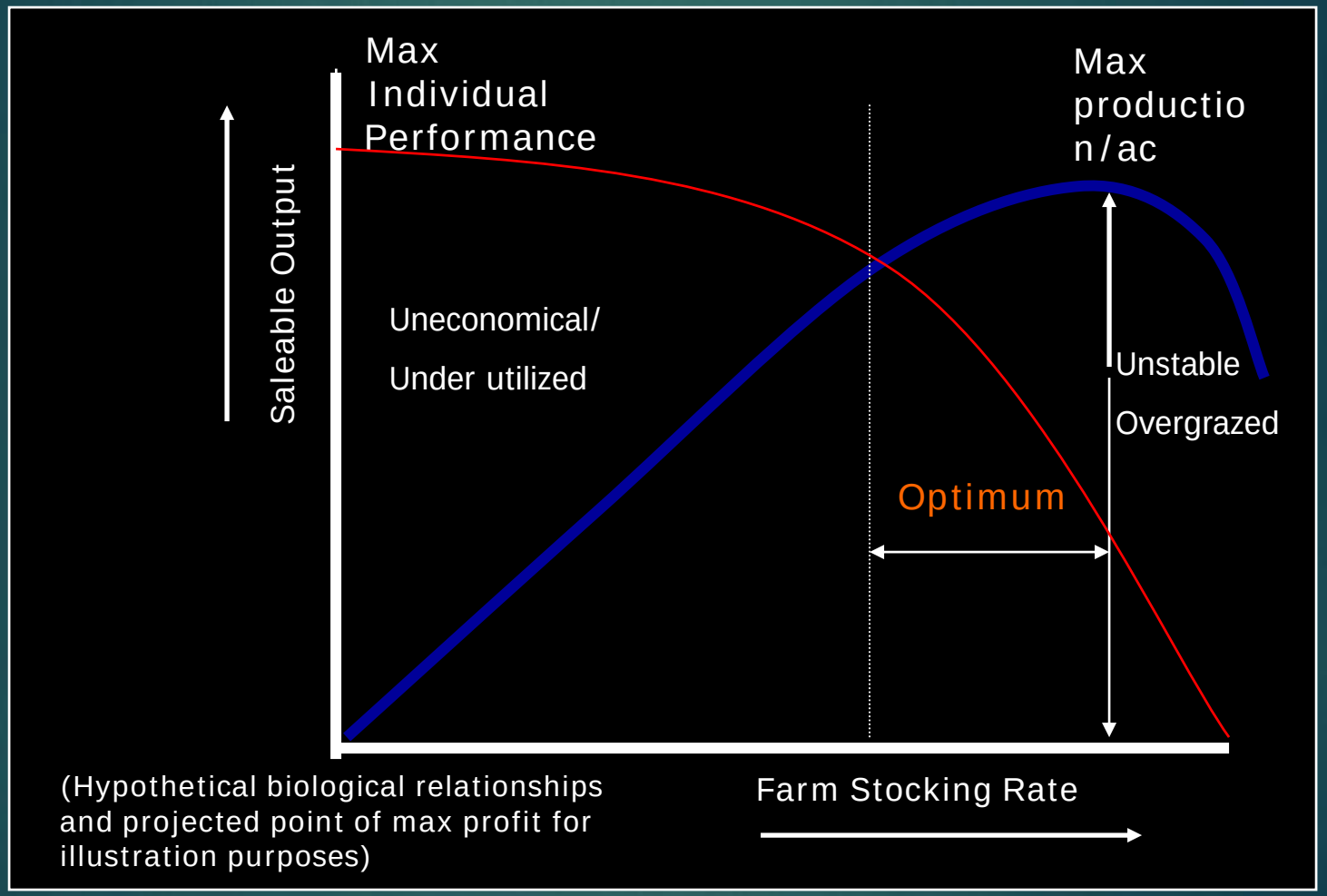
What can we manage?

- Livestock Number (stocking rate)
- Grazing heights
- Recovery periods
- Grazing periods

Balance Livestock Numbers with Forage Supply

- Stocking rate: The number of animals or animal liveweight assigned to a grazing unit on a seasonal basis.
- Carrying capacity: The stocking rate that provides a target level of performance while maintaining the integrity of the resource base.

Stocking Rate Effects



Proper Grazing Heights/Residual

- The amount of residual left in a pasture after each grazing affects:
  - Root system
  - Health and vigor of plants
  - Photosynthesis/rate of plant regrowth
  - Water conservation
  - Livestock Intake

Grazing Heights & Rest Period Needs

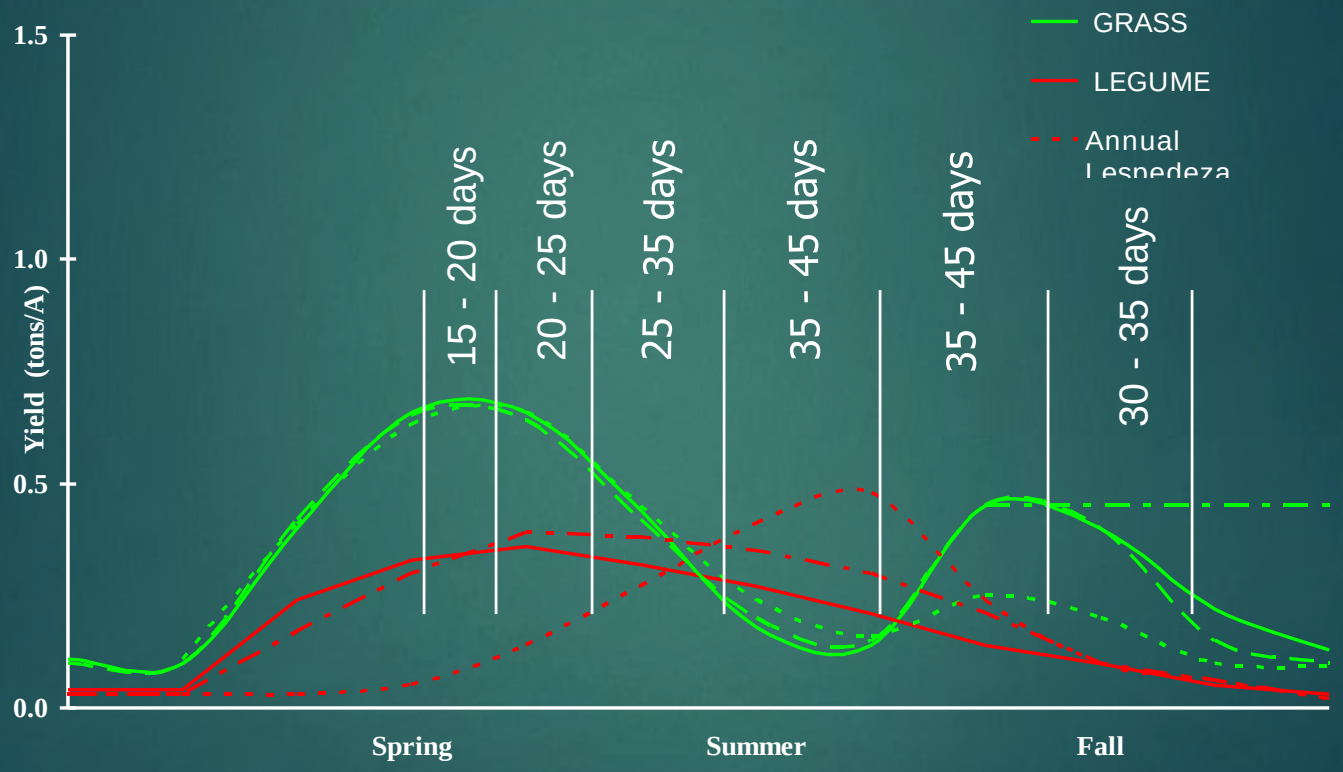
	Cool Season Grass - legume	Introduced Warm Season Grasses	Native Warm Season Grasses
Begin Grazing	6 – 8 inches	6 – 8 inches	12 – 18 inches
End Grazing	3 – 4 inches	2 – 3 inches	6 – 8 inches
Rest Period	20 – 40 days	21 – 35 days	30 – 45 days

Corresponding Root Growth

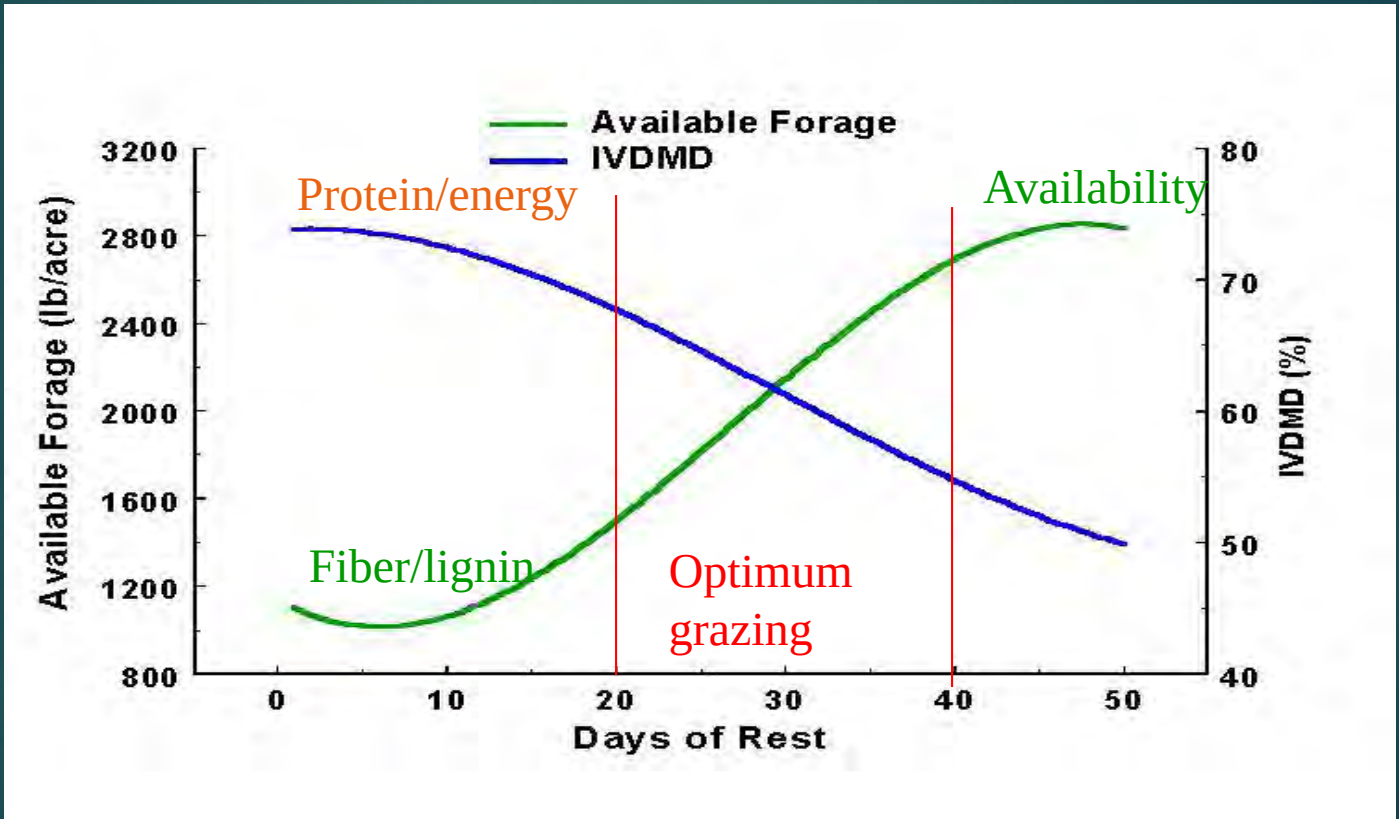
The Take Half-Leave Half Rule

% Leaf Removed	% Root Growth Stopped
10	0
20	0
30	0
40	0
50	2 to 4
60	50
70	78
80	100
90	100

Recovery Periods: Grazing Season



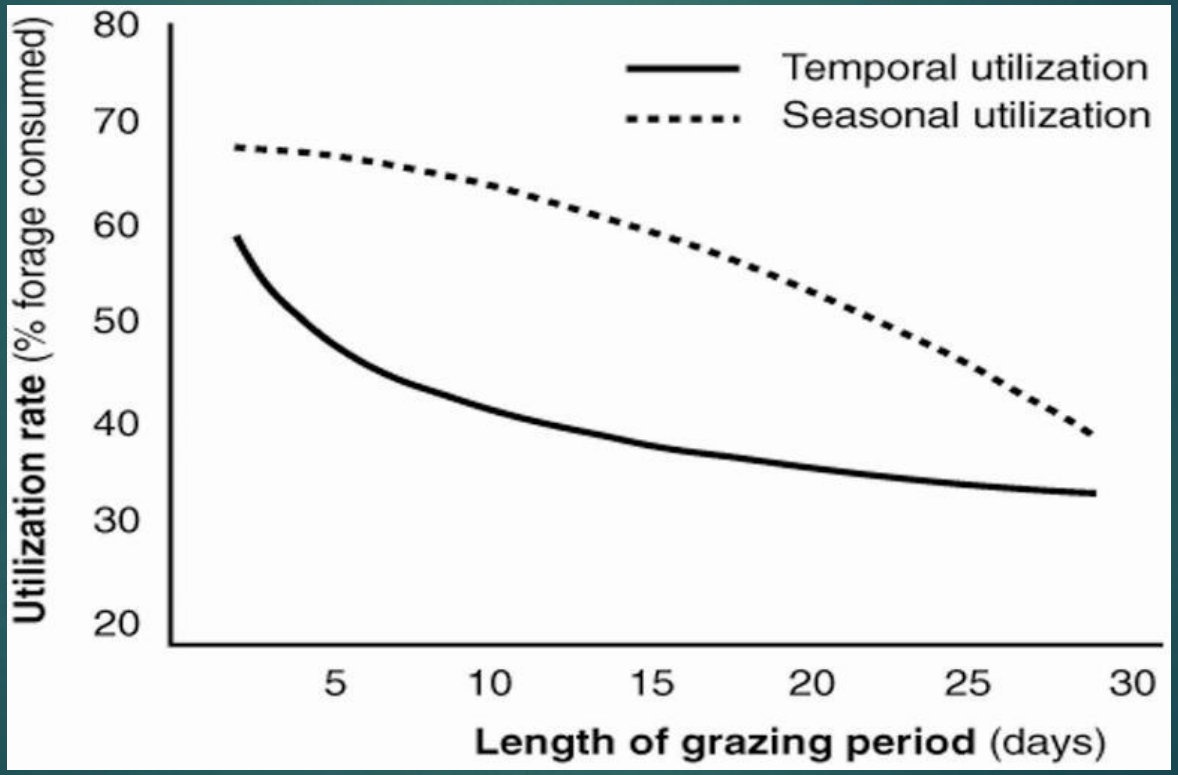
Recovery Period Effects on Quality



Grazing Periods

- Our first goal should be to never leave a grazing animal in a pasture long enough to get a bite of new regrowth
- Second, we need to have enough pastures to provide proper recovery periods between grazings

Grazing Period Length Affects Utilization



Length of the grazing period

- Stock density increases with shorter grazing periods
- Animals are concentrated on smaller areas for a shorter amount of time
- Selectivity decreases
- Utilization increases
- Manure distribution improves

Well-managed forage-based livestock systems can be the solution to building healthy soils

- Keep the soil covered
- Minimize soil disturbance
- Increase plant diversity
- Maintain living roots year round
- Utilize grazing livestock

Improving Soil Health