Impact of Cattle and Forage Management on Soil Surface Properties in the Southern Piedmont USA

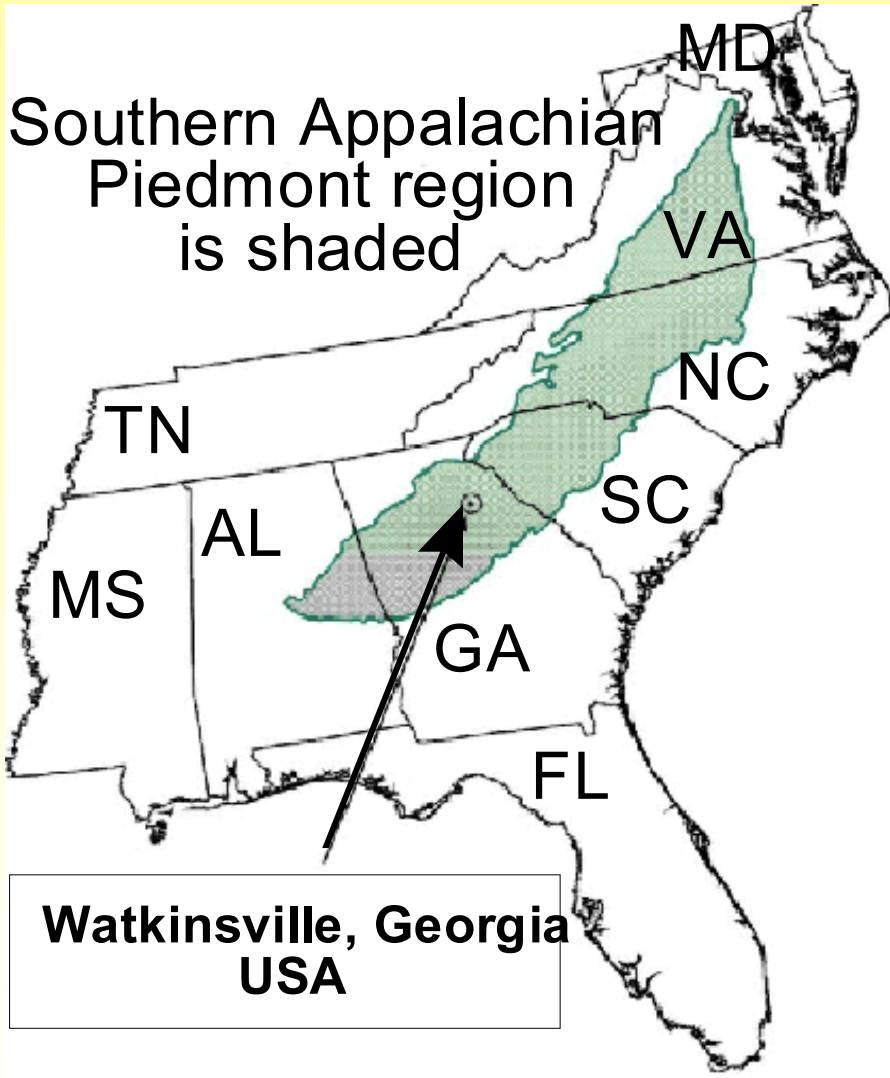
USDA

ARS

Watkinsville
GA

Rationale

- Forages are an integral part of the agricultural landscape in the southeastern USA.
  - Land use in the Southern Piedmont
    - Forest – 59%
    - Urban/road – 13%
    - Pasture – 12%
    - Cropland – 9%
    - Water/other – 8%



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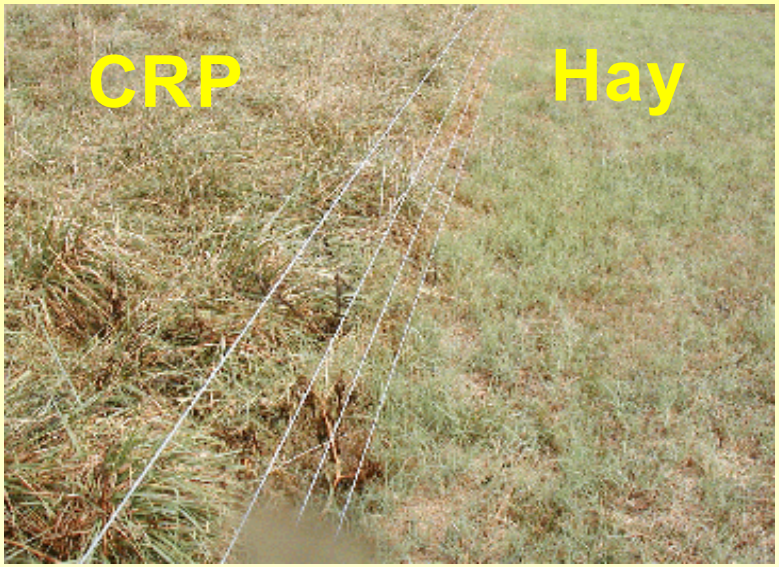
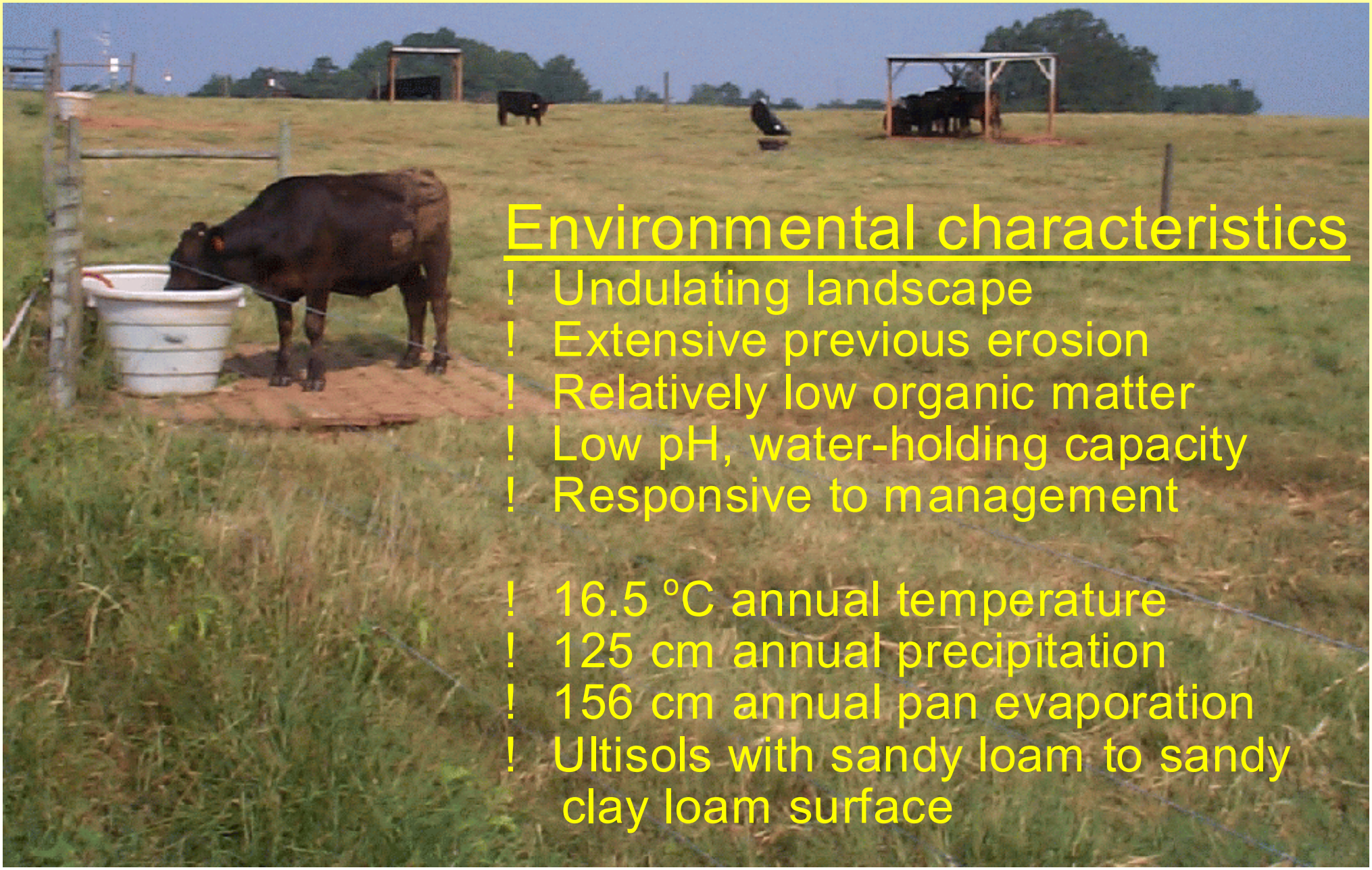


Impacts of above-ground activity on below-ground processes

Becoming well-known

Little known

Setting



Environmental characteristics

- Undulating landscape
- Extensive previous erosion
- Relatively low organic matter
- Low pH, water-holding capacity
- Responsive to management

- 16.5 °C annual temperature
- 125 cm annual precipitation
- 156 cm annual pan evaporation
- Ultisols with sandy loam to sandy clay loam surface

Methods

1. Long-term land use comparisons


NT cropland vs pasture

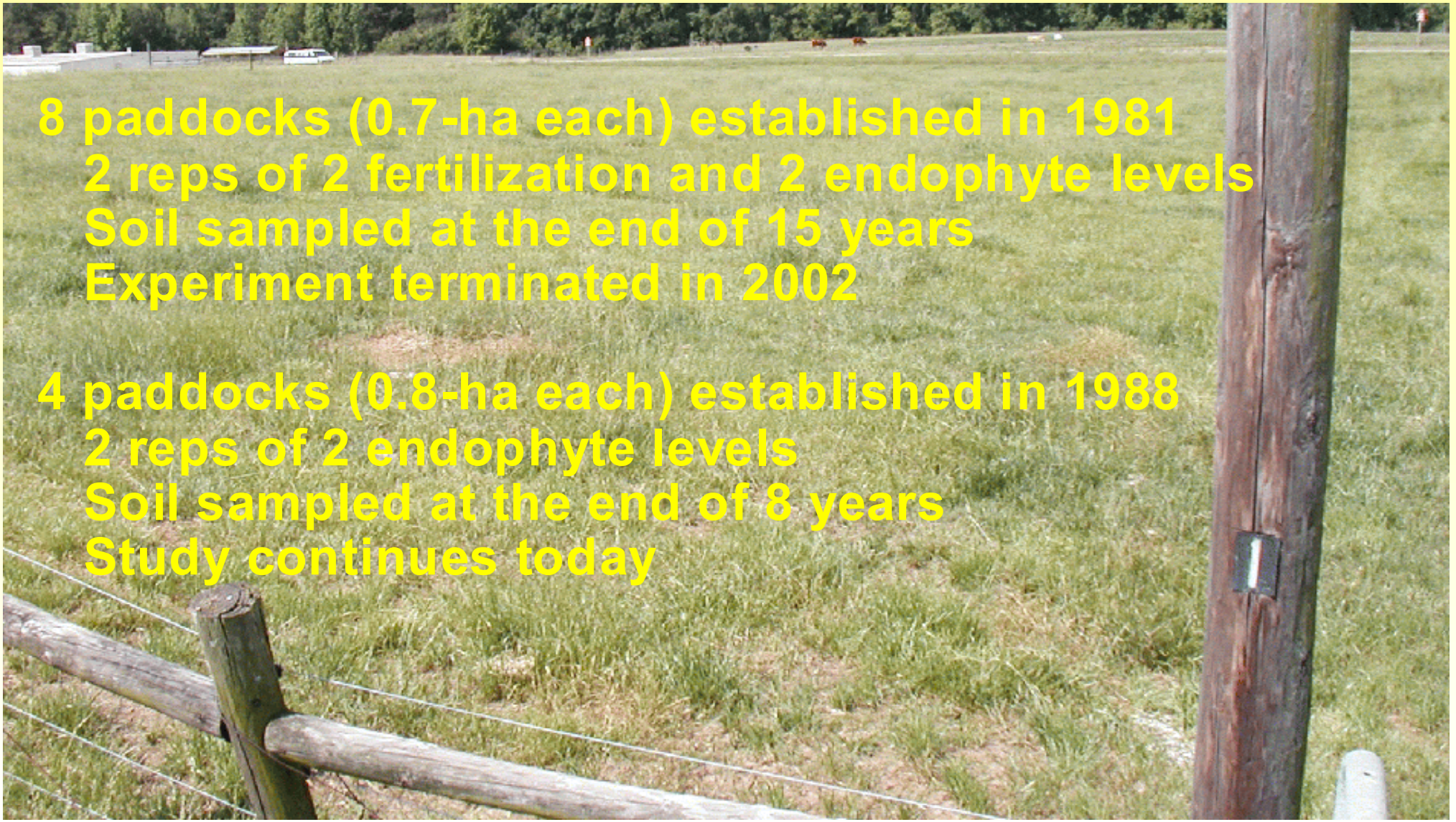

Haying vs grazing


Chronosequences of hayed bermudagrass and grazed tall fescue




Methods

2. Tall fescue study



Methods

3. Bermudagrass management study

36 experimental units of 'Coastal' bermudagrass in 1994
3 reps of 3 fertilization X 4 harvest strategy levels
0.7-ha grazed paddocks
Soil sampled yearly

<u>Fertilization</u>
Inorganic
Clover+inorganic
Broiler litter

<u>Harvest strategy</u>
Unharvested
Low grazing pressure
High grazing pressure
Hayed

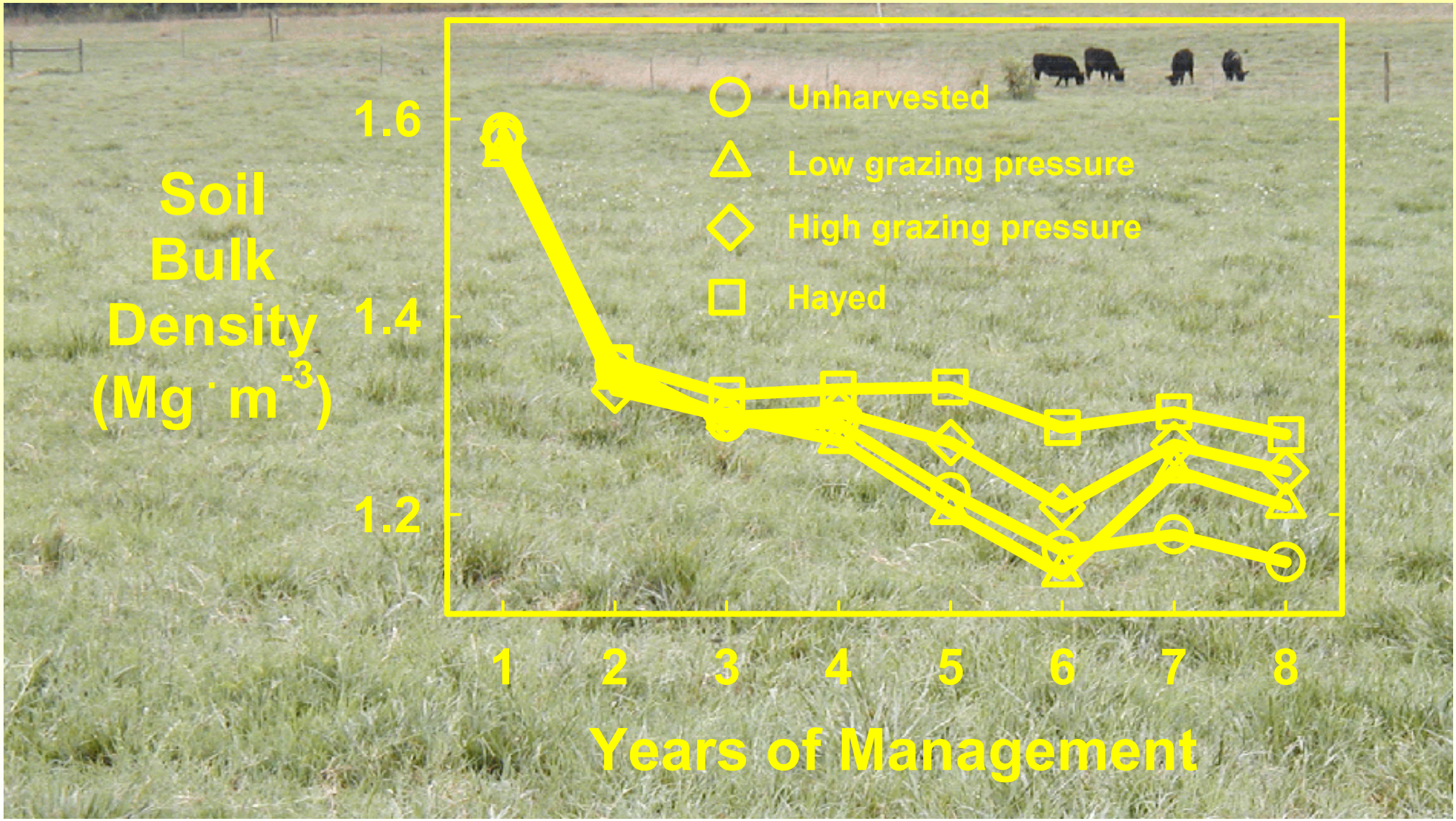
Methods

4. Soil properties

- Soil compaction
  - bulk density
- C sequestration and soil fertility
  - soil organic C
  - total soil N
- Active organic matter and nutrient cycling
  - soil microbial biomass C
  - potential N mineralization

Results

1. Soil compaction



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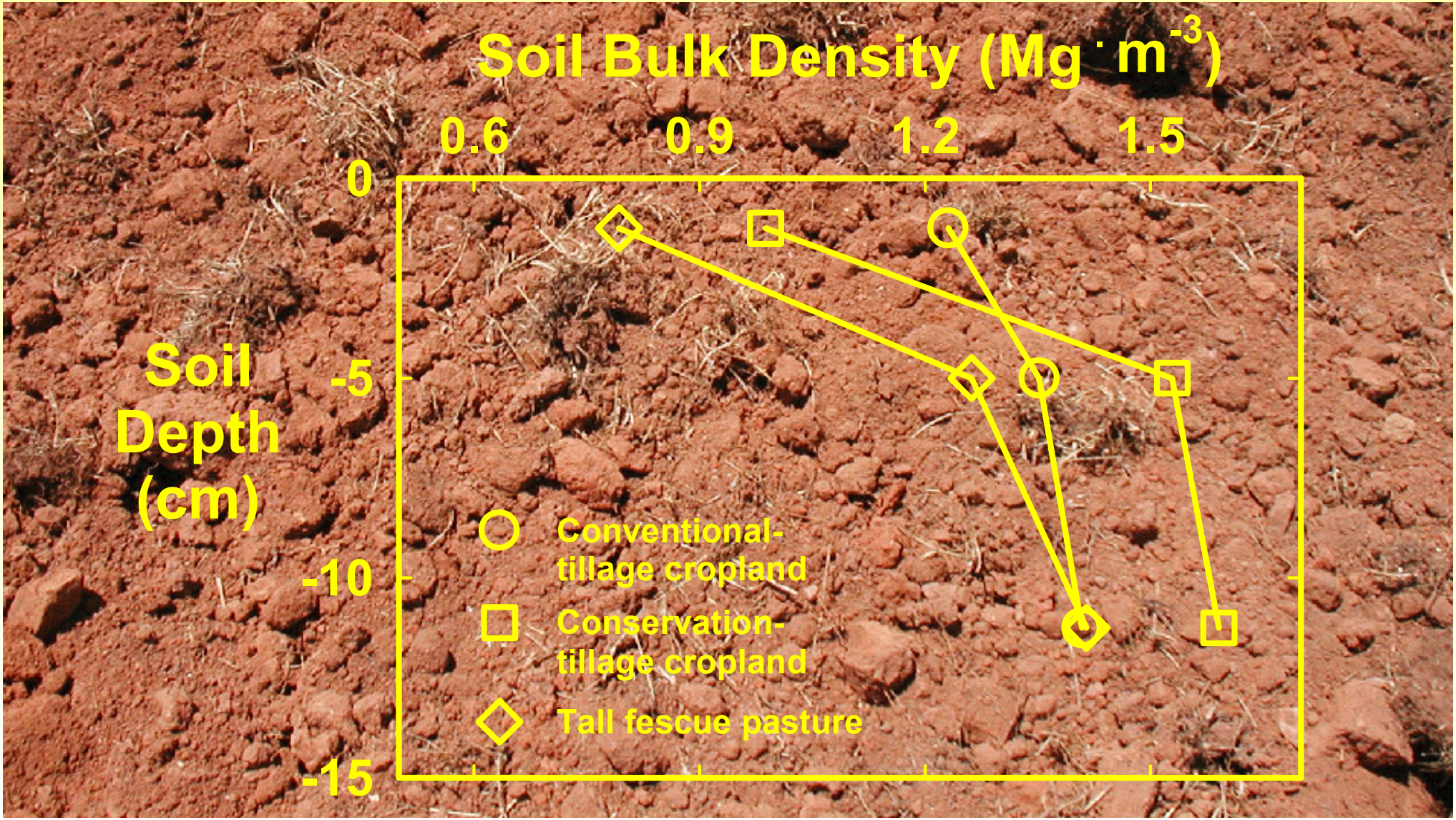
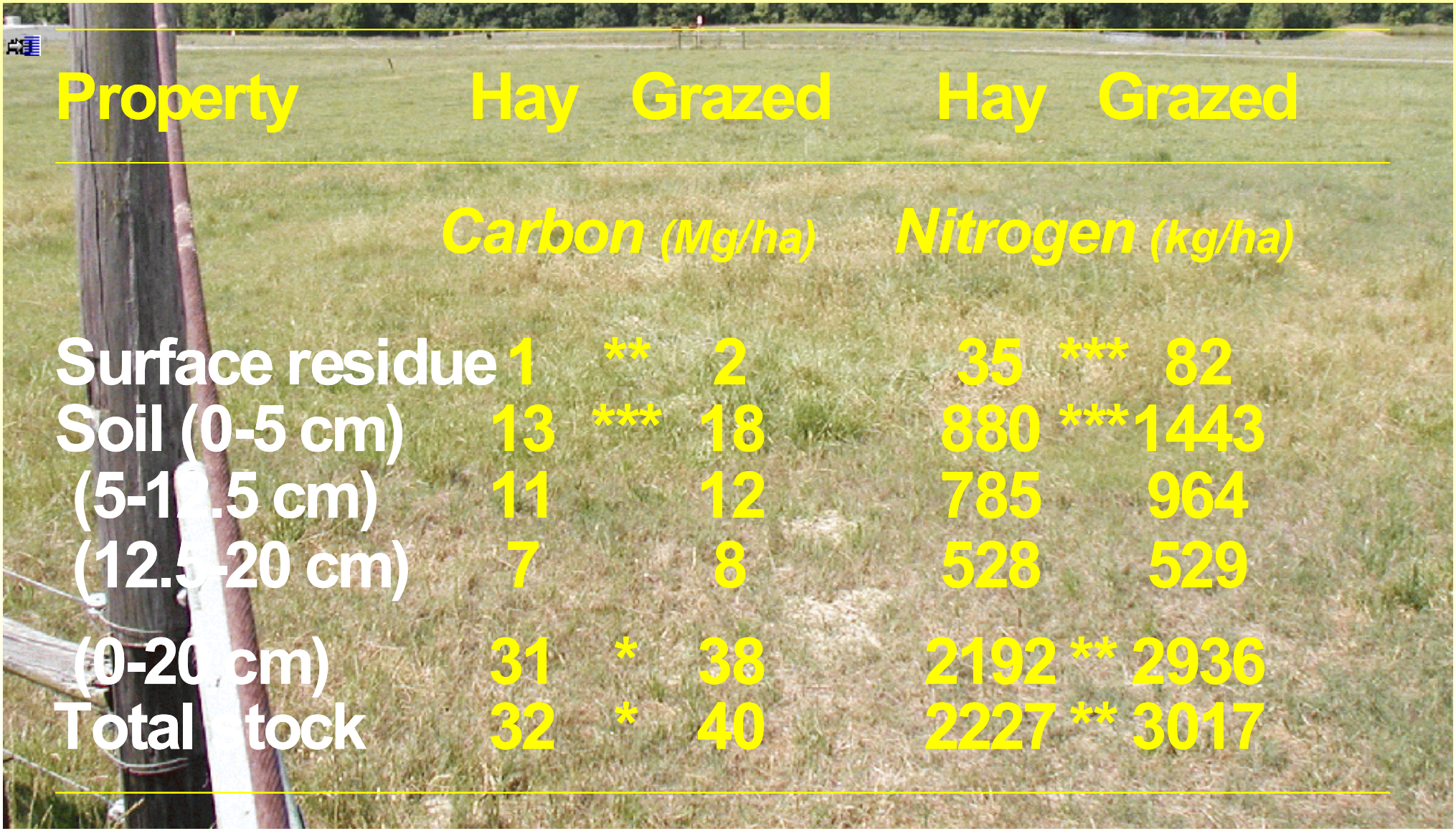


Results

2. Carbon sequestration and soil fertility



Property	Hay		Grazed	Hay		Grazed
	Carbon (Mg/ha)			*Nitrogen (kg/ha)*		
Surface residue	1	**	2	35	***	82
Soil (0-5 cm)	13	***	18	880	***	1443
(5-12.5 cm)	11		12	785		964
(12.5-20 cm)	7		8	528		529
(0-20 cm)	31	*	38	2192	**	2936
Total stock	32	*	40	2227	**	3017

Results

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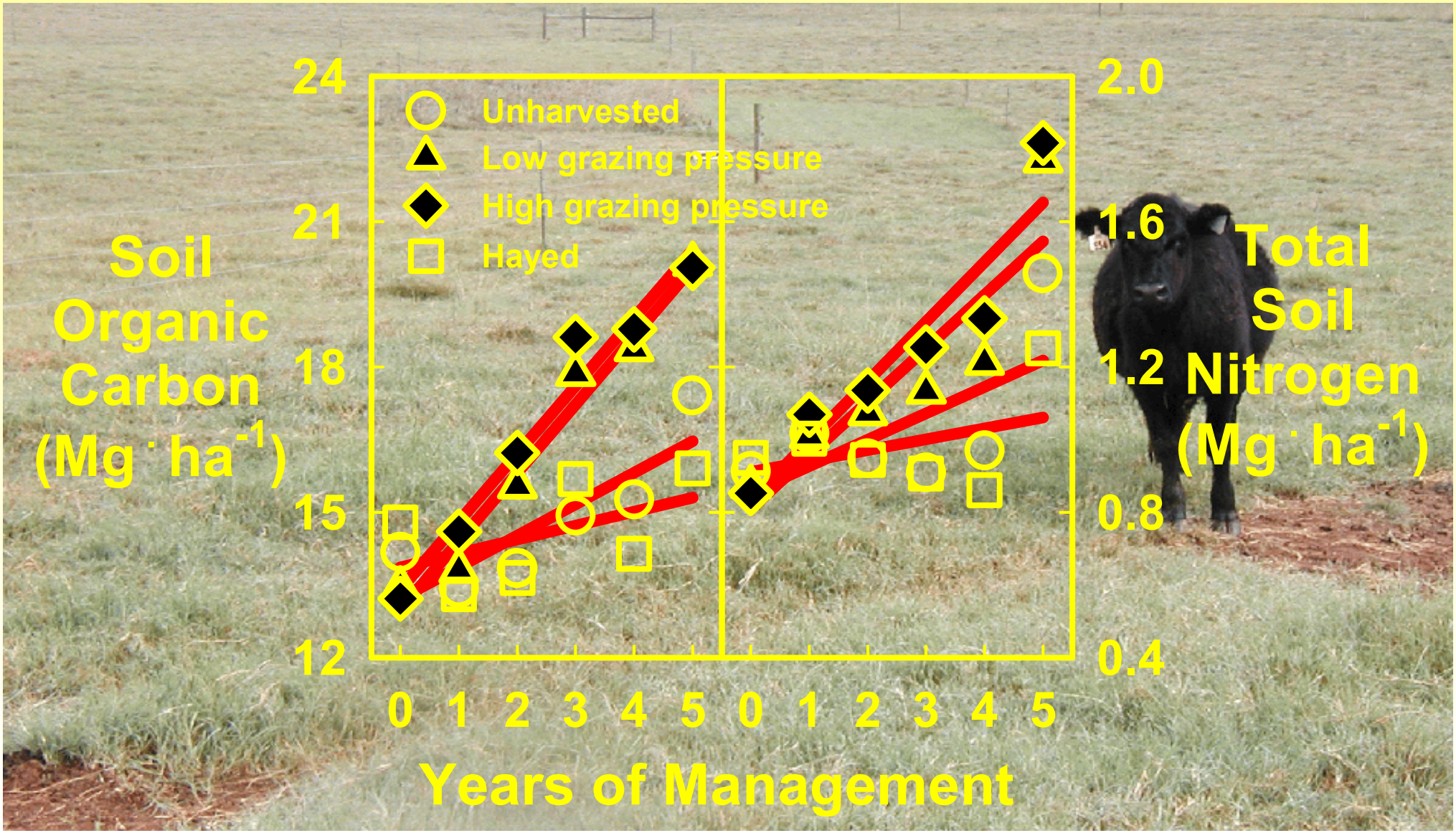

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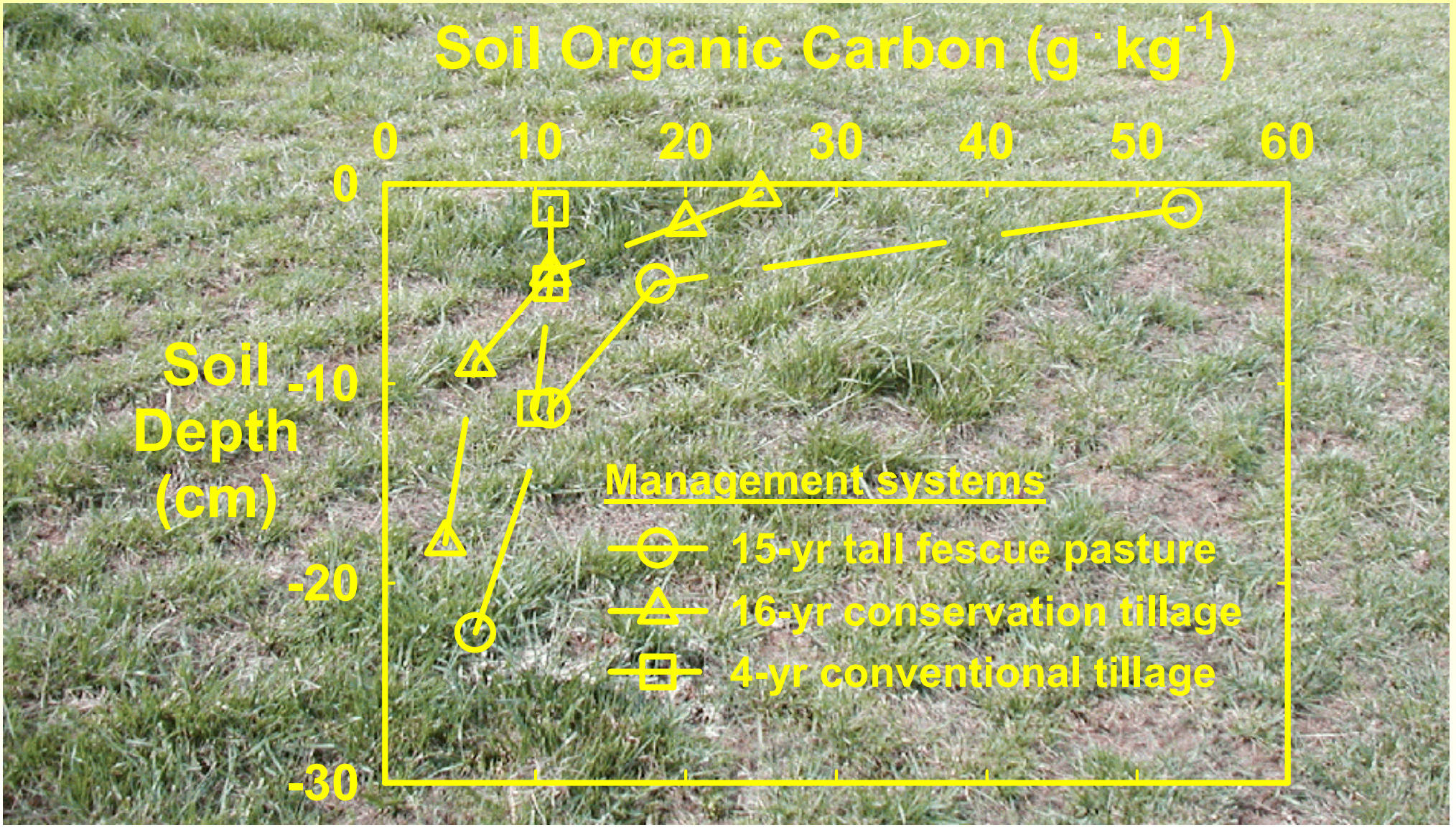
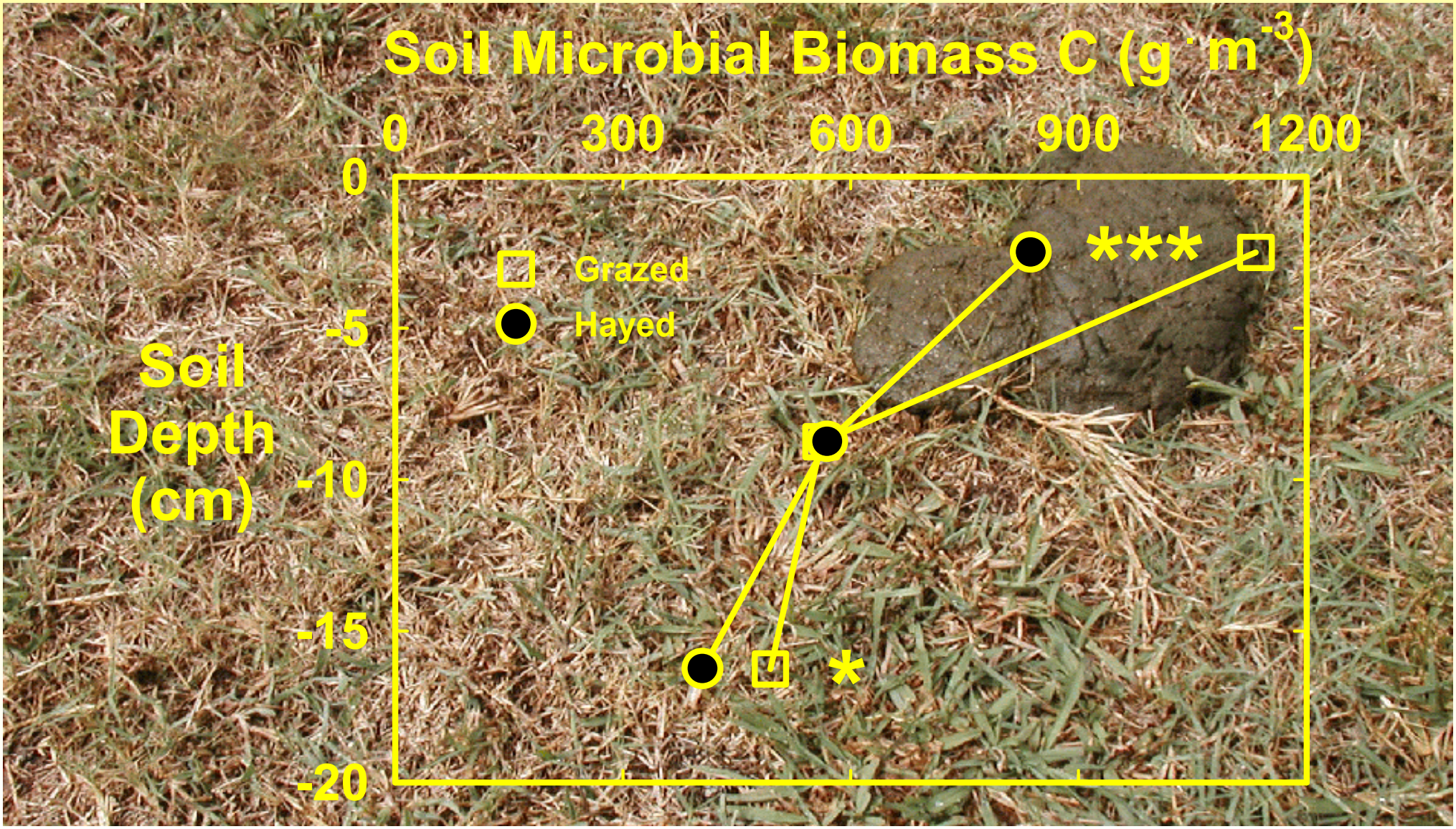


Results

3. Active organic matter and nutrient cycling



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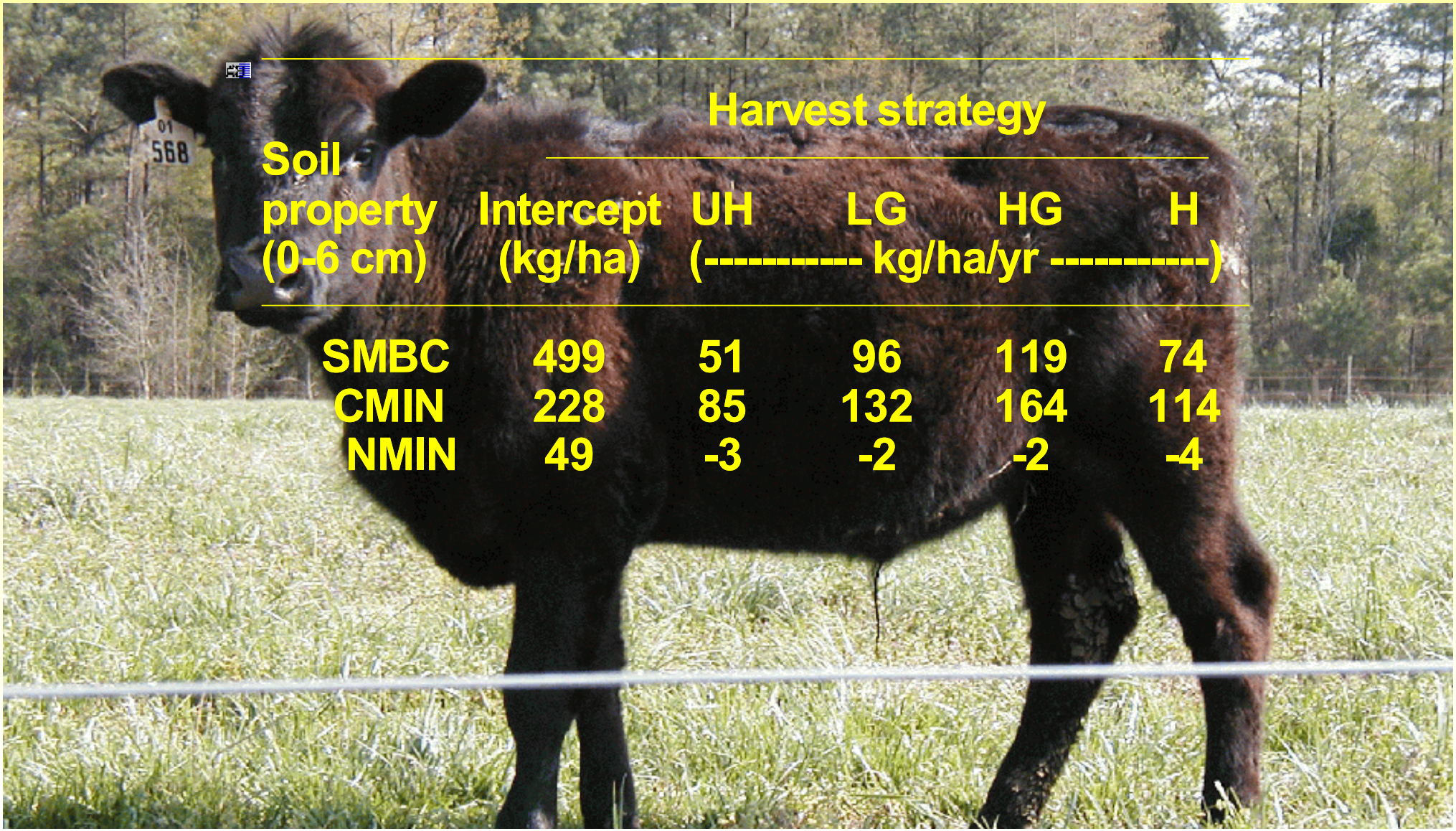

Soil property (0-6 cm)	Intercept (kg/ha)	Harvest strategy UH	LG	HG	H
		(---------- kg/ha/yr ----------)			
SMBC	499	51	96	119	74
CMIN	228	85	132	164	114
NMIN	49	-3	-2	-2	-4

Conclusions

- Forages have potential to alleviate compaction
  - Extensive root system penetrates soil
  - Roots leave behind organic materials that are utilized by microorganisms to manipulate structure
- Grazing can enhance loosening
  - Feces add to surface organic matter

Conclusions

- Cattle grazing can enhance the C sequestration potential of forage management systems
- High microbial biomass and activity under grazed forages
  - Stimulates decomposition
  - Temporarily immobilizes nutrients
  - Releases nutrients with time
  - Stabilizes soil aggregates necessary for efficient water infiltration and air transport