Pasture Fertility

Cache County Crop School 2023

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Maintaining Pastures for Grazing

- Determining Your Pasture Fertility Needs
- Environmental Concerns
- Monocultures and Grass-Legume Mixtures

Determining Pasture Fertility Needs

Pasture Systems

Pastures/Plants Need:

- Energy (sunlight)
- CO_2
- Water
- Essential Mineral Elements (nutrients)

- If any are limiting, plant growth is limited

Photo credit: Tim Griffin | USDA National Ag Library

Pasture Systems

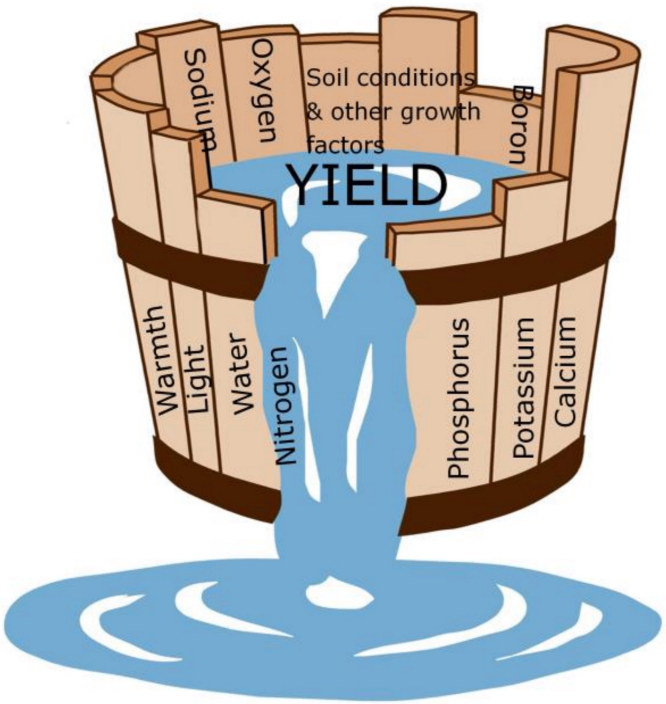


Photo credit: Yara, 2018

Essential Mineral Elements:

- Macro Nutrients
  - N, P, K
- Major/Secondary Nutrients
  - Ca, Mg, S
- Micro Nutrients
  - B, Zn, Fe, Cu, Mn, Mo, Cl, Ni

Pasture Systems

Soil Testing to Determine Nutrients Needed

Whole Field Random Sampling

- Appropriate for uniform fields
  - Sample composite of 15-20 subsamples
  - 1’ deep for most nutrients, 2’ deep for N
  - Sample for every ≤ 20 ac., or if MIG each paddock
- To see long-term trends:
  - Georeference sampling points
  - Sample in same location in subsequent years

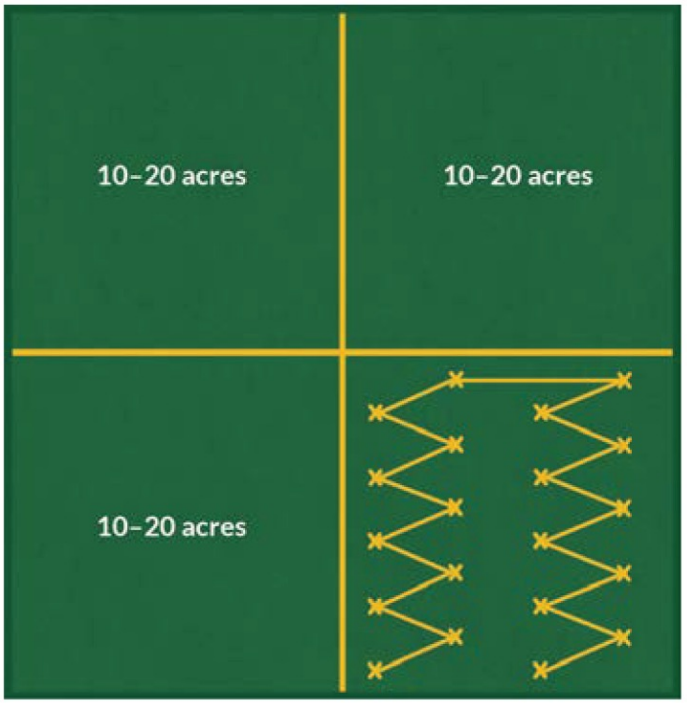


Photo credit: SCNcoalition.com

Pasture Systems

Soil Testing to Determine Nutrients Needed

Management Zone Sampling

- Zones should be:
  - Uniform areas that can be managed separately
  - Often based on soil type, slope, topsoil
  - Sample composite of 15-20 subsamples
- Benefit of zone-based sampling
  - Create map of soil fertility and pH
  - Can be used to develop precision, variable-rate fertilizer applications

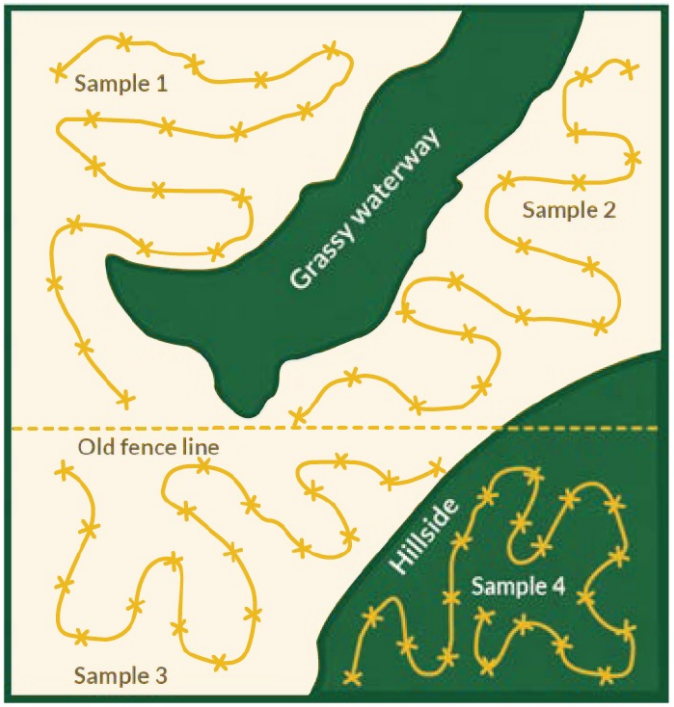


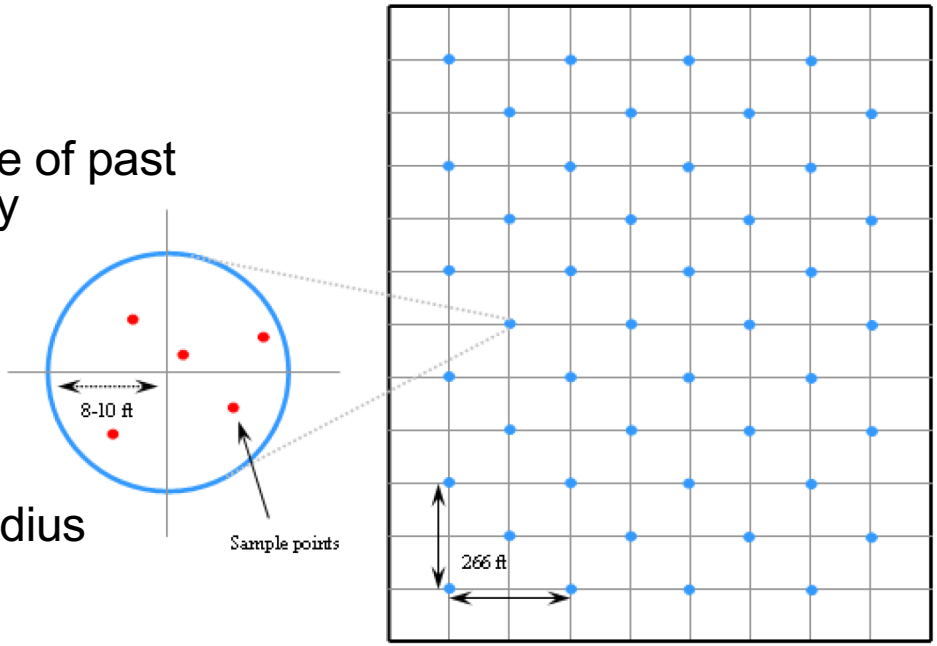
Photo credit: SCNcoalition.com

Pasture Systems

Soil Testing to Determine Nutrients Needed

Grid Zone Sampling

- Particularly useful when little prior knowledge of past management history, or within-field variability
- Grid Size – 1 to 2.5 acres, max 5 acres
- Offset grid pattern recommended
- Each sample composite of 5+ subsamples
- Randomly collect samples within an 8-10’ radius
- Will last for many years
- Best for developing map for precision, variable rate application



Source UNL Extension EC154

Pasture Systems

Soil Testing to Determine Nutrients Needed

Soil Sample Handling

- Sample size - 2 cups
- Keep cool
- Send immediately
- Certified lab

Areas to Avoid when Soil Sampling

- Areas within 100’ of roadways, lanes
- End rows, areas of compaction
- Highly eroded areas
- Locations of former farmsteads or animal enclosures
- Winter feeding areas (or sample separately)
- Areas near water troughs

Pasture Systems

Nutrients:

- Need to provide adequate nutrients for good plant growth
- P and K typically added only when planting
- N needed annually
  - Split application recommended

Table 2. Nitrogen recommendations for irrigated grass and grass-legume mixtures.

	Yield potential of the site			
Stand composition	**1-2 tons/acre**	**2-4 tons/acre**	**4-6 tons/acre**	**6-8 tons/acre**
	---------- nitrogen recommendation (lbs/acre) ----------			
100% grass	50	75[1]	100-150[1]	150-200[1]
75% grass, 25% legume	25	50	75-100	100-150[1]
50% grass, 50% legume	0	25	50	75
25% grass, 75% legume	0	0	25	50

[1]For pasture, split the total nitrogen rate into two or three separate applications. Apply 1/3 to 1/2 of the nitrogen in early spring, 1/3 to 1/2 in June, and the remainder in late August. Schedule mid- and late-season nitrogen applications to coincide with irrigation or rainfall events. For hay-pasture systems, apply 2/3 of the nitrogen in early spring and 1/3 after the hay crop is removed to stimulate regrowth for grazing.

Source: USU Extension AG-FG-03

Grazing Systems

In a grazing system we have two sources of nutrients:

- Addition of Nutrients through fertilizers
- Recycling of Nutrients through fecal and urine deposition

Nutrients & Environmental Concerns

Environmental Concerns

Grazing Systems:

- In a grazing system 60-90% of the nutrients are returned to the pasture
- A grazing cow will return:
  - 79% N
  - 66% P
  - 92% K

Photo Source: Visual Indicators of Soil Condition. Meat & Livestock Australia.

- Uneven distribution of nutrients
  - 10% of paddock receives urine or fecal spot
  - Congregated near water sources, shade, etc.
  - Urine N content high (1,000 lbs N/acre in that spot)
  - Subject to leaching and volatilization losses

Environmental Concerns

Nutrients biggest source of pollution from agriculture:

Water Quality

- ***Eutrophication*** **–** algae growth, fish kills
- ***Groundwater concerns*** **–** blue baby syndrome, cancer, spontaneous abortions in livestock

Air Quality

- ***Volatilization*** **–** $PM_{2.5}$, acid rain, smog

Inorganic vs Organic Fertilizers

Nitrogen Fertilizers

Addition of Nutrients:

- Commercial fertilizers
  - Inorganic N
  - Organic N

- Manures add a mix of organic and inorganic N (ammonium and nitrate-N) to our soils
  - Application limits when soil test levels for P are >50ppm

Nitrogen Fertilizers

Inorganic N Fertilizers:

- Inorganic Nitrogen fertilizers
  - Ammonium sulfate
  - UAN
  - Urea
- Rapidly available
- Leaching/volatilization
- Timing critical

Organic N Fertilizers:

- Organic Nitrogen fertilizers
  - Feather meal
  - Fish meal
  - Manures/compost
- Slower release of nutrients

Inorganic N is more susceptible to environmental loss to the air and water

Monocultures vs Grass-Legume Mixtures

Pasture Systems - Nitrogen

Nutrients:

- Can reduce N needed by adding legumes

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Source: USU Extension AG-FG-03

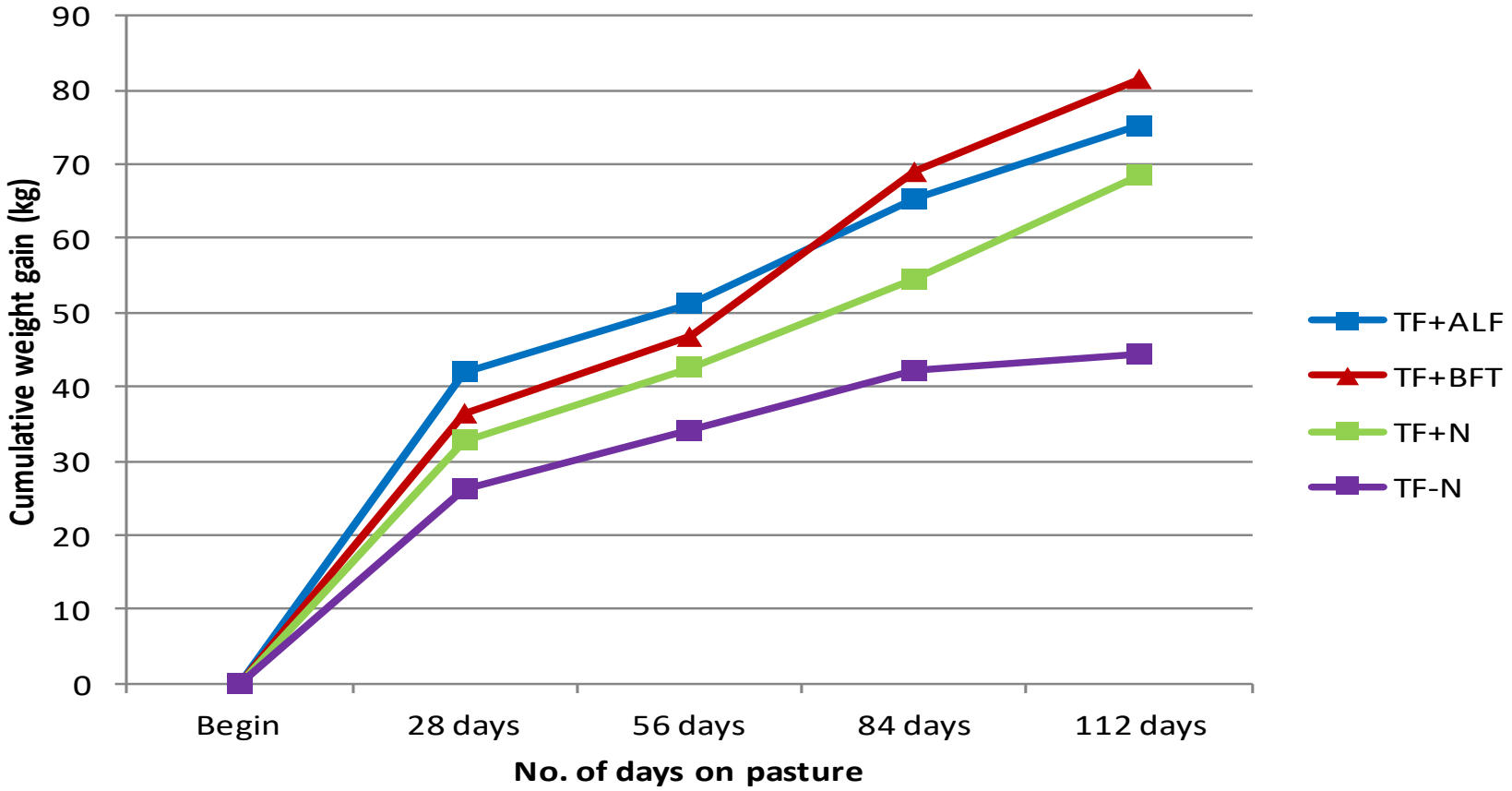
Adding Legumes to Pasture Systems

Goal: Identify economically and environmentally sustainable grazing systems

- Maximize rates of gain
- Maximize forage production
- Economical return
- Protect the environment

Research Study

RATE OF GAIN WHEN ADDING LEGUMES INTO THE SYSTEM

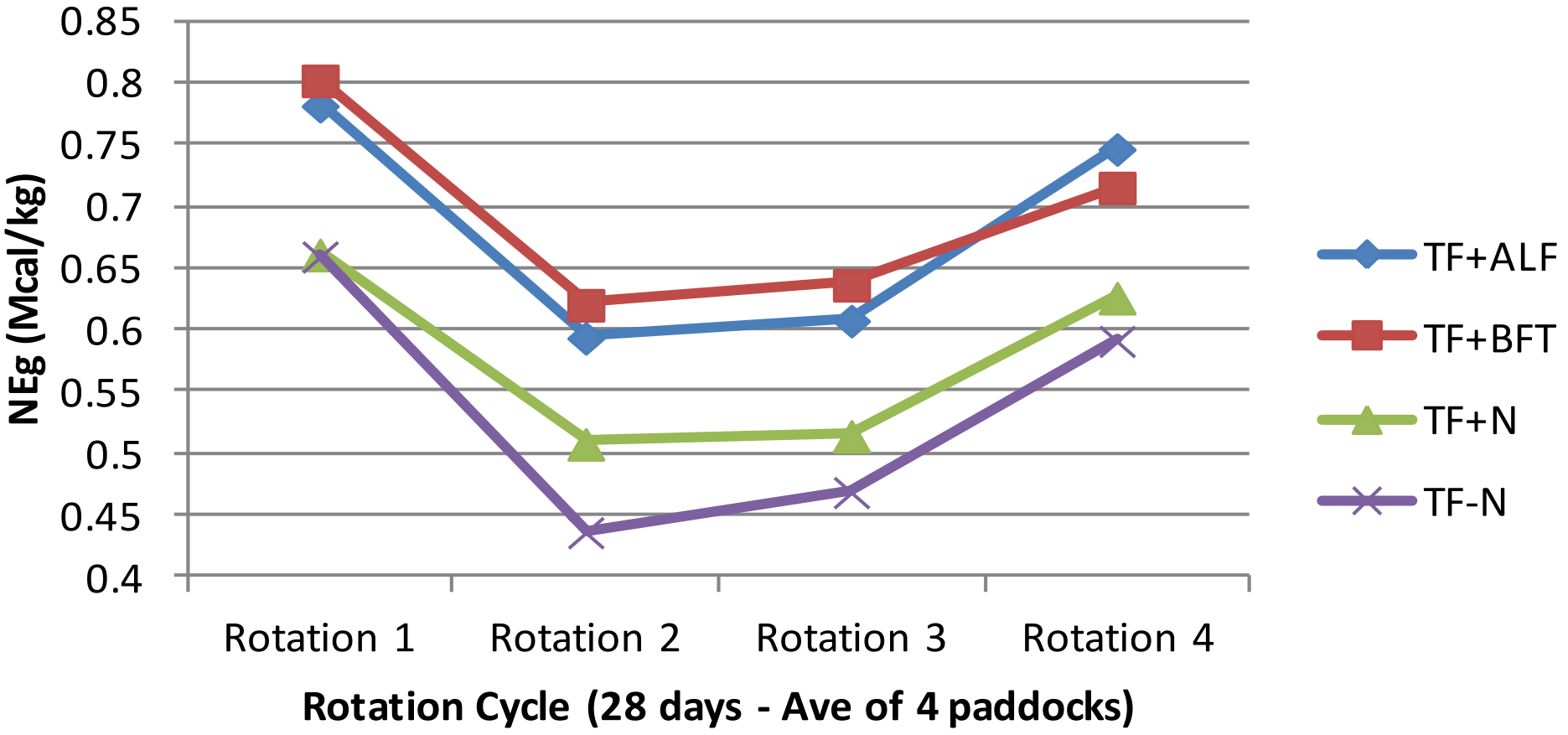


Results

Data from: Waldron et al., 2019; DOI 10.1111/grs.12257

	TF + BFT	TF + ALF	TF + N	TF - N
Establishment/ Maintenance Cost	$133.72/acre	$132.87/acre	$275.62/acre	$141.60/acre
Crude Protein	145 g/kg	159 g/kg	134 g/kg	105 g/kg
Average Daily Gain (ADG)	1.61 lbs/day	1.48 lbs/day	1.34 lbs/day	.88 lbs/day
Stocking density (Gain lbs/acre)	653.97 lb/ac	576.35 lb/ac	506.76 lb/ac	222.15 lb/ac
Net Return/acre	$484.41/acre	$342.36/acre	$100.92/acre	$55.04/acre

Net Energy


0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
0.45
0.4
NEg (Mcal/kg)
Rotation 1
Rotation 2
Rotation 3
Rotation 4
Rotation Cycle (28 days - Ave of 4 paddocks)
TF+ALF
TF+BFT
TF+N
TF-N

Possible Solution

Hypothesis: Use high energy grass-legume mixtures to improve DMI and performance on pasture

HIGH ENERGY GRASS
+
LEGUME with LOW LEVELS OF CONDENSED TANNINS (BIRDSFOOT TREFOIL)

MATERIALS & METHODS

Treatments

EIGHT GRAZING TREATMENTS

Four grass monocultures:

- Tall Fescue (TF)
- Meadow Bromegrass (MB)
- High sugar Orchardgrass (OG)
- High sugar Perennial Ryegrass (PR)

Four grass+ Birdsfoot trefoil (BFT) mixtures:

- Tall Fescue + BFT
- Meadow Bromegrass + BFT
- High sugar Orchardgrass + BFT
- High sugar Perennial Ryegrass + BFT

Control:

- Open Lot
- TMR

Fertilization & Irrigation

FERTILIZER

Grass Monocultures

Chilean Nitrate 25 lbs N/acre in April

Feathermeal ~31 lbs N/acre (late spring/early summer)

Chilean Nitrate 25 lbs N/acre in July

Grass-Legume Mixtures

Chilean Nitrate 25 lbs N/acre in April

Irrigated every 2 weeks

Grazing

- Nine acre pasture
- Eight treatments
- Each treatment divided into 5 paddocks
- Two or three jersey heifers per treatment
- Each paddock grazed for 7 days
- Rested for 28 days (35 day stocking cycle)
- Three grazing cycles per year
- At end of each grazing cycle:
  - Heifers weighed
  - Urine, fecal, and blood samples collected

Fecal Samples

- Grab samples
- Collected every five weeks during the grazing rotations
- Analyzed for Total N by combustion method on an Elementar

Urine Samples

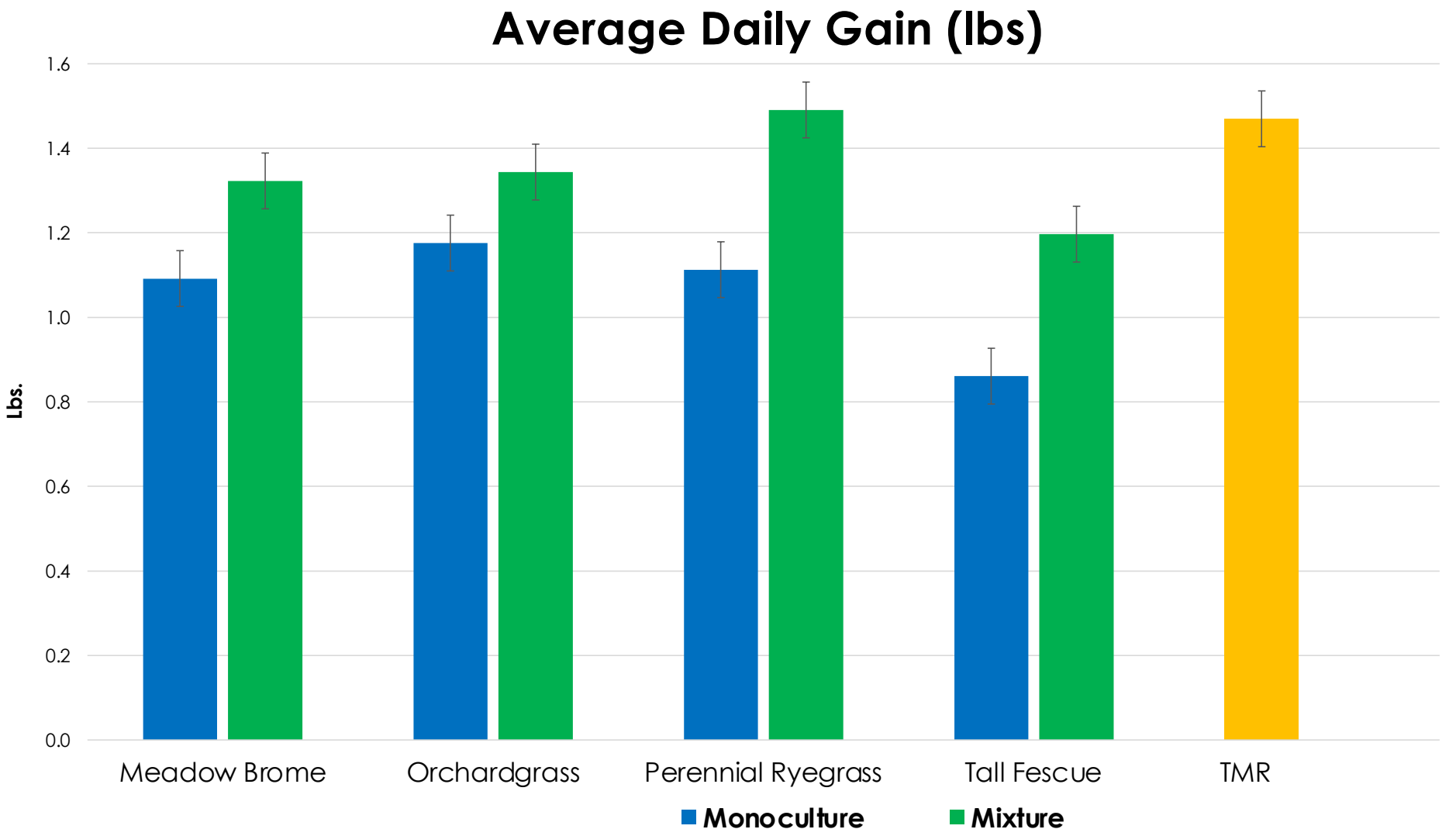
- Tickle Method
- Collected every five weeks
- Analyzed for Urea using QuickChem Method 10-206-00-1-A on a Lachat FIA analyzer

ZERO-TENSION LYSIMETERS

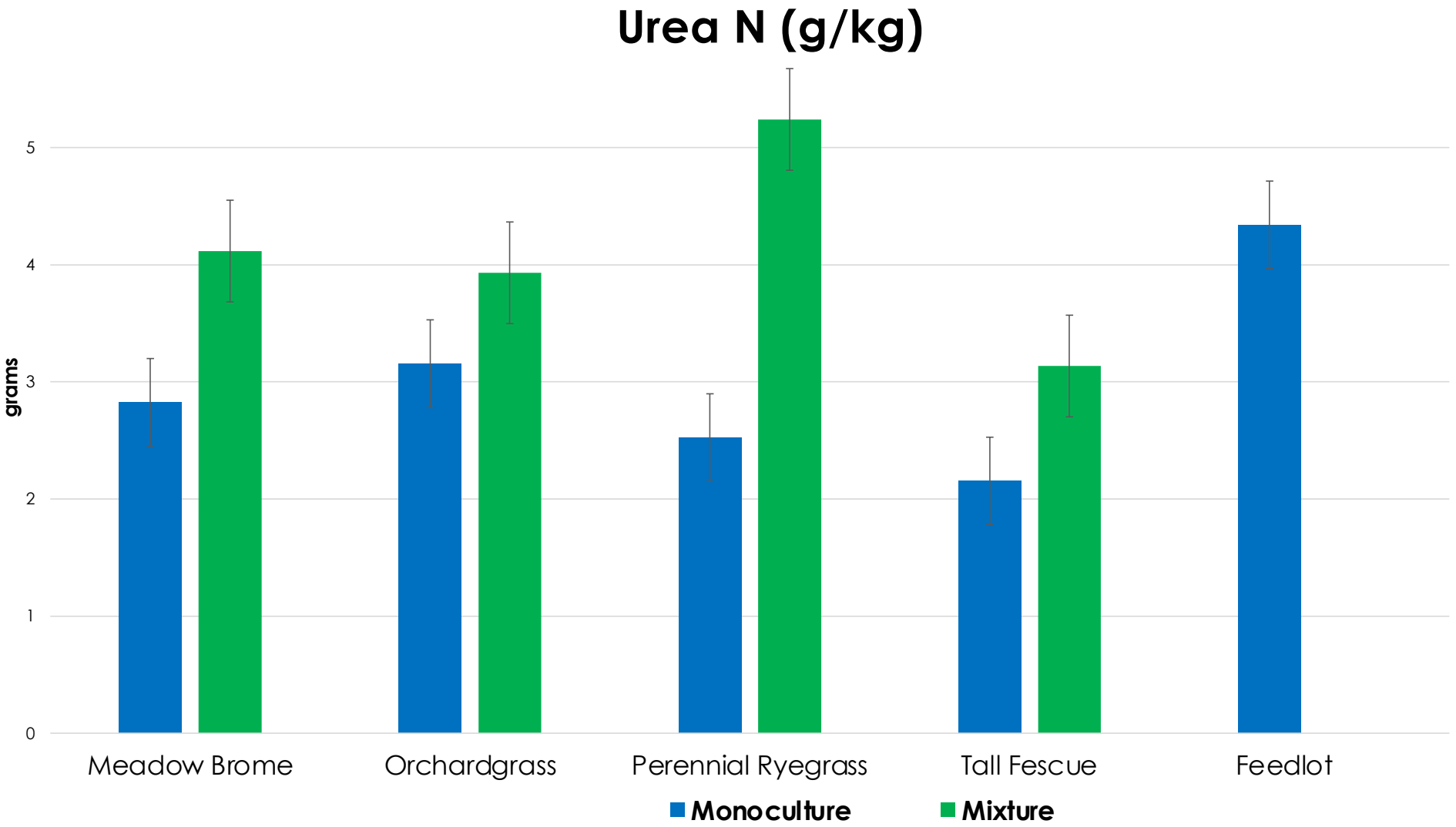
- Collected bi-weekly during growing season
- Reservoir collects all leachate


RESULTS

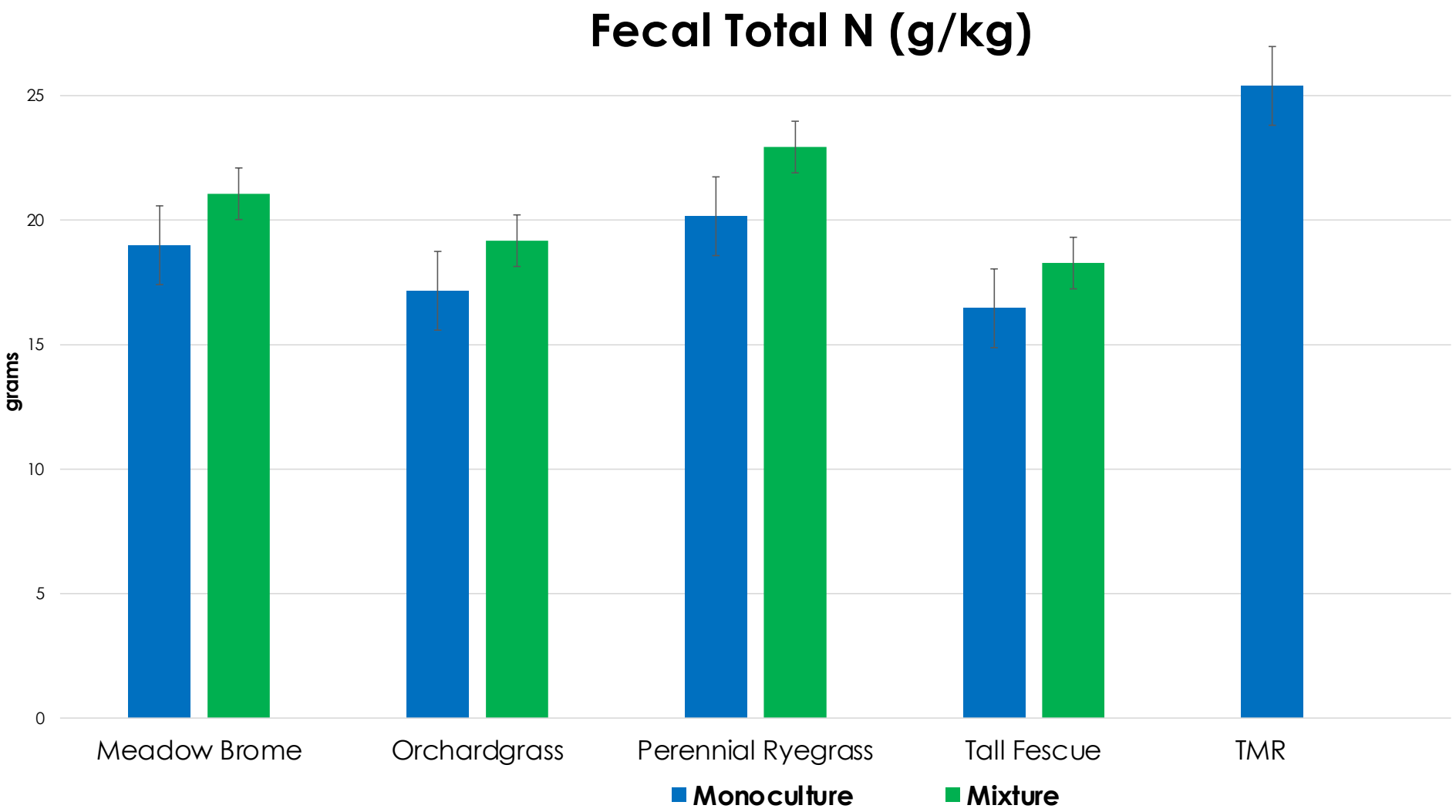
Gain


Average Daily Gain (lbs)
Lbs.
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Meadow Brome
Orchardgrass
Perennial Ryegrass
Tall Fescue
TMR
Monoculture
Mixture

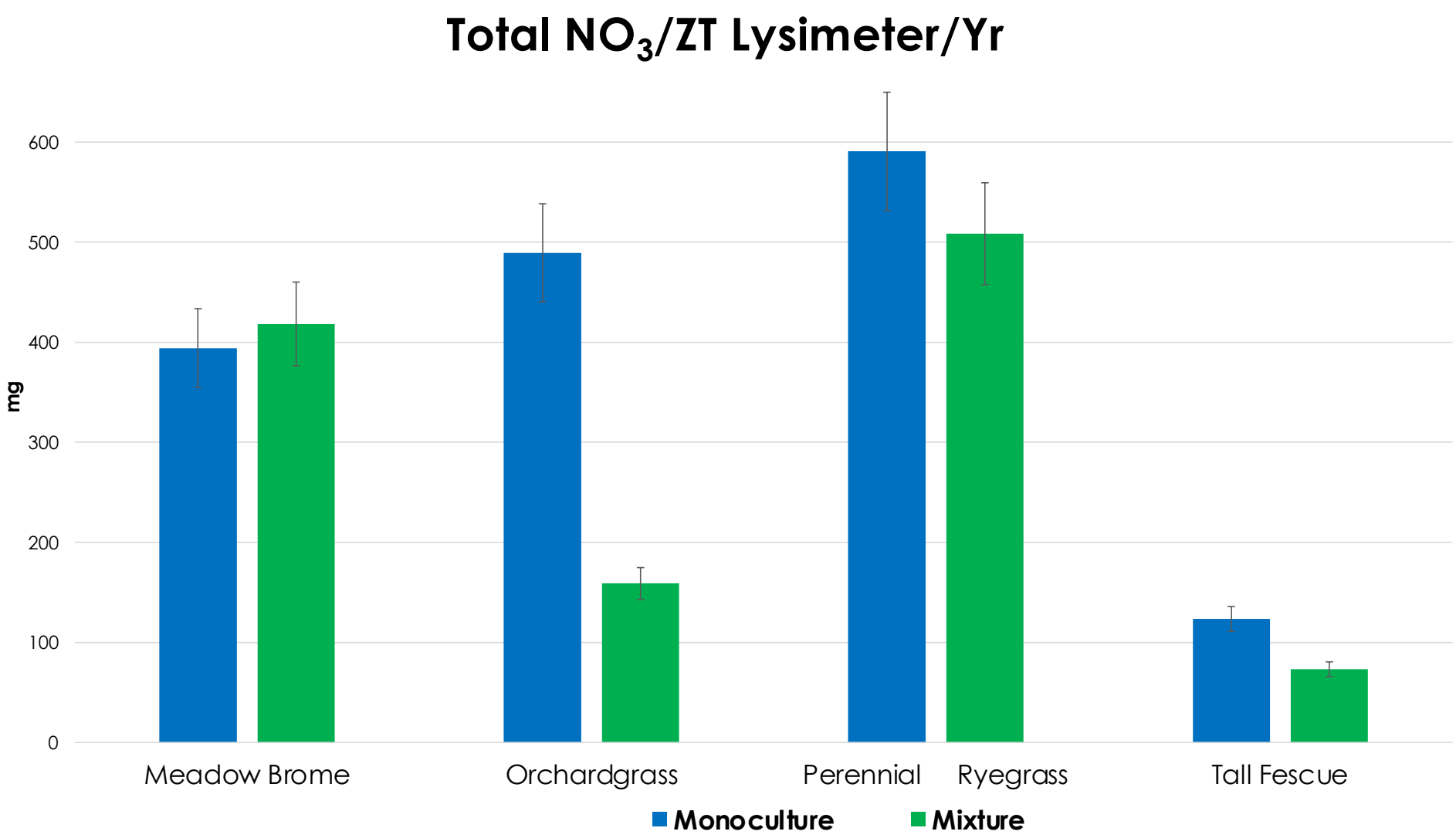
Urine


Urea N (g/kg)
grams
0
1
2
3
4
5
Meadow Brome
Orchardgrass
Perennial Ryegrass
Tall Fescue
Feedlot
Monoculture
Mixture

Feces


Fecal Total N (g/kg)
grams
25
20
15
10
5
0
Meadow Brome
Orchardgrass
Perennial Ryegrass
Tall Fescue
TMR
Monoculture
Mixture

Leaching


Total NO_3/ZT Lysimeter/Yr
mg
600
500
400
300
200
100
0
Meadow Brome
Orchardgrass
Perennial Ryegrass
Tall Fescue
Monoculture
Mixture

Study Results

Photo credit: Rhonda Miller

- **Nitrogen leaching did not increase when using grass-legume mixtures**
  - Rooting systems
  - Different microbial populations
- **Some species are better at capturing Nitrogen than others**
  - Tall Fescue exceptionally good
  - Perennial ryegrass not so good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SUMMARY

SUMMARY

Pasture Systems:

- Management of nutrients important
- Soil sampling recommended
- N fertilizer additions should be timed to minimize leaching
- Forage species selection matters
- Legumes can be added to system without increases in leaching

Grazing Systems:

- Uneven distribution of urine and fecal deposits
  - Rotational grazing helps
  - Place supplements, shade, etc. so as to encourage distribution of livestock

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