# Nutritional Considerations of the Grazing Ruminant

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Pasture and Forages Short Course
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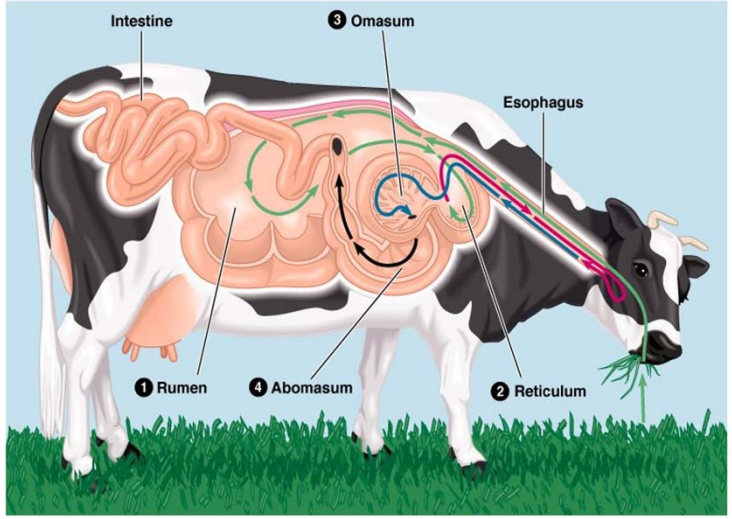
## Overview

- Qualities of a Ruminant
- Forage Concerns
- Deficiencies that may occur year round
  - Potential supplementation strategies
- Minerals/Vitamins

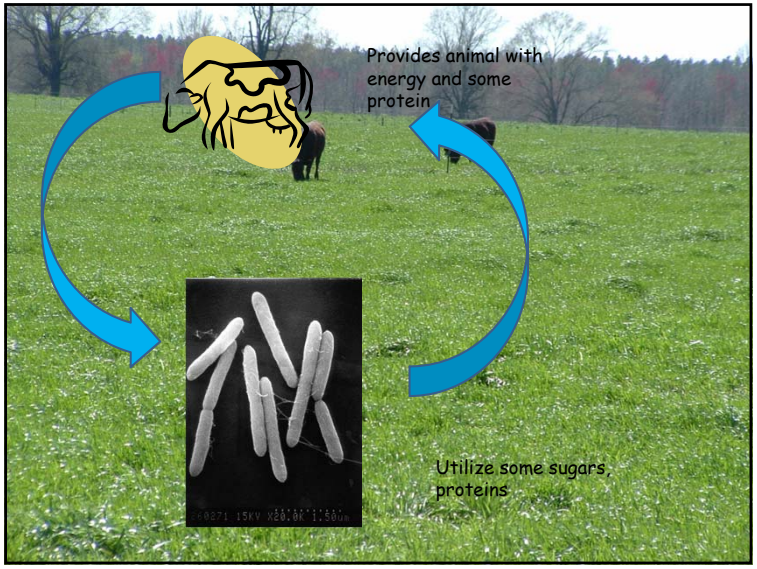
## Ruminant

- Four chambered digestive area
- Ability to break grass and forage down into energy precursors
  - Microbial action



## Rumen Microbes

- Bacteria, protozoa, some fungi

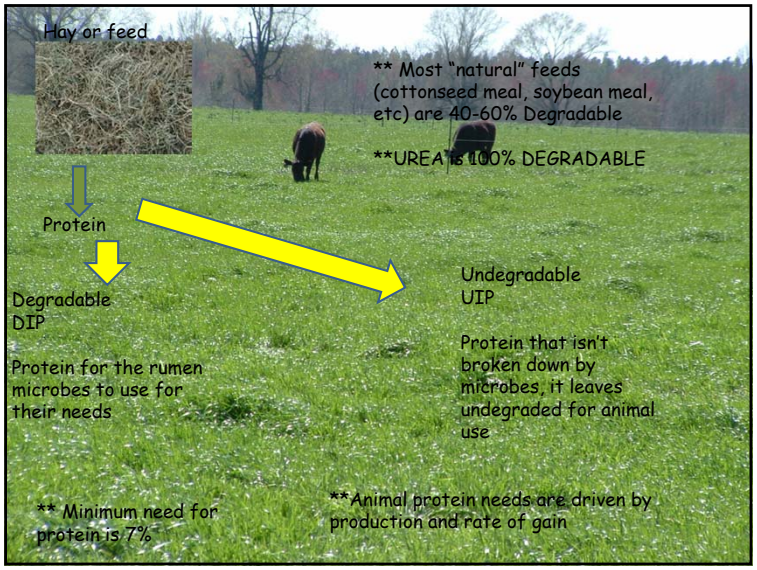


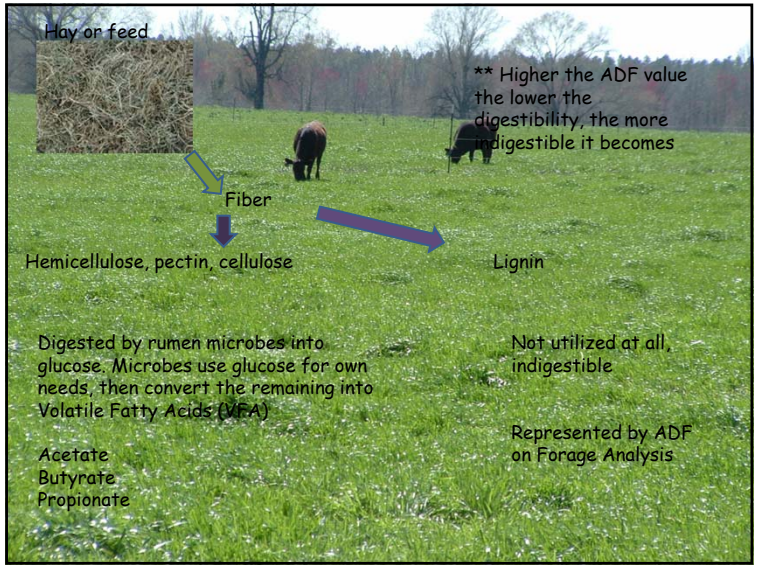

- What are two major components for any living organism to live, grow and reproduce?

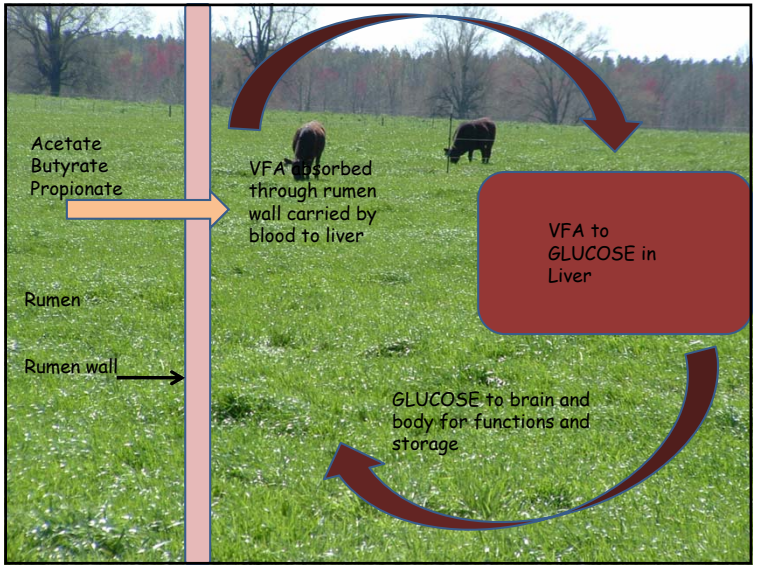
- ANSWER:

Protein and Energy


Hay or feed
Minerals
Fiber
Protein


Hay or feed
** Most "natural" feeds (cottonseed meal, soybean meal, etc) are 40-60% Degradable
**UREA is 100% DEGRADABLE
Protein
Degradable DIP
Protein for the rumen microbes to use for their needs
Undegradable UIP
Protein that isn't broken down by microbes, it leaves undegraded for animal use
** Minimum need for protein is 7%
**Animal protein needs are driven by production and rate of gain


Hay or feed
** Higher the ADF value the lower the digestibility, the more indigestible it becomes
Fiber
Hemicellulose, pectin, cellulose
Lignin
Digested by rumen microbes into glucose. Microbes use glucose for own needs, then convert the remaining into Volatile Fatty Acids (VFA)
Acetate
Butyrate
Propionate
Not utilized at all, indigestible
Represented by ADF on Forage Analysis


Acetate
Butyrate
Propionate
VFA absorbed through rumen wall carried by blood to liver
VFA to GLUCOSE in Liver
Rumen
Rumen wall
GLUCOSE to brain and body for functions and storage

Hay or feed

Minerals

Some will be used by the rumen microbes, remainder will by pass rumen and get absorbed for animal use

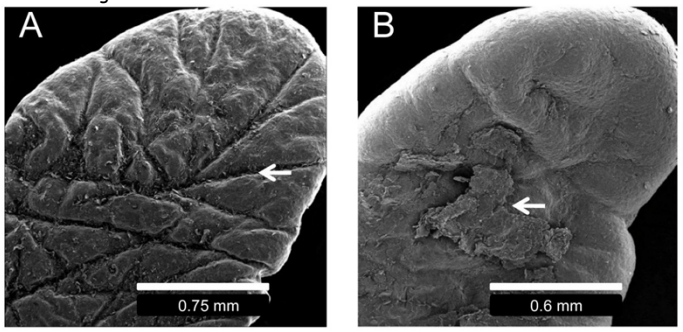
## Rumen Characteristics

| Characteristic | Forage Diet | Grain Diet |
|---|---|---|
| pH | 6.0 | 5.4 |
| VFA most produced | Acetate | Propionate |
| Microbe Population | Forage Digesters | Starch Digesters |
| Glucose Level mg/dL | 40-50 | 90-110 |
| Eff. Forage dig. | High | Low |

## Rumen Papilla

Forage Diet

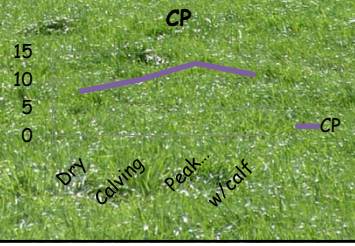
Grain Diet




Steele et al., 2009, Acta Vet Scandanavia, Vol 51:39

## Various Cattle Nutrient Requirements

- Cow
  - Body weight (maintenance)
  - Stage of gestation
  - Stage of lactation



## Cow

- When she needs it, she needs it!
  - Will have to supplement feed if forage quality not sufficient for needs

## Various Cattle Nutritional Requirements

- Growing Cattle
  - Bred Heifer
    - Challenge to manage
    - Two requirements
      - Cow
      - Growing animal

## Various Cattle Nutritional Requirements

- Growing Cattle
  - Heifers
    - Depends upon rate of gain
    - Targeted breeding dates?
  - Steers/Bulls
    - Depends upon rate of gain
- Feed supplementation not necessary
  - Graze poorer quality at times and take advantage of compensatory gain
  - Can supplement if desiring a targeted endpoint

## Complete Performance of Cattle Grown on Native Grass or Wheat Pasture[1]

| Item | Native Grass | Wheat Pasture |
|---|---|---|
| Nov. Initial Wt, | 505 | 505 |
| May Final wt, lbs | 613 | 895 |
| Feedlot performance | | |
| Days on feed | 130 | 88 |
| ADG lbs/d | 4.15 | 3.85 |
| Feed intake, lbs/d | 22.7 | 23.4 |
| Feed:Gain | 5.46 | 6.06 |
| Final wt, lbs | 1155 | 1221 |
| Carcass wt | 717 | 773 |
| Quality Grade[2] | 382 | 391 |

[1] Native grass was blue grama, tobosa, little bluestem, buffalo grass
[2] 300 select 400 Choice

Choat et al., JAS 2003.

## Various Cattle Nutritional Requirements

- Bulls
  - Growing are like steers/heifers
  - Older need to maintain BW and condition
  - Prior to going in for breeding

## Cattle Nutritional Requirements (Some Examples)

| | Cow 1200 lb peak lact. | Stocker (600 lb) gaining 2.5 | Stocker (800 lb) gaining 2.5 | Bred Heifer (1000 lb) |
|---|---|---|---|---|
| Intake, lb/d | 30 | 18 | 22 | 25 |
| CP | 12% | 12-13 | 11-12 | 9%-10% |
| TDN | 64% | 65-70 | 70 | 57% |

## Take Home

- Cows are in a symbiotic relationship with microbes
  - Must meet needs of both
- Protein in feeds (except for urea) has two fractions
  - UIP meets animal needs
  - DIP meets microbe needs

## Take Home

- Fiber content of forages provide energy for microbes (glucose)
- Microbes synthesize VFA from glucose
  - VFA become glucose outside of rumen for animal to use
- Lignin is indigestible
  - Represented by ADF in forage analysis report

## Take Home

- Rumen environment can change
  - Some changes might be irreversible
- Bovine Nutrient Needs
  - Heifer lactating
  - Cow lactating
  - Heifer Steer Bull Growing
  - Bull maintenance
  - Cow maintenance

## Questions and Discussion

## Forage Concerns

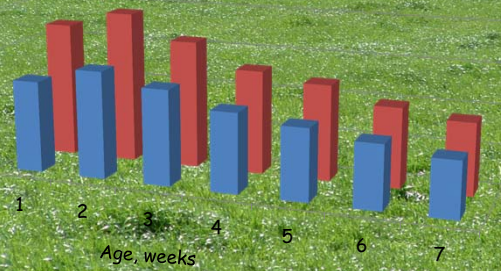
**Forage Quality**
Crude Protein
Digestibility

Producer Inputs
Stage of maturity used
Species
Time of year

Will determine the animal's utilization

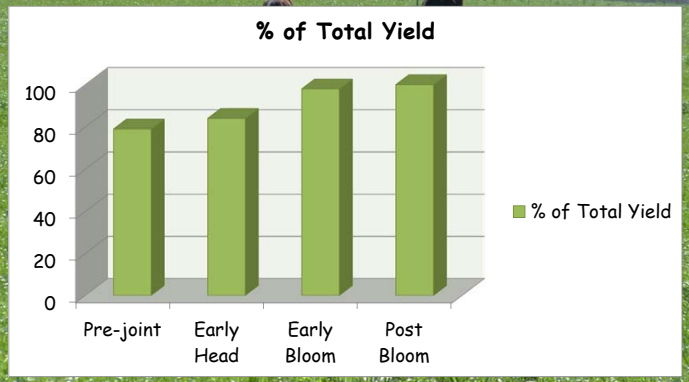
Supplement decision

## Maturity level on Nutrient Content




Coastal Bermuda, Ball, et al., 2002

## Effect of maturity on quantity of hay yielded

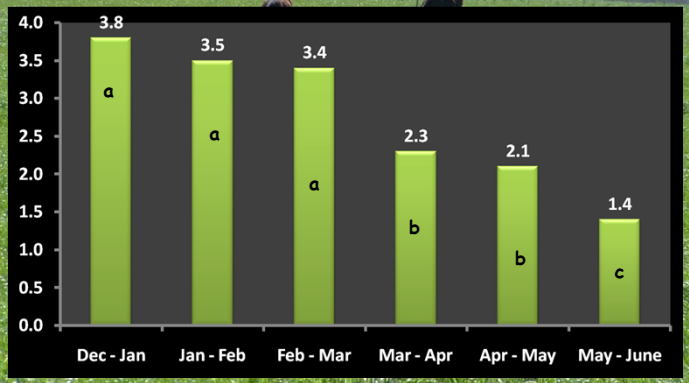



Ball, et al., 2002

## Maturity

- Tightrope of sorts
  - Quantity of hay produced
  - Quality of hay produced
- Changing dynamics of cattle requirements
  - Stockers/heifers

Period effect on average daily gain (ADG) of steers, estimated at 28-d intervals from December 2001 to June 2002, grazing Marshall ryegrass pastures




Macoon et al., 2008

## Producer Inputs

| | Control | Fertilized |
|---|---|---|
| Animal Grazing Days | 837 | 897 |
| Acres | 7.16 | 4.95 |
| Gain, lb | 242 | 238 |
| Gain/acre | 177 | 271 |

Smooth Bromegrass pastures, Nebraska

Greenquist, et al., 2009. J. Anim. Sci. 87:3639

## Yield and CP content of Kentucky Bluegrass and Tall Fescue Under Different N Applications

| Nitrogen Applied Lb/Acre | Kentucky Bluegrass Yield lb/Acre | Kentucky Bluegrass % Crude Protein | Tall Fescue Yield lb/Acre | Tall Fescue % Crude Protein |
|---|---|---|---|---|
| 0 | 700 | 12.8 | 1700 | 11.1 |
| 45 | 1600 | 15.5 | 2800 | 11.8 |
| 90 | 2100 | 19.1 | 3900 | 14.8 |

C2

## Forage Type

| | Bahia | Bermuda | Crabgrass | Sorghum S. grass | Millet |
|---|---|---|---|---|---|
| CP | 10 | 15 | 16+ | 16-22 | 14 |
| TDN | 50 | 55 | 55+ | 55-60 | 55 |
| Pests | None | Yes | Yes | Yes | Yes |

## Forage Type

| | Ryegrass | Fescue | Clover* |
|---|---|---|---|
| CP | 16+ | 13 | 22 |
| TDN | 60 | 55 | 60 |
| Pests | Blast, rust, FAW | Nematodes | weevils |

* While there are many varieties, data is general for white, ball and crimson

## Forage Type

Digestibility (from Animal)

Legumes

Cool Season Grasses

Warm Season Grasses

## Slide 33

**C2** I will leave KY BG since it does not grown in MS.
Cowboy, 8/15/2010

## Forage Type

Digestibility (from Animal)

Cooler weather also leads to less maint. Req from cattle

Legumes

Cool Season Grasses

Warm Season Grasses

Options available:

Accept lower quality and decreased performance

Supplement (stockers?)

Provide inputs for higher quality forage (fertilizer, and pest cont.)

## Winter Annual Production

| Species * | N rate** | Dates | Cow ADG | Calf ADG | Gain lb/A |
|---|---|---|---|---|---|
| Rye +clovers | 100 | Jan 8-Oct 5 | .90 | 1.91 | 511 |
| Arrowleaf and crimson clover | 0 | March 11 - Oct 5 | 1.37 | 1.94 | 410 |
| Ryegrass | 150 | Feb 14-Oct 5 | .81 | 1.76 | 422 |
| None | 100 | April 6-Oct 5 | .49 | 1.57 | 293 |

*Overseeded on bermuda pasture

** lb per acre per year

Hoveland, et al. Auburn

## Take Home

- Maturity, forage type, and inputs determine forage quality
- Legumes and cool season forages more digestible than warm season
  - Heat stress situations as well

## Questions

## Special Issues

- Nutritional Concerns
- Potential Pitfalls
- How to manage

## Pasture Bloat

Any highly digestible forage typically seen in legumes

Rapid consumption, leads to a foam forming in the rumen

This foam blocks gases from escaping

Animal can suffocate

Control graze, offer hay, ionophore blocks

## Nitrate Poisoning

Nitrates can accumulate in certain plants during periods of low moisture or humidity, esp. when heavily fertilized

Sorghum sudangrasses, pearl millet, pigweed, nightshade all potential problem plants

More than 1.5 % nitrate can cause problem.

Grazing heavily fertilized pastures

## Nitrate Poisoning

Nitrate consumed

Nitrite

Bind iron in blood reduce $O_2$ carrying capacity

Membranes of eyes are bluish, blood sample will be chocolate in color

## Prussic Acid

Often confused for Nitrate

Sorghum sudangrass, johnsongrass

Build up of prussic acid, esp. after a frost

Young tender growth after a drought (or not)

Prussic acid affects $O_2$ carrying capacity

Unlike Nitrates, prussic acid deteriorates over time

## Grass Tetany

Feb-April time with most likely chance of problem

Soil low in P, but high in N and K

Affects Mg uptake by plant
Broiler litter

Deficiency of Mg

Staggers, spasms, loss of coordination, possible death

Prevention is best option

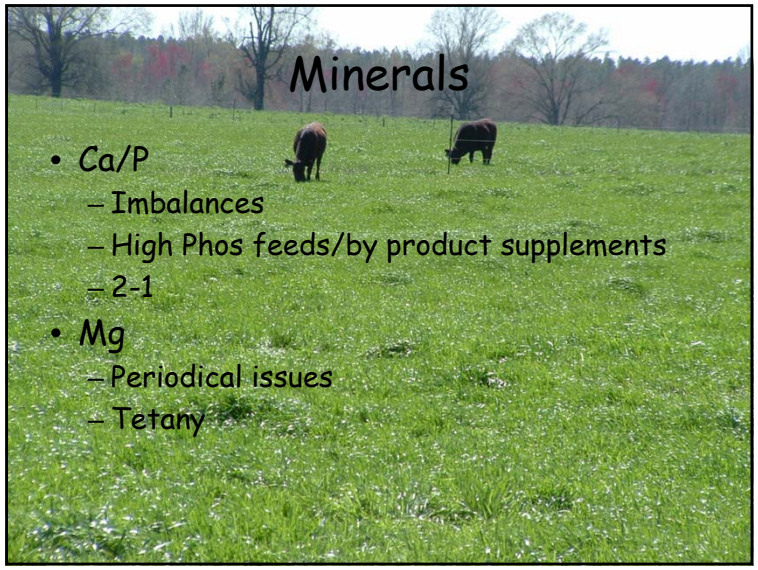
High Mg minerals
Use of legumes

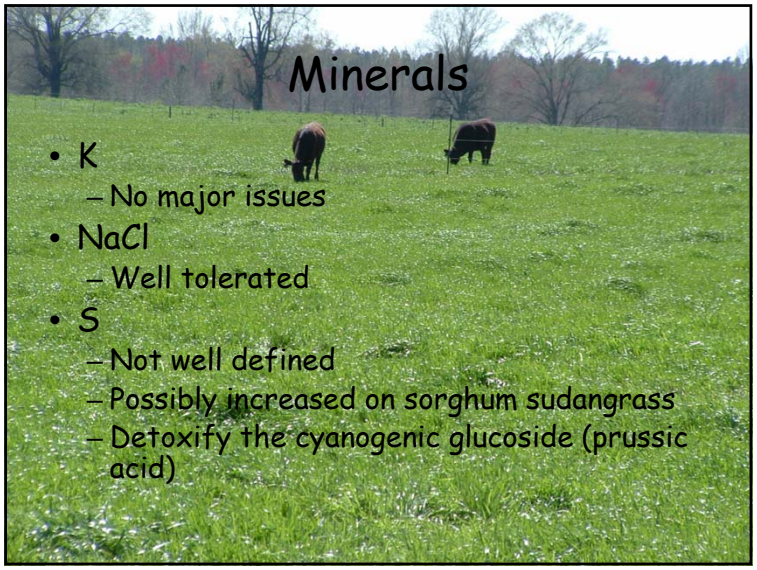
Dolomite

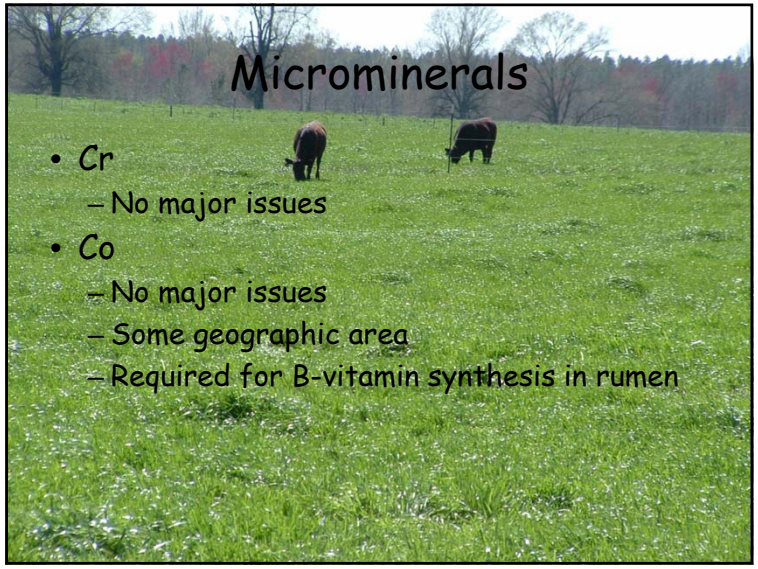
## Questions

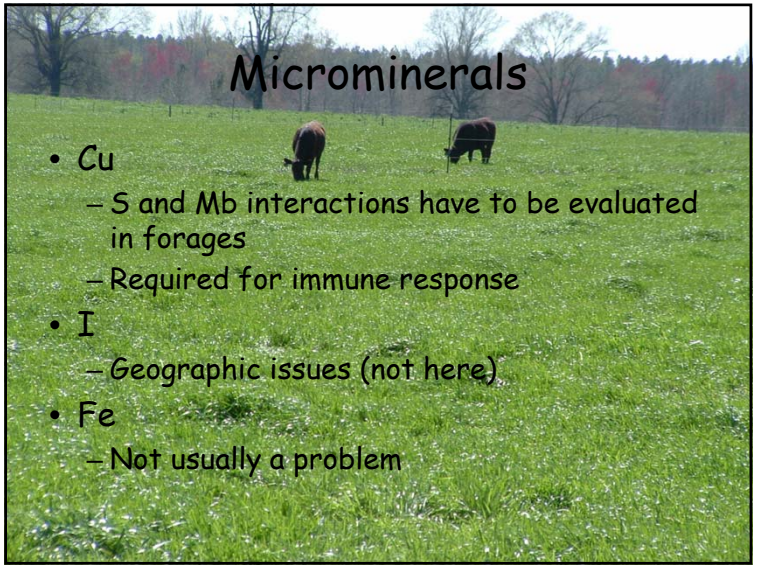
## Minerals

- Ca
  - Most forages/legumes will have enough
  - Feeding anything with high P, may increase need
- P
  - Areas where **low** in forages may benefit from supplementation
    - Reproductive performance
      - TX Data
      - LA Data (Holsteins)


Minerals
• Ca/P
– Imbalances
– High Phos feeds/by product supplements
– 2-1
• Mg
– Periodical issues
– Tetany


Minerals
• K
– No major issues
• NaCl
– Well tolerated
• S
– Not well defined
– Possibly increased on sorghum sudangrass
– Detoxify the cyanogenic glucoside (prussic acid)


Microminerals
• Cr
– No major issues
• Co
– No major issues
– Some geographic area
– Required for B-vitamin synthesis in rumen


Microminerals
• Cu
– S and Mb interactions have to be evaluated in forages
– Required for immune response
• I
– Geographic issues (not here)
• Fe
– Not usually a problem

## Microminerals

- Mn
  - May be related to Ca and P
- Se
  - Geographically deficient
  - Immune function
  - Stress
- Zn
  - Higher in legumes
  - Immune response, structural component

The good news is that by feeding a COMPLETE BEEF MINERAL 95% of issues will be resolved

Mg is the only concern we have at times

Ca/P relationship depending upon supplementation, and soil test

## Mineral Management

- Monitor intake
  - Excessive
    - Usually driven by salt
    - Not driven by need
  - Mineral package is like medication
    - Based upon a range of intake
    - Read label
- Mineral feeder for 25-30 head

## Chelated Minerals

- Zinpro, Alltech, etc.
  - Micromineral Cu, Zn, Mn, Co chemically attached to an organic substance (sugar, seaweed, protein, etc)
  - Facilitates absorption
    - Consistent results in poultry and swine
  - Data variable in ruminants
    - Difficult animal models
    - Zinpro/Optaflexx feedyard data

## Vitamins

- A, D, E
  - Actually required by animal
  - A in green forage
  - D sunlight
  - E forage
- B vitamins
  - Functional rumen should produce its own source
  - Offered in feed destroyed in rumen

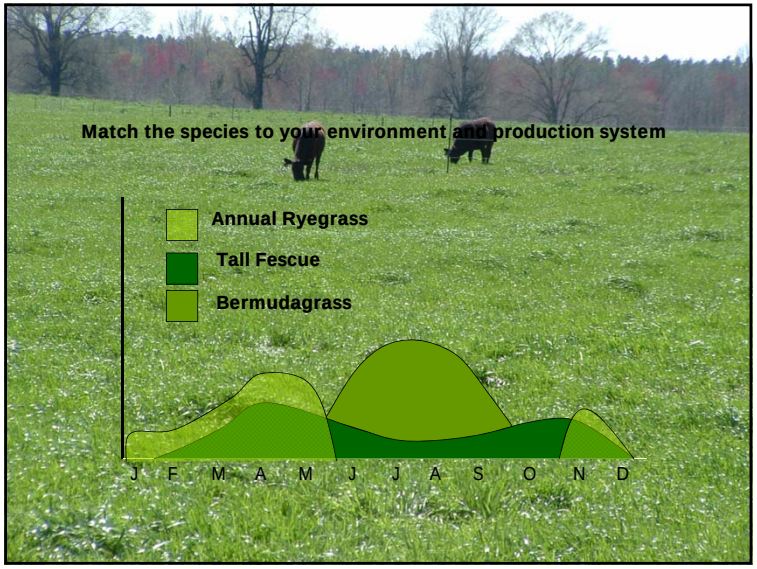
## Take Home

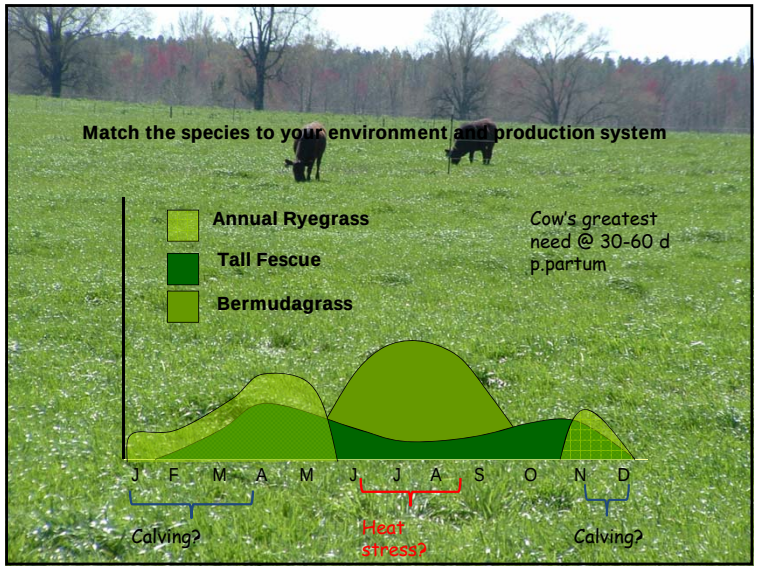
- Year round feeding of a good quality beef mineral can take care of most issues
- Mg is mineral of concern
- Chelates may or may not be beneficial

## Supplementation Programs

- Meet a deficiency in cow nutrient requirements
  - If managing forage and cows/calves correctly should not need to supplement (other than mineral)

Stockers?







## Stockers

- Targeted rate of gain
- Summer pasture not the best
- High quality summer grasses
  - Can be grown
  - Fertilizer concerns
  - Weather
  - Bugs/Pests

## Stockers

- Mixed summer grass
  - 11% CP
  - TDN (52%)
  - 650 lb yearling
  - Eating about 55 lbs of grass daily (16.5 Dry matter)
  - Will gain 1 lb/day
    - Not considering heat stress conditions

White Sands Pasture Sample, July 2010

Calculated using NRC equations

## Supplement

- Mixed feed
  - CP% 14.66
  - TDN 68
  - Fed at 9 lbs per head (8.2 dry matter basis)
  - $150/ton
  - Fed alone will get .54 lb ADG

## Stockers

- Feed together
  - 2.12 (calculated)
  - 2.05 (actual)

Data from W. Givens
Monticello, MS

## Supplements

- Should compliment forage
- Do not want animals on FULL FEED

## Supplementation

| | Control Pasture | Fertilized Pasture | Supplement/ no Fert |
|---|---|---|---|
| Anim.Grazing days | 834 | 897 | 884 |
| Area | 2.90 | 2.01 | 2.01 |
| BW gain kg/ha | 197 | 302 | 404 |
| ADG, kg/d | .68 | .67 | .92 |

Supplement: 5 lbs of DDG per head daily (30% CP, roughly 65% UIP)

## Supplementation Data

| Item | Control | High Starch | High Fiber | High Fiber Free choice |
|---|---|---|---|---|
| Supplement intake, lbs | 0 | 4.21 | 4.27 | 4.98 |
| Daily gain (115 d) | 2.14 | 2.205 | 2.36 | 2.25 |
| Conversion (supp) | - | 5.9 | 4.8 | 6.4 |
| Final BW | 710 | 716 | 732 | 725 |

OSU data

## What's wrong with this Picture

## Calculation of Supplement Needs

Our cow needs 12% CP and 62% TDN, she is eating about 30 lbs DM

Our pasture gives us 10% CP and 57% TDN

| Needs | - | Supplied | = Status |
|---|---|---|---|
| 12 | - | 10 | = 2% Short on CP |
| 62 | - | 57 | = 5% Short on TDN |

Our supplement has 25% CP and 75% TDN

2% need on CP/.25 = 8 % of diet to meet CP
5% need on TDN/.75 = 6.7% of diet to meet TDN

Which is the bigger value?

Our cow needs 12% CP and 62% TDN, she is eating about 30 lbs DM

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| Needs | - | Supplied | = Status |
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Our supplement has 25% CP and 75% TDN

2% need on CP/.25 **= 8 % of diet to meet CP**
5% need on TDN/.75 = 6.7% of diet to meet TDN

Which is the bigger value? 8% of total diet will meet CP and TDN (since TDN only required 6.7%)

30 lbs x 8% = 2.5 lbs per animal daily of protein supplement


## Take Home

- Supplementation
  - Based upon forage quality and animal needs
  - Tie into stage of production, and desired outcomes
  - Supplement ONLY what you need

## Questions