Dairy Extension

Educating the dairy industry on today's and tomorrow's dairy technologies.

Smooth Transitions: Feeding Heifers for a Smooth Transition into Lactation

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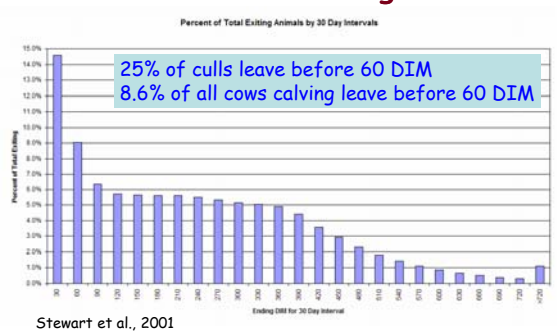
Today's Discussion

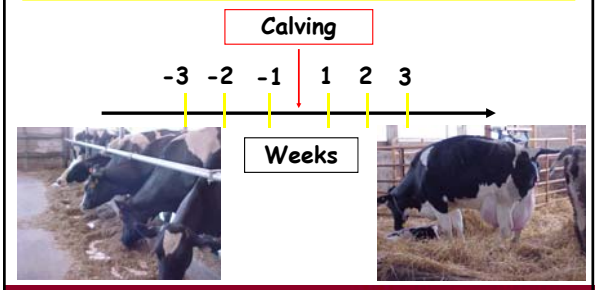
- Fresh cow health challenges.
- Feeding strategies to minimize health challenges.
  - Controlled energy diets
- Focus on optimizing forages for dry cows.
  - Forage type
  - Forage management

When are cows leaving herds?



Stewart et al., 2001

Transition Period



The problems with primiparous heifers are.....

- They are likely not a producers first priority.
- Producers may not harvest or purchase forages with dry cows or primiparous heifers in mind.
  - Often "too good"
- Dry cows and primiparous heifers do a poor job of moderating energy intake

Effects of Problems At Parturition on Performance

	Stillbirth	RP	Dystocia	Metritis
Milk Yield, lb	-399.4	-526.1	-381.7	215.3
Days open	-1.0	+31.1	+48.6	+25.1
Calving Interval	-1.5	+33.1	+44.7	+27.2

N= 1144 heifers (Florida)
1959-1979
Simerl et al., 1992

Item	Incidence in first calf heifers
RP, %	3.3
LDA, %	2.9
Day @ DA	20.1
Lameness, %	15.1
Mastitis, %	19.4
Day @ Mastitis	97.9
Mortality, %	3.9
Culling After Calving, %	17.6
Proportion leaving the herd before 310 DIM	21.7

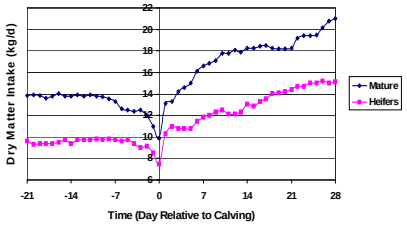
Ettema and Santos et al., 2004
N= 1905 heifers

What happened?

Transforming the Springing Heifer

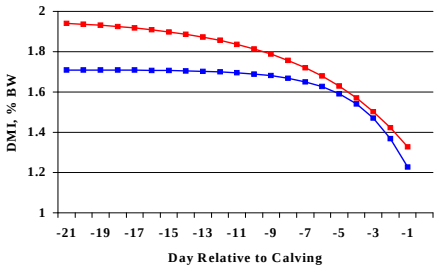
- Unique nutrient requirements
  - Growth @ 1.5+/day
- Mammary gland development
- Lower DMI
- BCS has less impact on heifers
- Different protein requirements
- Social challenges

Change In DMI At Calving



Robinson and Garrett, J. Animal Sci. 77:988-999, 1999.

NRC 2001 Heifer vs Cow



Energy (NE_L) requirements 2 days before versus 2 days after calving

	1550 lb cow		1250 lb heifer	
Function	Pre	Post	Pre	Post
Maintenance	11.2	10.1	9.3	8.5
Pregnancy	3.3	...	2.8	...
Growth	...	...	1.9	1.7
Milk Production	...	18.7	...	14.9
Total (Mcal)	15.5	28.8	14.0	25.1
Typical Intake	14-17	19-21		

Dry cows will easily consume more energy than they require

NE_L (Mcal/lb)	DMI (lb) for 15 Mcal	NE_L (Mcal) at 27 lb DMI
0.60 (high straw)	25.0	16.2
0.64	23.4	17.3
0.68	22.0	18.4
0.72 (typical close-up)	20.8	19.4

High-energy diets predispose cows to health problems

- May not be a problem in well-managed herds
- If intake is interrupted (stressors, disease, poor management, etc.)
- Overfed cows are more likely to develop subclinical ketosis, fatty liver, and other problems.

The Smorgasbord Affect

- Cows fed a moderate-energy diet (0.69-0.73 Mcal NE_L/lb DM) will consume 40-80% more NE_L than required during the dry period.

(Drackley and Janovick-Guretzky, 2007)

Hepatic Lipidosis (Fatty liver)

Occurs when the rate of triglyceride synthesis exceeds the rate of oxidation and export.

Fatty Liver

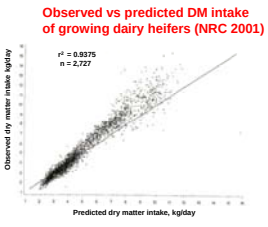
Healthy Liver

Problems with Excessive Energy Intake

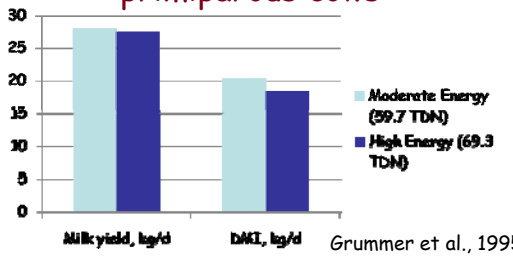
- Increased reliance on the diet and less on their own resolve.
- Metabolically lazy:
  - Fat burning capacity ↓
  - Glucose production ↓
  - Insulin resistance
    - Similar to Type II diabetes in humans

First Calf Heifers and DMI

- % of Body weight
  - 3% around weanin
  - 1.8% near calving



Effect of prepartum energy intake on lactation in primiparous cows



Grummer et al., 1995

Effect of prepartum energy intake on lactation in primiparous cows

	Treatment			
Item	Moderate energy (59.7 TDN)	High energy (69.3 TDN)	SEM	*P* (prepartum effect)
NEFA, µM	572	720	2.0	0.01
BHBA, mg/dL	12.6	21.2	0.3	.01
Liver TG, % of DM	4.4	5.6	0.7	.10

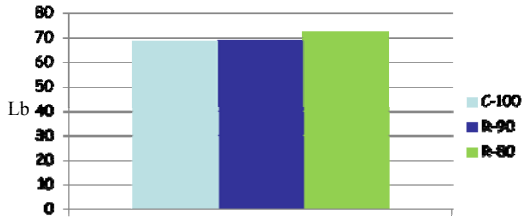
Grummer et al., 1995

Effect of Prepartum Dietary Protein Amount

	Treatment			
Item	Moderate Protein (12.7%)	High Protein (14.7%)	SEM	*P* (prepartum effect)
Milk, kg/d (120 DIM)	30.4	32.4	0.38	0.03
Prepartum NEFA, mEq/L	0.093	0.171	.01	0.09
Postpartum NEFA, mEq/L	0.229	0.260	0.03	0.93

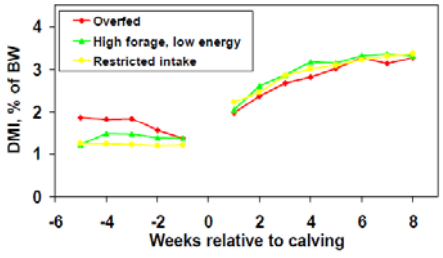
Santos et al., 2001

Limit Feeding Approach



Hoffman et al., 2007

Avoid Overfeeding Energy During the Far-off Dry Period



Janovick Guretzky and Drackley, 2006

Changes in Blood Calcium

Cow Description	Blood Calcium Levels
Normal lactating cow	8.4-10.2 mg/dL
Normal at calving	6.8-8.6 mg/dL
Milk fever (slight)	4.9-7.5 mg/dL
Milk fever (moderate)	4.2-6.8 mg/dL
Milk fever (severe)	3.5-5.7 mg/dL

Milk Fever Prevention

- Feeding diets with anionic salts during the close-up dry period PREVENTS milk-fever and hypocalcemia.
- Minimizing dietary
  - Potassium
  - Sodium

How do I know what my DCAD is?

Step 1. All feed must be tested for sodium, potassium, sulfur, and chlorine.

Step 2. DCAD equivalents are calculated using this formula:

DCAD = (Na + K) – (Cl + S)

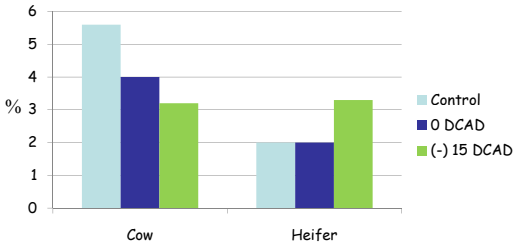
Effects of Anionic Salts on Blood Calcium (Moor et al., 2000)

	Treatment			
	Control	0 DCAD	-15 DCAD	SEM
Item				
		Cows		
iCa prepartum, mg/dL	4.4	4.7	4.9	0.09
iCa calving, md/dL	3.7	3.8	4.3	0.17
		Heifers		
iCa prepartum, mg/dL	4.7	4.8	4.9	0.05
iCa calving, md/dL	4.4	4.6	4.6	0.05

Effects of Anionic Salts on Intake and Energy Balance (Moor et al., 2000)

	Treatment			
	Control	0 DCAD	-15 DCAD	SEM
Item				
		Cows		
Prepartum DMI, kg/d	15.5	14.4	13.0	1.6
Energy balance, Mcal/d	8.42	8.24	6.01	2.6
		Heifers		
Prepartum DMI, kg/d	10.5^{a}	9.6^{bc}	8.0^{bd}	0.5
Energy balance, Mcal/d	3.75^{a}	2.62^{bc}	0.09^{bd}	0.9

Effects of DCAD on Liver Triglyceride (Moore te al., 2000)



Forages are an Important Source of Macro Minerals for Dry Cows

- Amount:
  - Potassium (K) in forages:
    - Legumes 2.0 - >3.0%
    - Grasses 1.5 - >3.0%
    - Corn Silage 1.5 - >3.0%
- Availability 85-90%
- Interactions
  - High level of K will ↓ Mg absorption

Udder Edema

- Minimize:
  - Salt intake
  - High K and Ca
  - Avoid overfeeding grain
- Prepartum milking
- 3 X milking

Diet is an important component, but not the whole story…

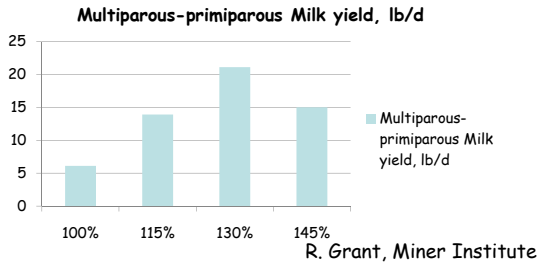
- Cows need low stress, comfortable non-crowded environments.
- Stressors decrease DMI, increase NEFA, divert nutrients from milk to stress response and immune system.

Behavioral Differences Between Cows and Heifers

- Heifers take smaller bites and spend more time feeding.
- Use of less desirable stalls
- More time grooming and fighting
- Struggle with overcrowding.
  - Animals lowest on social hierarchy affect to a greater extent.

Stress: Overcrowding and Pen Movement

Effects of Stocking Density



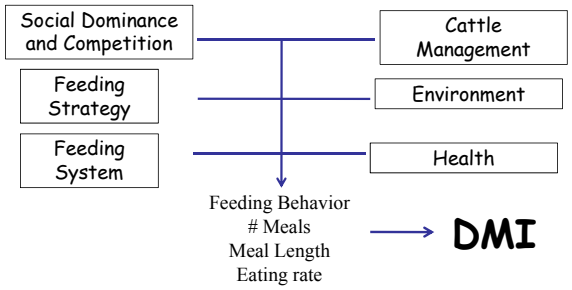
R. Grant, Miner Institute

Feeding behavior of primiparous cows housed alone or with multiparous cows

	Treatment		
	PP	PP + MP	SEM
Item			
Total eating time, min/d	163.5	192.9	6.3
Meal size, kg of DM/meal	3.45	4.20	0.4
Number of meals/day	4.9	4.0	0.4
Total DMI, kg/d	18.1	18.7	0.9

Bach et al., 2006

Control of DMI



Evaluation Tools

- First lactation animals:
  - Target an 8% increase in milk per day for the first 18 days of lactation.
  - A problem exists if:
    - There is no increase in milk yield.
    - Milk yield is less than 65 lb/d at 30 DIM.

What should a dry cow diet offer?

- Avoid excessive energy intake.
  - Offered at an ad libitum rate.
- Address minerals
  - Milk fever prevention.
- Consistent and high quality.
- Optimize milk production.
- Minimize metabolic disorders postpartum.

Dry Cow feeding Strategies

1. Roughing it
2. Steam-up feeding
3. Limit feeding
4. High bulk, moderate energy diets

"Roughing it" strategy

- Concept:
  - Feed dry cows only poor-quality roughages and other ingredients to minimize the potential for excessive intake.
- Problem:
  - Excessive variation of ingredient quality.
  - Inconsistent intake of nutrients.
  - Imbalanced nutrient profile.

"Steam-up" Feeding

- Concept:
  - Feed a high energy diet to maximize energy intake.
  - Stimulate rumen
  - Adjust to lactation ingredients
- Problem:
  - Metabolic "laziness"

"Limit Feeding" Strategy

- Concept:
  - Feed to an empty bunk.
- Problem:
  - Need adequate bunk space.
    - Negative social issues
  - Bunk management is key.
  - Variable feed intake.
  - Lack of diet bulk/rumen fill.

High bulk/low energy

- Concept:
  - Low energy diet formulated for ad libitum consumption.
  - Feed a diet of sufficient fiber (bulk) so cows cannot over-consume energy.

The "Goldilocks diet" to the Rescue?

- Not excessive energy…
- Not restricted energy…
- But, just right!

Controlled energy Dry cow diets should allow ad libitum access to feed without allowing cows to over-consume energy

Controlled energy means less or more energy

- May need to dilute energy density
  - If feeding high corn silage and alfalfa
- May need to increase energy density
  - If feeding poor quality roughaghes.

Item	Recommendation
Dry matter intake	30 lb/cow/day (60 lb as-fed)
Ration dry matter	50%
Energy density	0.60 Mcal NE_L/lb of dry matter
Crude protein	12-14% of Dry Matter
Metabolizable protein	1,000 g/cow/d
Starch	12-16% of dry matter
Forage NDF	40-50% of DM (0.7-0.8% of body weight)
Vitamins and Minerals	Follow NRC, 2001 recommendations

Forage Options for Dry Cows

- Corn silage
- Straw
  - Wheat straw
  - Oat straw
  - Barley straw
- Grass hay
- Corn stocks
- Sorghum silage
- Tropical corn silage

What should dry cow forages provide?

- Moderate energy density
- Palatable
- Free of negative nutritional factors
- Address mineral imbalances
- Provide rumen fill

Corn Silage

Should not provide greater than 50% of forage dry matter (Overconditioning)

Advantages:

- Adds moisture
  - 65%
- Low protein
  - 8%
- Highly palatable
- Low Calcium
  - 0.25%
- Low Potassium
  - 1.1%

Disadvantages:

- High moisture
- High NE_L
  - 0.7 Mcal/lb
- High starch
  - 30%
- Low fill factor (eNDF)
- High sorting
- Avoid poor quality

Wheat Straw

Advantages:

- Low energy
  - 0.3 Mcal/lb
- Excellent bulk
  - 74% NDF
- Palatable
- Consistent
- Low calcium
  - 0.34%
- Moderate potassium
  - 1.4%

Disadvantages:

- Low moisture
  - 8%
- Processing challenges
- Sorting issues

Reasons for Use of Wheat Straw in Dry Cow Diets

- Dilute the energy density of the diet.
- Dry out "wet" diets
  - High byproduct diets
- Alter the dietary cation:anion ratio
  - Milk fever prevention

Dry Cow Diets Affected Cows During the First 10 Days in Milk

	Straw	Overfed	Limit-fed
Variable			
DMI, % of BW	2.5	2.2	2.5
Energy balance, % of requirements	88	80	93
NEFA, micro M	787	792	627
Milk, lb	65.3	57.2	58.1

Dann et al., 2006

Example Diet

Ingredient	% of Diet Dry Matter
Corn Silage	35.3
Chopped wheat straw	31.8
Chopped alfalfa hay	17.1
Corn grain, ground, dry	3.6
Soybean meal, solvent, 48%	5.1
Expelled Soy	4.0
Urea	0.9
Minerals and vitamins	2.2

Example Diet Composition

Chemical composition	%
Forage NDF	50.4
NFC	25.4
Crude protein	14.4
Metabolizable protein (grams)	1,085
NE_L, Mcal/lb DM	0.62

Wheat Straw Composition

Component	Mean	Standard Deviation
DM, % as fed	93.3	0.82
CP, % of DM	3.8	0.83
NDF, % of DM	79.6	3.7
ADF, % of DM	53.3	2.9
NFC, % of DM	11.6	3.0
Ca, % of DM	0.27	0.11
K, % of DM	1.30	0.12

Values are from 21 monthly composite samples from two experiments (Dann et al., 2006; Janovick Guretzky et al., 2006) analyzed by wet chemistry (Dairy one, Ithaca, NY)

Evaluating Nutrient Composition of Straw

- Obtain a representative sample.
- Limited data for NIR prediction of straw composition.
  - Check with your lab.
- Be safe: Use wet-chemistry.
  - Important for minerals (limited spectra absorbance)

Straw Particle Size Guidelines

- Weigh-back should be less than 10% different in particle size and nutrient composition.
- Penn-State Particle Size Box:
  - Top screen: ~10-15%
  - Middle screen:~40%
  - Bottom pan: ~40-50%

Sorting Issues

Sorting Example

Normal TMR

- CP- 15.5%
- NDF- 40.1%
- ADF- 25.8%
- NFC- 36.5%
- NE_L- 0.68 Mcal/lb DM

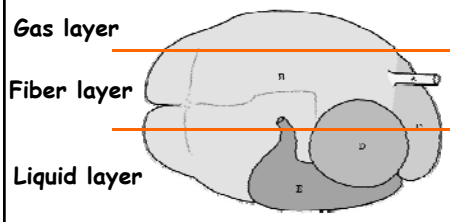
Sorted TMR (ate ½ of the straw)

- CP- 17.6%
- NDF- 33.9%
- ADF- 21.6%
- NFC- 41.0%
- NE_L- 0.73 Mcal/lb DM

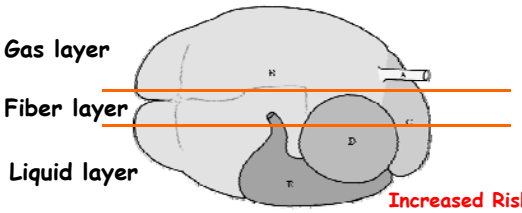
Feeding Behavior Advantages?

- Prepartum eating time
  - 5 hours daily?
- Rumen
  - Stretch
  - Muscular tone
  - Rumination time
  - Reduce change

Normal Rumen Fill

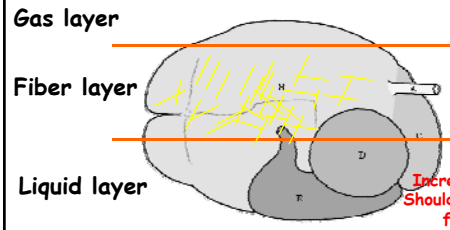


Off-Feed Rumen Fill



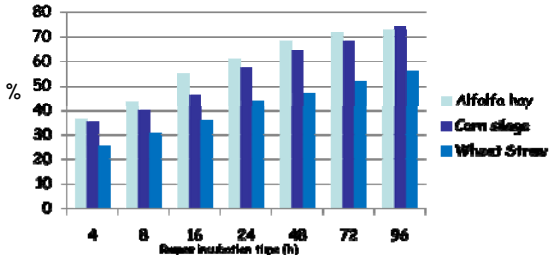
Increased Risk for Displaced Abomasum

Rumen Filled With Wheat Straw

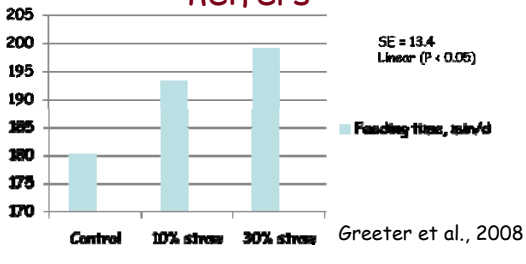


Increased Rumen Fill Should Reduce the risk for Abomasal Displacement

In Situ Dry Matter Disappearance of Forages



Wheat Straw increased feeding time in growing heifers



Greeter et al., 2008

Advantages and Benefits of High Straw Diets

- Straw and corn silage generally are low in potassium.
  - Helps prevent milk fever
  - May reduce the amount of anionic salt mixture to decrease the DCAD.

Advantages and Benefits of High Straw Diets

- Simplified dry cow management and ration changes
  - Feed one TMR with two different mineral mixes.
    - Far-off group
    - Close-up group
      - Essentially the same diet, but with concentrate mix incorporating anionic salts, extra vitamins and minerals, additional protein, and selected feed additives.

Controlled Energy Diets are a Dry period Strategy, not a close-up or pre-fresh strategy only

- Allow 7-10 day adjustment
- May observe reduced intake

Small Grain Straw Comparison

Component	Wheat Straw	Oat Straw	Barley Straw
DM, % as fed	93.6	93.3	93.1
CP, % of DM	4.6	4.8	4.4
NDF, % of DM	78.8	77.0	77.3
NDFD, % of NDF	39.0	45.0	39.8
NFC, % of DM	9.7	9.7	11.5
Ca, % of DM	0.23	0.32	0.45
K, % of DM	1.24	2.12	1.44
Ash, % of DM	7.7	8.8	7.2

Values are from: Anderson and Hoffman: Focus on forages Vol 8: No 1.

Alfalfa Silage

Limit to less than 30-50% of forage DMI

Advantages

- Moderate moisture
  - 60%
- Moderate NE_L
  - 0.61
- Moderate fill factor
- Minimal sorting (palatable)

Limitations

- High crude protein
  - 21%
- High potassium
  - 2.8%
  - Udder edema and milk fever
- High Calcium
  - 1.4%

Grass Hay

Advantages:

- Low moisture
  - 10%
- Moderate crude protein
  - 11%
- Moderate NE_L
- High fill factor (NDF)
  - 60%
- Moderate Calcium
  - 0.5%

Disadvantages:

- High Potassium
  - 2.0%+
- Higher energy than straw
- More digestible
- More rapid rate of passage
- Potential for sorting

Dietary Cation Anion Difference of Five Cool-season Grasses

	Spring growth	Summer regrowth
	DCAD mmol Kg^{-1} DM	
Orchardgrass	656	633
Meadow bromegrass	540	569
Tall fescue	510	496
Smooth bromegrass	490	447
Timothy	384	332

Tremblay et al., 2006

Moderating Forage Potassium

- Select low K fields for production of dry cow forages.
  - Soil test
  - Monitor manure application
- Delayed harvesting
  - Forage K declines with increasing maturity.

Management of Dietary Potassium

- When low K forages are not available:
  - Far-off dry cows and springing heifers ("higher" K forages)
  - Close-up dry cows (lower K forages)

Challenges With Processing Grass Hay

- Time consuming
  - "Mixer A" 45 minutes
  - "Mixer B" 35 minutes
  - "Mixer C" 22 minutes
- Challenge to evaluate particle size
- Management of round bales

Sorghum Silage

Advantages:
- Adds moisture
  - 70%
- Moderate energy
  - 0.53 Mcal/lb
- Moderate starch
  - 10%
- Low protein
  - 9.5%
- Low calcium
  - 0.5%

Disadvantages:
- High Potassium
  - 1.9%
- Less digestible
  - %IVTD 24hr 67%

Corn Stalks

Advantages:
- Low energy
  - 0.36 Mcal/lb
- Low starch
  - 5%
- Moderate calcium
  - 0.5%
- Moderate potassium
  - 1.3%
- Excellent bulk
  - 71% NDF

Disadvantages:
- High ash
  - 8.6%
- Low moisture
  - 15%
- Sorting challenges
- Beware of molds

Corn Stalks

- Processing challenge (Particle size)
- Winter feed
- Spring moisture a challenge
- High ash content (7%+)

Tropical Corn Silage

Advantages:

- Low energy
- Low starch
- High fiber
- High yield tonnage
- Low protein
- Potassium?

Disadvantages:

- Late harvest
- Difficult to get seed
- Limited research

Avoid Challenging Primiparous Cows

- Overfeeding energy
- Keep an eye on DCAD
- Social Stress
  - Overcrowding

Forage Selection for dry cows

- There is no single perfect forage for dry cows.
- Diets based on corn silage and either wheat straw or grass can be successful.

Take Home Messages

- Moderate energy diets for dry cows show promise.
- Use low energy, high bulk forages, with favorable mineral profiles.
- Allow cows to consume at an ad libitum rate without over-consuming energy.

Any Questions?