K·STATE
Research and Extension

Forage Inventory Considerations: Managing Now and Looking Ahead

Brought to you by:

K-State Beef Extension Team

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

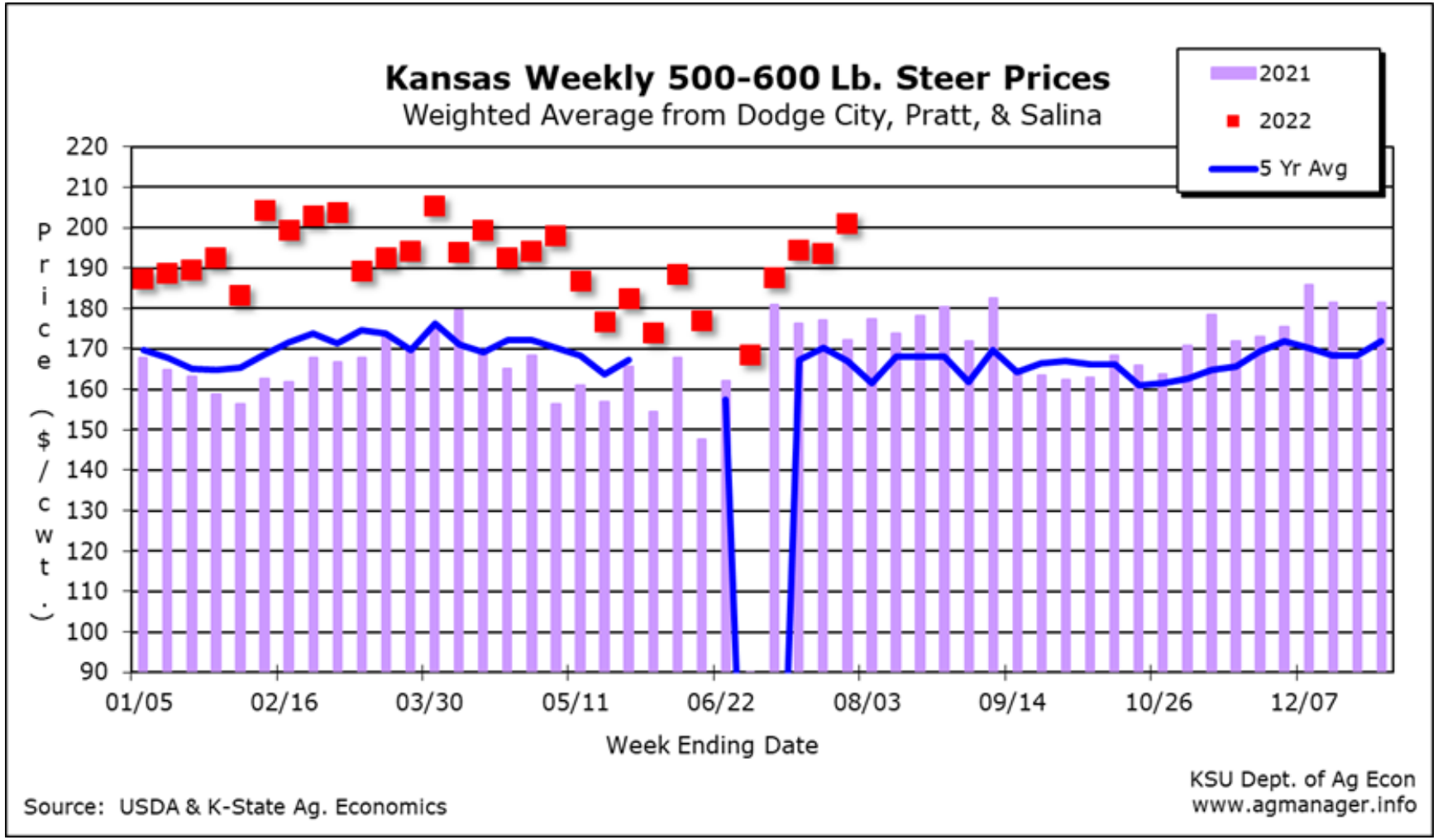
What Should We Prepare For?

- Continued dry conditions
  - Limited production of winter annual forages for grazing
  - Likely low supplies of harvested forages
  - Delayed grass growth/production next spring and early summer
- High prices for feed commodities and forages
- Reduced water supplies in ponds, dams, springs
- Strong prices for bred females and feeder calves…?

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

KS Feeder Cattle Prices (Current vs. Last 5 Yrs



K STATE BEEF
KSUBeef.org

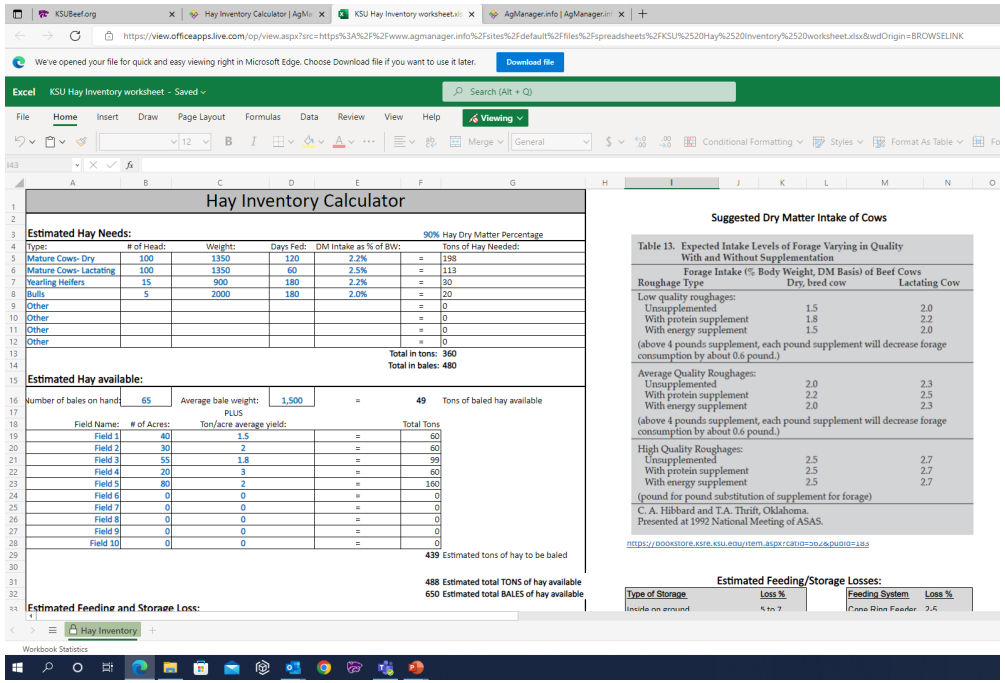
Developing or Re-Evaluating Your Forage Plan

Key Points:

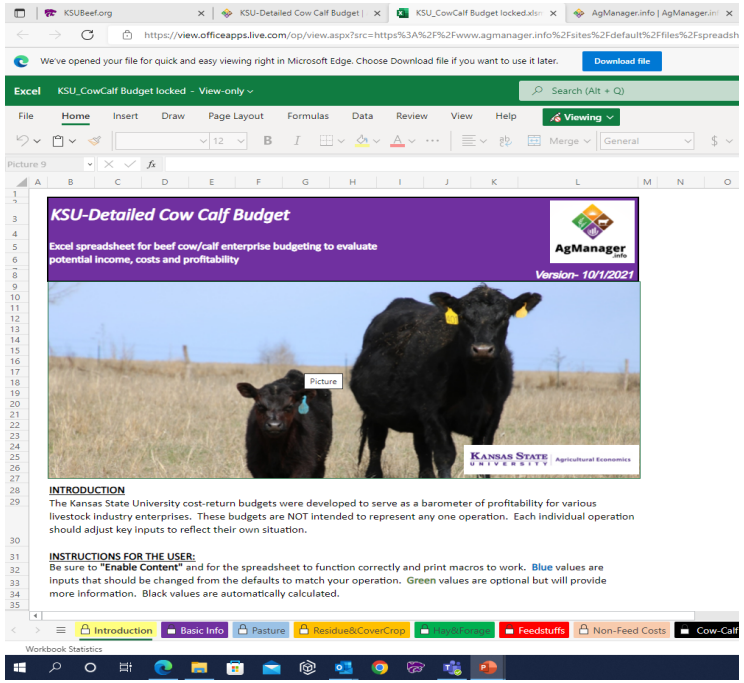
1) Know your herd inventory (accurately account for intake)
   - # of head, weight, & projected inventory changes
2) Know your feed inventory (inventory of tonnage and quality)
   - Baled hay, silage, co-products, grain
3) Calculate harvested forage needs if grazing is limited
4) Consider all your alternatives
5) Minimize any feed/forage shrink
6) Be flexible, remain calm, manage, look for opportunities

KSU Decision Support Tools

https://www.agmanager.info/hay-inventory-calculator



https://www.agmanager.info/farm-mgmt-guides/livestock-budgets/ksu-detailed-cow-calf-budget



Drought Supplementation is Not Normal

- Normal supplementation program
  - Adequate supply low/moderate forage
    - Less than 7% CP
    - Protein 1st limiting

- Drought situation or limited grazing
  - Energy 1st limiting nutrient followed by protein
  - Replace forage with hay or fiber-based supplement
  - Feed combination supplements that supply both energy and protein

K·STATE
Research and Extension

BEEF COW SUPPLEMENT DECISION GUIDE*

Does each cow have all she can eat in the pasture?

YES
Forage supply is adequate

NO
- Forage supply is inadequate; energy deficient
- Reduce the forage needs of herd by lowering stocking rate and/or feeding supplement

What color is the forage? (YES)

BROWN
Protein is likely <7% and limiting forage intake and digestion

GREEN
No supplement
- Protein is sufficient
- Energy is sufficient

Are cows in adequate body condition (i.e., ≥4.5)?

YES
Supplement with ≥32% CP
- 0.1 to 0.3 % BW/day
- improve rumen efficiency
- price $/lb CP

NO
Supplement with 28-32% CP
- 0.25 to 0.40 % BW/day
- improve rumen efficiency
- provide extra energy
- consider $/lb CP and $/lb TDN

What color is the forage? (NO)

GREEN
Supplement energy with <20% CP
- 0.4 to 0.8 % BW/day
- Protein is sufficient
- Energy is deficient
- Price $/lb TDN

BROWN
Supplement with 20-28% CP
- 0.3 to 0.5 % BW/day
- Energy is deficient
- Protein is likely <7% and limiting forage digestion
- consider $/lb TDN and $/lb CP

If forage shortage is severe
Supplement with <20% CP
- 0.4 to 0.8% BW/day
- Price $/lb TDN

**This decision guide is a general tool and is not as accurate as measuring actual forage quality and quantity to develop a strategic supplementation program for a specific class of cattle.*

Mathis 2006

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

Supplement Delivery "Rules of Thumb"

- Energy supplements
  - Daily or every other day
- Protein supplements < 30% CP
  - Daily or every other day
- Protein supplements > 30% CP
  - Infrequently as 1 time per week

K STATE BEEF
KSUBeef.org

Supplement Programs

- Based on the assumption that animals consume the supplement at the targeted amount
  - Forage quality
  - Supplement form/type
  - Delivery method
  - Social behaviors

Supplement Consumption % non-eaters

- Supplement delivery method
  - Hand Fed = 5%
  - Self Fed = 19%

- Supplement type
  - Blocks = 14.3%
  - Dry Supplements = 15%
  - Liquid Supplements = 23.5%

Bowman and Sowell, 1997

Supplementing pairs on bromegrass pastures (Warner et al., 2015)

	3.82 AUM/acre	2X with Supp
Cow ADG, lb	0.42	0.62
Calf ADG, lb	2.27	2.37
Grazed forage intake, lb DM/pair	41.0	26.3
Supplement intake, lb DM/pair	--	15.7
Total DMI, lb/pair	41.0	42.0

K·STATE
Research and Extension

Managing Nitrate and Prussic Acid Issues

K STATE BEEF
KSUBeef.org

Forage Challenges

Nitrate Accumulators

Barley
Corn
Flax
Oats
Radishes
Rape
Rye
Soybeans
Sugar beets
Sweetclover
Turnips
wheat

Canada Thistle
Curly Dock
Jimsonweed
Kochia
Lambsquaters
Nightshade
Pigweed
Russian Thistle
Smartweed
Wild sunflower

Prussic Acid

Common milkweed
Wild cherry
Black night shade
Horsenettle

Sorghums
Sorghum-sudans
Sudan grass
Millets
Johnsongrass

SAFE
Pearl millet
Foxtail millet
Corn

K·STATE Research and Extension

Conditions of Concern

Nitrates	Prussic
Plant stress	**Plant stress**
Drought	Drought
Drought breaking rain	Drought breaking rain
Hail	Hail
Frost	Frost/freeze
Soil Nitrogen	
Soil fertility imbalance	Soil fertility imbalance
	Regrowth/immature plants
	Herbicide injury (?)

K STATE BEEF KSUBeef.org

K·STATE
Research and Extension

Symptoms

Nitrates

- Rapid/difficult/noisy breathing
- Rapid pulse
- Bluish mucus membranes
- Dark chocolate-colored blood
- Salivation
- Tremors, staggering, weakness
- Coma
- Abortion
- Death

Prussic Acid

- Rapid then slow labored breathing
- Muscle spasms
- Dilated pupils
- Bright cherry-red blood
- Death in 15 minutes to 2 hrs from asphyxiation

K STATE BEEF
KSUBeef.org

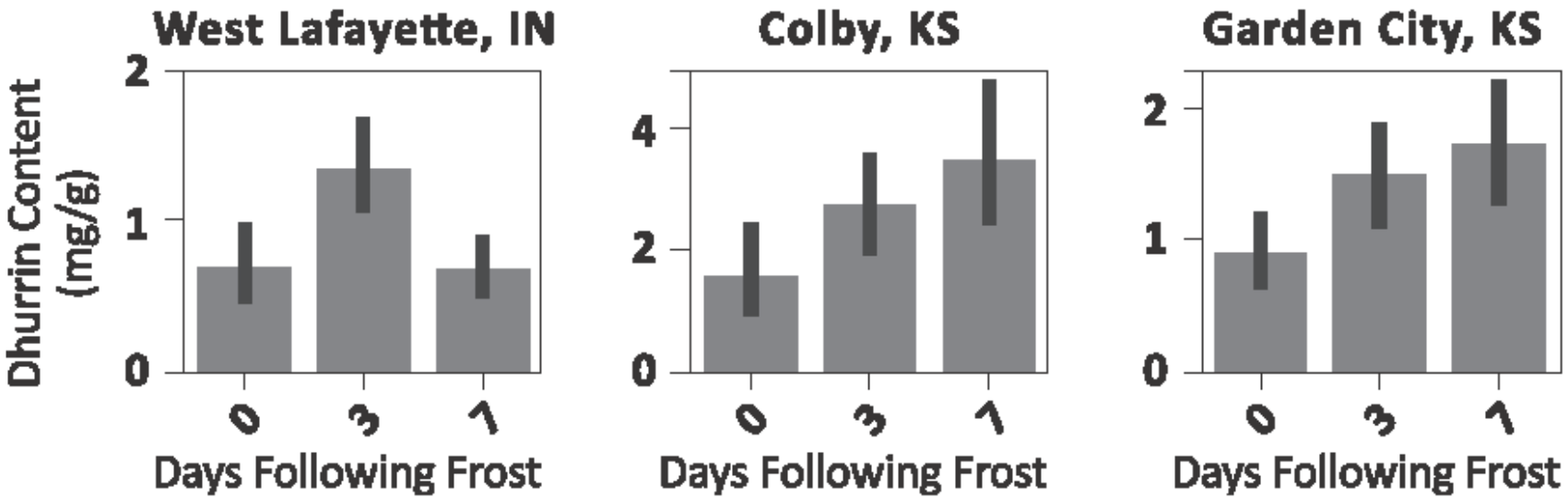
K·STATE Research and Extension

Harvest considerations

Item	Nitrate	Prussic Acid
Plant parts most affected	Base of plant	Young or new growth
Grazing problems	Rarely, unless forced to eat entire stem, or very high levels	Consumption of newest growth
Hay	Not impacted by drying	If very high, may remain dangerous after drying
Silage	Reduces ~ 50%	Reduces ~ 50%
Green chop	High risk	Less risk than hay, not as safe as silage

K STATE BEEF KSUBeef.org

Sorghum hybrid dhurrin content (fresh Weight) response following frost events.



Day zero represents dhurrin content before the frost occurred. The Garden City
and Colby locations had another hard freeze between three and seven days.

Harvesting high nitrate forage

- Sample field prior to harvesting
- Options:
  - Allow plant to mature longer
  - Raise cutter bar (minimum of 6 inches)
  - Make into silage (if still moisture less than 40%)

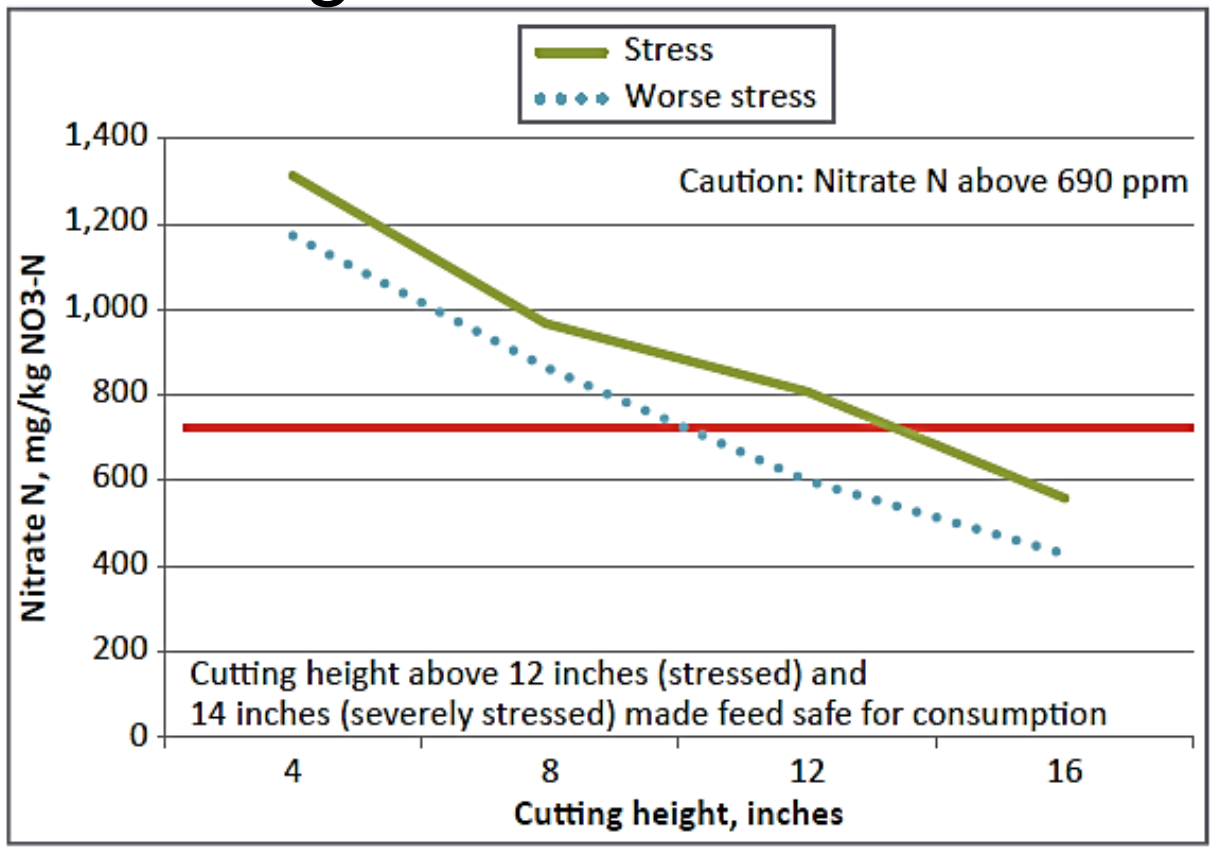


Figure 1. Holman, J. 2010. Effect of cutting height on nitrate-N level in forage sorghum that was either stressed or severely drought-stressed within the same field near Garden City, Kansas, in 2010.

Harvesting high nitrate forage

- Ensiling process can reduce nitrates 40-60%
  - IF DONE properly
  - Still need to **test prior to feeding** for nitrate values

  - Do not feed as green chop – unless feeding immediately
    - Any heating will cause nitrate to convert to nitrite and is 10x more toxic to cattle

K·STATE
Research and Extension

Nitrate Map (5 acres)ppm

34,600	31,000	37,700	37,800	12,200	22,500	7,930	
		20,100	30,600	11,700	17,200	9,610	13,400	16,100
20,200	22,800	26,700		21,100		21,300	
		26,100	43,600	10,400	33,100	11,800	33,400	23,700	25,400
30,000		20,200	28,300	9,590	19,700	22,200	27,400	25,600	22,900
		26,500		9,010		13,500		35,500	
22,200	36,400	23,300		25,300		13,300	15,400	18,400	10,700

Hibbard et al., 1993

K STATE BEEF
KSUBeef.org

General Guidelines On Prussic Acid

ppm HCN (Dry Matter Basis)	Effect on cattle
0-500	Generally safe, should not cause toxicity
500-1,000	Potentially toxic, should not be the only source of feed
≥ 1,000	Dangerous to cattle and usually will cause death

- Don’t graze after a light frost or after rain during a prolonged drought
- Feed safe hay to cattle prior to turning out on suspected forages to graze
- Avoid grazing or green chopping young plants or new regrowth
- Test forages prior to feeding if levels are likely high at harvest

General Guidelines On Nitrates

NO_3 ppm DM Basis	Effect on Animals
0-3,000	Generally safe, little risk
3,000-6,000	Moderately safe in most situations, limit to 50% of total ration for stressed animals
6,000-9,000	Potentially toxic depending on situation, should not be the only source of feed
≥ 9,000	Very dangerous, will often cause death

Conversion factors for expressing nitrate content of forages.

Potassium Nitrate (KNO_3) × 0.61	= Nitrate (ppm NO_3)
Nitrate Nitrogen (NO3 N) × 4.42	= Nitrate (ppm NO_3)
% Nitrate × 10,000	= Nitrate (ppm NO_3)

K·STATE Research and Extension

Nitrate Guidelines For Water[a]

Nitrate (NO_3), mg/L	Nitrate Nitrogen (NO_3 N), mg/L	Guidelines
0-44	0-10	Safe for consumption by ruminants
45-132	11-20	Generally safe in balanced diets with low-nitrate feeds
133-220	21-40	Could be harmful if consumed over long periods
221-660	41-100	Cattle at risk and possible death
≥661	≥101	Unsafe – possible death; should not be used as a source of water

[a]NRC (1974, 2001).

K STATE BEEF KSUBeef.org

K·STATE
Research and Extension

Dilution is the solution to nitrate pollution

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

Health Concerns Following a Drought Year

K STATE BEEF
KSUBeef.org

Scenario

- Limited Forage through fall/winter
  - Stored forage for months
- Difficult to maintain Body Condition Score (BCS)
- How will this impact calf health and performance next spring??

K·STATE
Research and Extension

Early Life Disease Concerns

K STATE BEEF
KSUBeef.org

K·STATE Research and Extension

Vitamin A

- Cattle convert beta carotene from green vegetation
- Stored in liver of cow for ~4 months
- Newborn calves obtain vitamin A through colostrum intake

	Colostrum	Milk
Vit A (IU/100ml)	982	113

K STATE BEEF KSUBeef.org

Vitamin A deficiency in problem herds

Sample	Number	Deficient
Serum	368	95.1%
Liver	109	53.2%

Pregnant cows and/or newborn calves in problem herds
KSVDL: 2021

Vitamin A Deficiency

- Signs:
  - Reduced intake and growth, night blindness, edema, diarrhea, low conception rates, abortions, stillbirths, weak calves, abnormal development, impaired immune response
  - Essentially weak poor doing calves

Vitamin A deficient calves & survival

Serum Vitamin A Concentration and Health Outcomes n = 887			
Outcome	*Serum concentration ug/ml*	*Risk ratio*	*95% CI*
Calf death	>.225 (normal)	Reference	
	<0.14	2.90*	1.04-8.11

Cows need Vitamin A

- Consume 30,000- 50,000 IU/hd/day
  - Supplement in feed/mineral
  - Does not have long shelf life. Will oxidize over time.
  - High nitrates in feed may interfere with absorption
- Injections available
  - Take to Veterinarian. Follow dosage recommendations
- Deficiencies need to be addressed prior to

Colostrum

- Calf is born with a functional but naïve immune system
  - Colostrum
    - Antibodies, fat, vitamins, and WBC
    - 10% BW by 24 hrs (~3-4L)
    - Absorption time limited
      - Closure starts at 6 hours
      - 50% by 9 hours

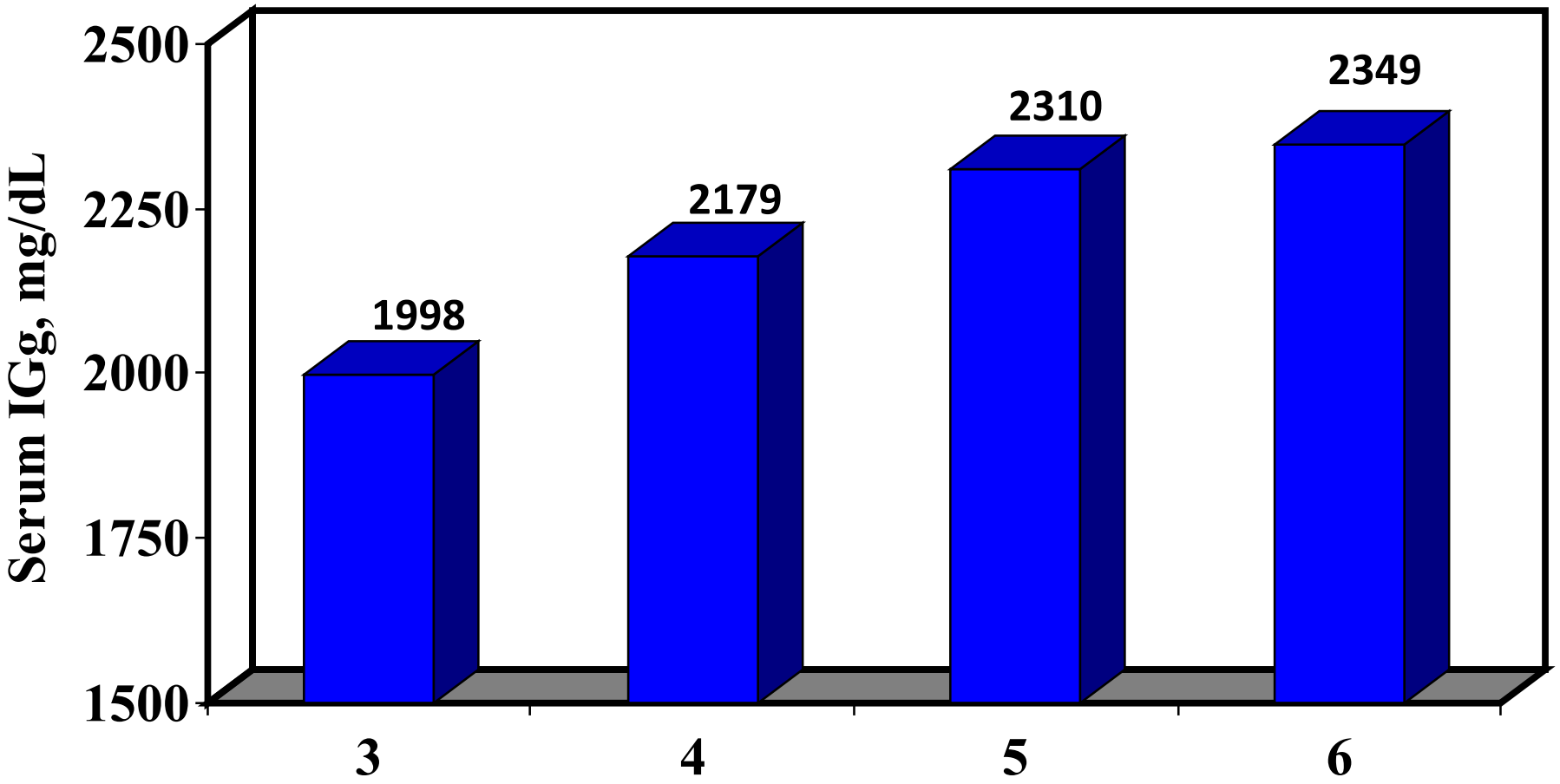
K·STATE
Research and Extension

Ensure Good Immunity Transfer

- Healthy Cow
  - Age
  - Body Condition
    - 4 or below= poor quality/quantity colostrum
  - Immunity Status
- Easy Delivery
- Clean Environment

K STATE BEEF
KSUBeef.org

Effect of BCS on the immune system of calves?



Odde, 1997

Colostrum Management

Drs. Tom Wittum and Louis Perino

2-year study @ US-MARC

- 263 crossbred calves
- 23% had inadequate colostrum intake

Colostrum Management

Results of inadequate colostrum intake:

- Birth to weaning
  - 3X more likely to get sick
  - 6X more likely to get sick during first 28 days
  - 5X more likely to die
  - Weighed 35# less at weaning

Colostrum Management

Results of inadequate colostrum intake:

- Feedlot
  - 3X more likely to get sick
  - Gained 24# less over 242-day feeding period

K·STATE
Research and Extension

Are you forced to calve in a different area??

K STATE BEEF
KSUBeef.org

Cold Stressed Calves

- Mild- (<100F)
- Severe- (<94F)
- Options??
  - Floorboard heater in pickup, heating lamps and blankets, warm water immersion (**warm slowly** to 100F/replace water frequently to keep temp), warming boxes, warm water IV Fluids
  - Can take 1-1.5 hrs to warm calves back to normal body temperature. **It takes time!!!**

Calf Health

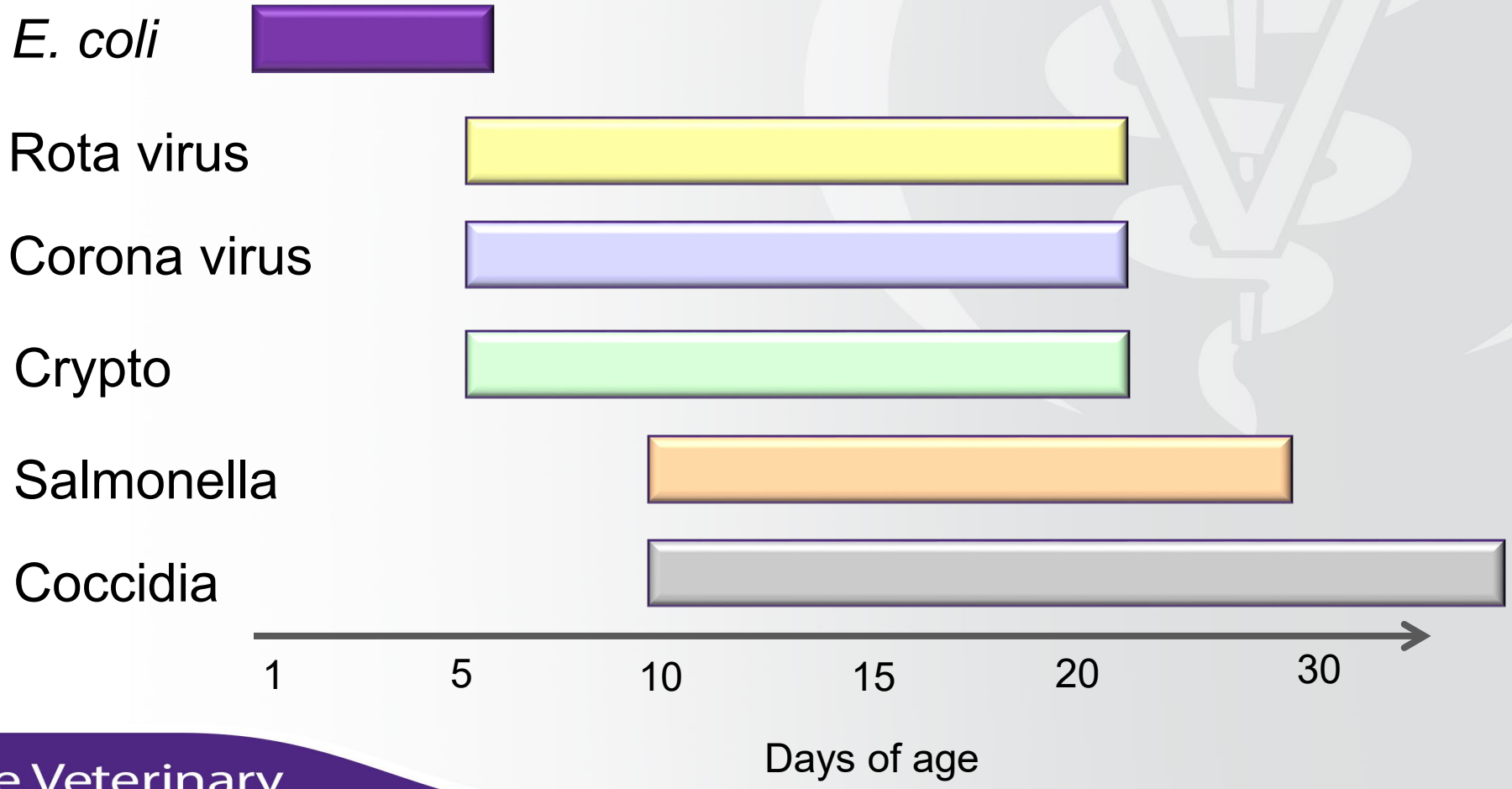
- **Scours:**
- Costly due to poor performance, death, medical expense, and labor

Neonatal diarrhea (scours)

- Bacteria
  - *E. coli*
  - Salmonella
- Viruses
  - Rota
  - Corona
- Protozoa
  - Crypto
  - Coccidia

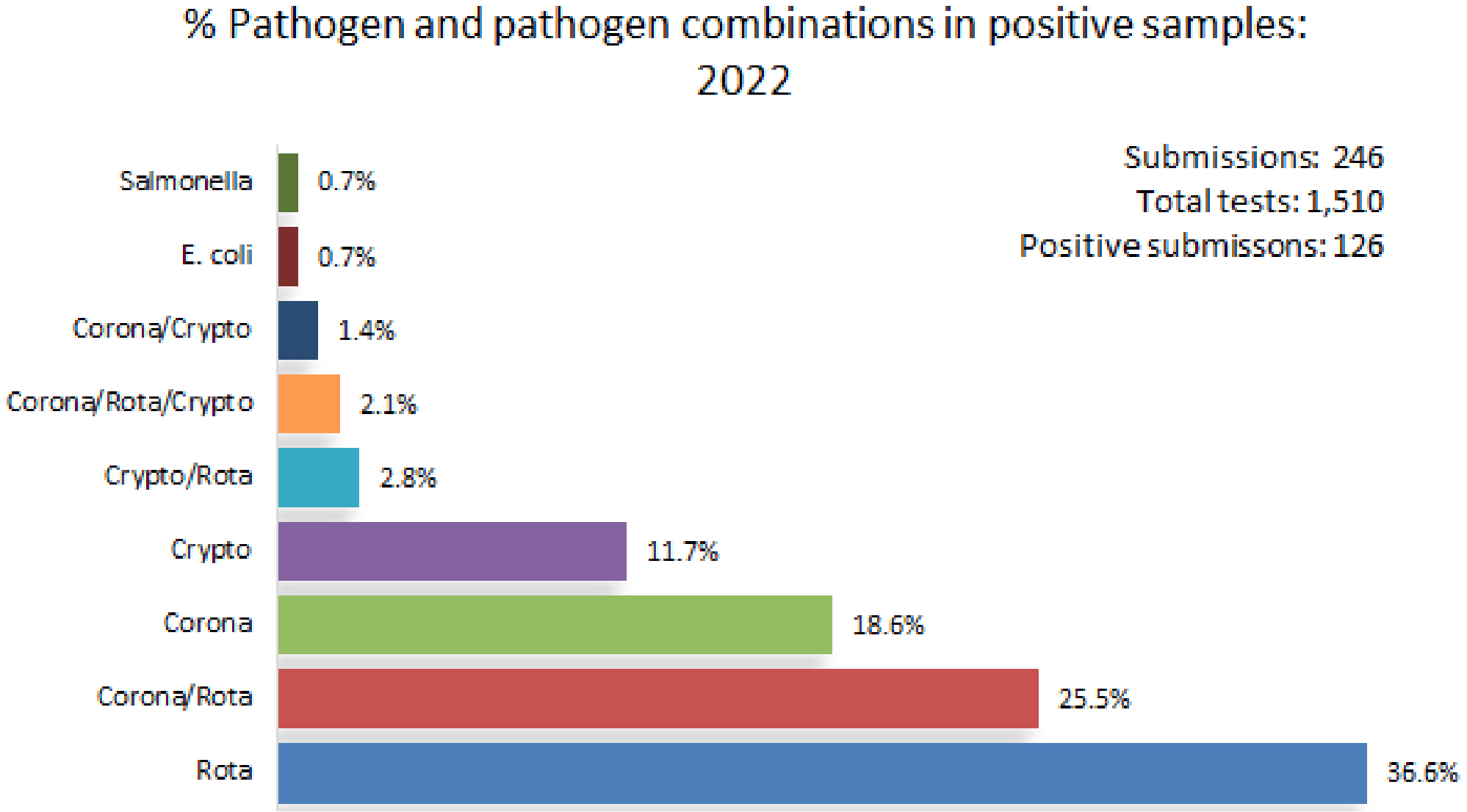
Most of these are on every cow-calf operation

Age when scouring



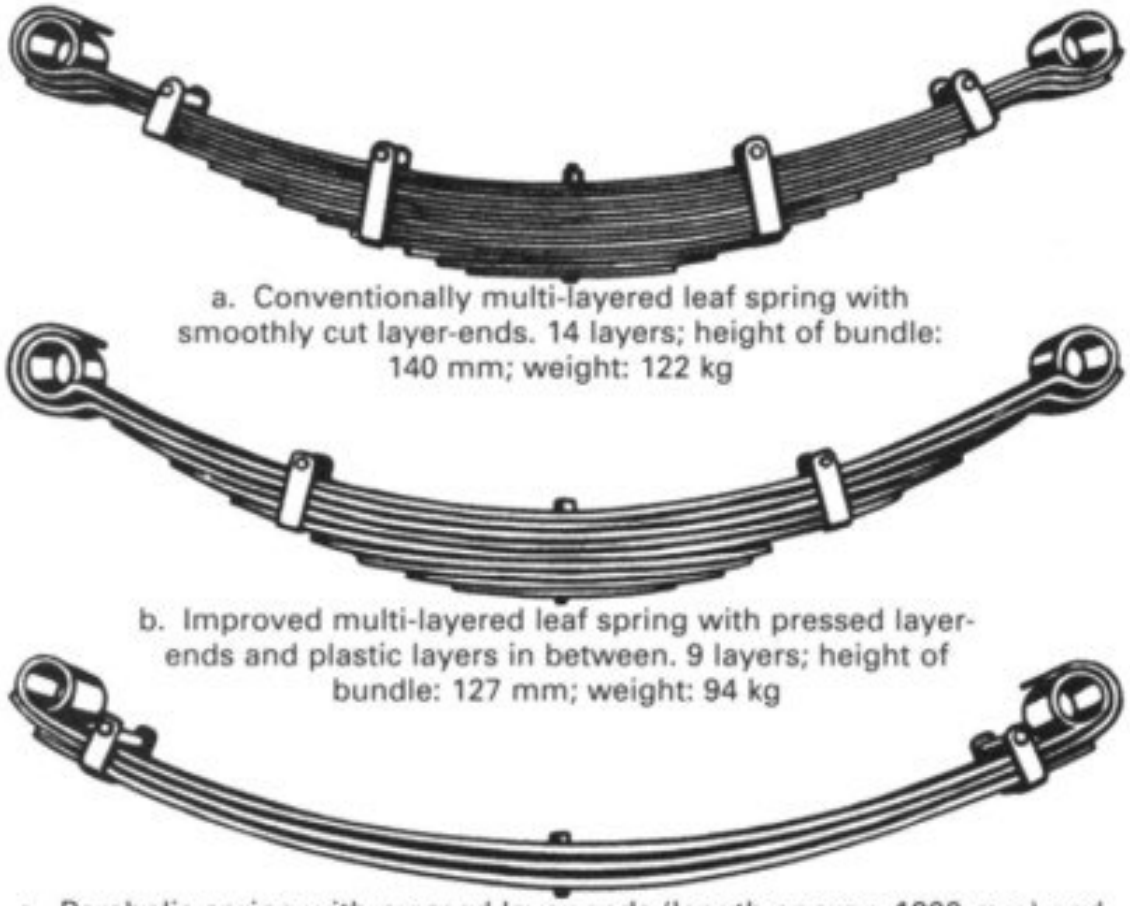
K·STATE
Research and Extension

2022 KSVDL Scour Submissions



K·STATE
Research and Extension

Maintaining over winter will build suspension for your calves!



a. Conventionally multi-layered leaf spring with smoothly cut layer-ends. 14 layers; height of bundle: 140 mm; weight: 122 kg

b. Improved multi-layered leaf spring with pressed layer-ends and plastic layers in between. 9 layers; height of bundle: 127 mm; weight: 94 kg

c. Parabolic spring with pressed layer-ends (length approx. 1200 mm) and plastic layers in between. 3 layers; height of bundle: 64 mm; weight: 61 kg

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

Limit Feeding Systems for Backgrounding Cattle

K STATE BEEF
KSUBeef.org

Limit feeding

- Feeding practice since the 1980's
- Improvements in feed efficiency
- No negative effects on health, improved morbidity detection
- Decreases in feed costs, waste removal, and expertise for bunk management
- Flexibility in commodity trading
- Less roughage and manure handling
- Decreased feed wastage
- Less labor, equipment and feeding expense
- Marketing

Loerch, 1990
Galyean et al., 1999
Spore et al., 2019

K·STATE
Research and Extension

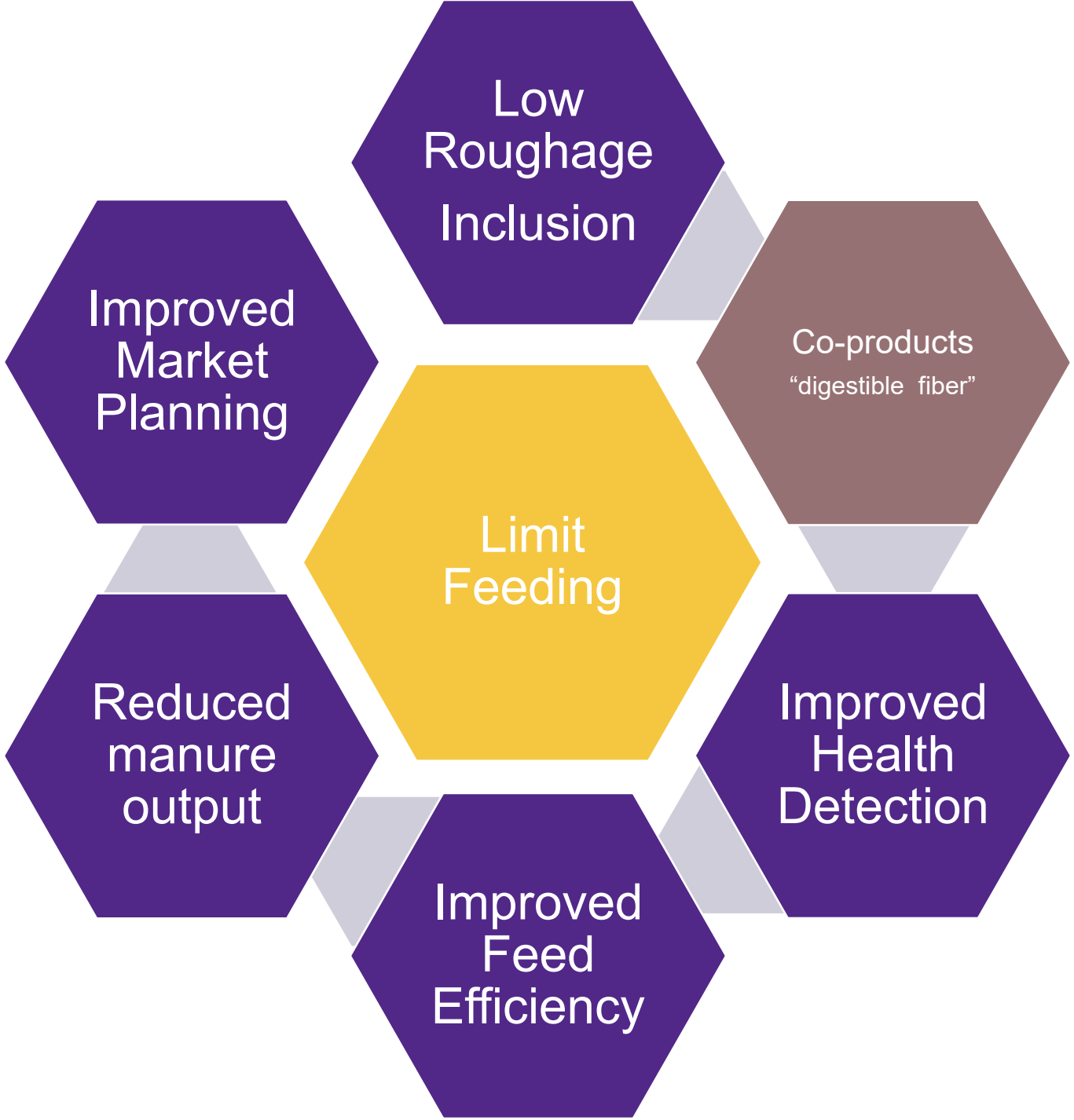
Limit Feeding

- Feeding a limited amount of a high-concentrate (high energy) ration to achieve a targeted weight gain for backgrounding cattle.

- Restricting cattle up to ¾ of *ad libitum* intake.

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

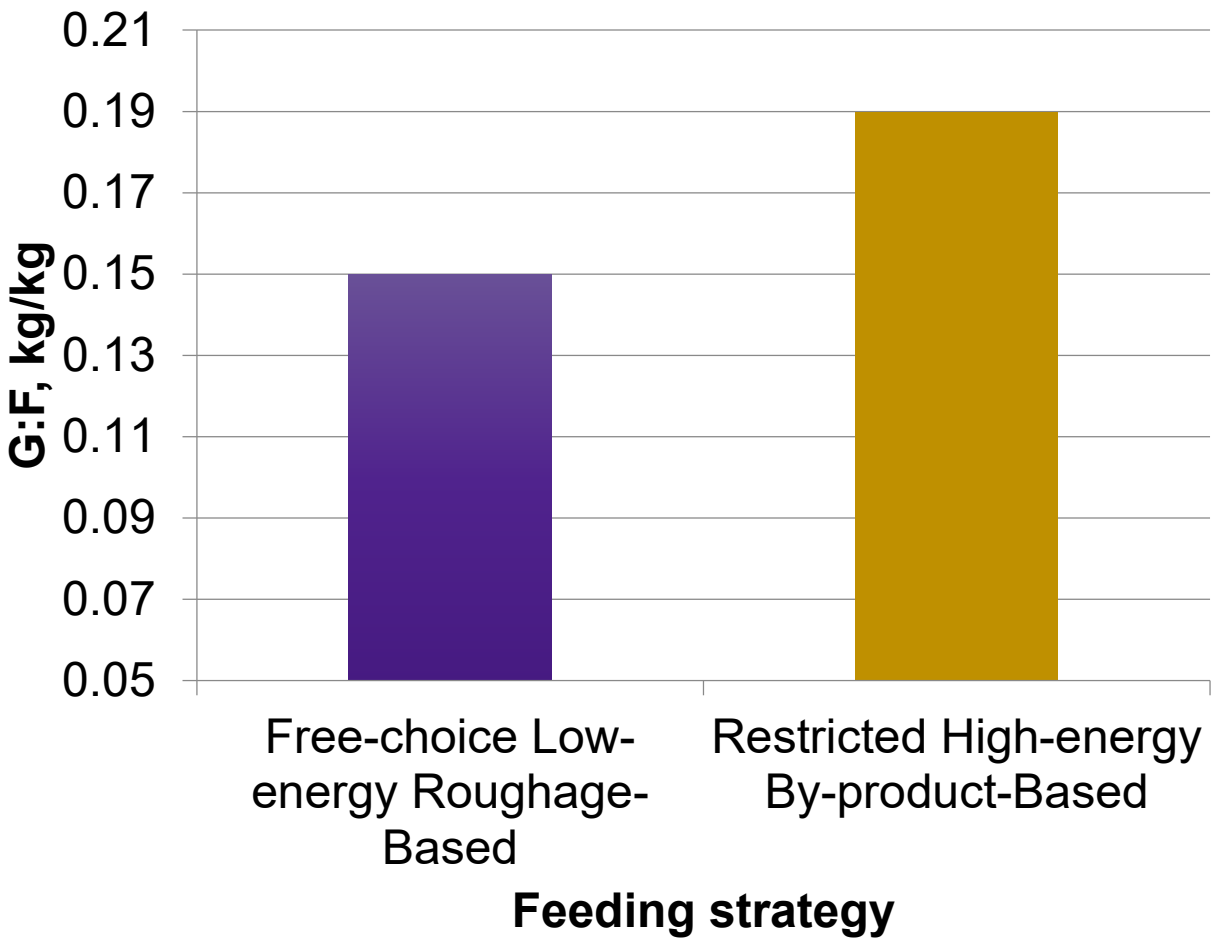


K STATE BEEF
KSUBeef.org

Effects of bunk allotment on performance of growing steers – KSU 2022

	Treatment – Inches/animal					P-value[3]		
Item	10	15	20	25	SEM[2]	LIN	Quad	Cubic
Body weight, Day 0	472	475	473	475	7.6	0.77	0.94	0.69
Body weight, Day 58	566	572	580	572	9.6	0.37	0.29	0.58
0 to 58	1.61	1.67	1.85	1.68	0.100	0.23	0.10	0.13
0 to 29	1.79	1.94	2.17	2.06	0.148	0.03	0.23	0.38
29 to 58	1.44	1.41	1.54	1.30	0.104	0.40	0.15	0.10
DMI, lb/day – 0 - 58	9.74	9.73	9.83	9.76	0.054	0.54	0.49	0.12
Feed:Gain, lb/lb – 0 - 58	6.37	6.32	6.20	6.03	0.677	0.60	0.90	0.99

KSU Research Summary – 12 trials and ongoing



No adverse effects on health

27% improvement in efficiency

Diets

	Intake level, % of *ad libitum*			
	100	95	90	85
	Mcal NEg/kg DM			
Item	0.99	1.10	1.21	1.32
Ingredient, % DM				
Alfalfa	22.50	17.00	12.00	6.50
Prairie Hay	22.50	17.00	12.00	6.50
Dry rolled corn	8.57	19.08	28.50	38.82
Sweet Bran	40.00	40.00	40.00	40.00
Supplement	6.43	6.92	7.50	8.18

- Fed once daily, programmed to gain 2.2 lb/day

Limit Feeding Cows

- Decisions leading to limit feeding
  - Do I need to supply more than 50% of the diet
    - Remove cattle from the pasture to limit long-term damage
  - Compare the price of corn vs. the price of hay
    - Comparisons should be based on COST/Mcal NEm
    - Other feeds should be considered and compared

Byproduct feeds, other grains

- Distillers grains, corn gluten feed, soybean hulls, wheat midds
- Milo, wheat, barley

K·STATE
Research and Extension

Limit-Feeding Programs For Cows

- Provide adequate bunk space (24-36”/hd).
- Cows will be discontent the first 7-14 days:
  - Appear gaunt, act hungry, and aggressive.
  - Will adjust and become settled if fed routinely.
- Be consistent!
  - Amount fed, time of feeding, feed placement and distribution.
- Sort cows by age.
- Include an ionophore in diet (except if horses are around).
- Grind forages to approx. 3’’ for stalks, cane hays.
- Typically lowers feed costs (depends on price).

K STATE BEEF
KSUBeef.org

K·STATE Research and Extension

Example limit-fed diets for gestating beef cows.

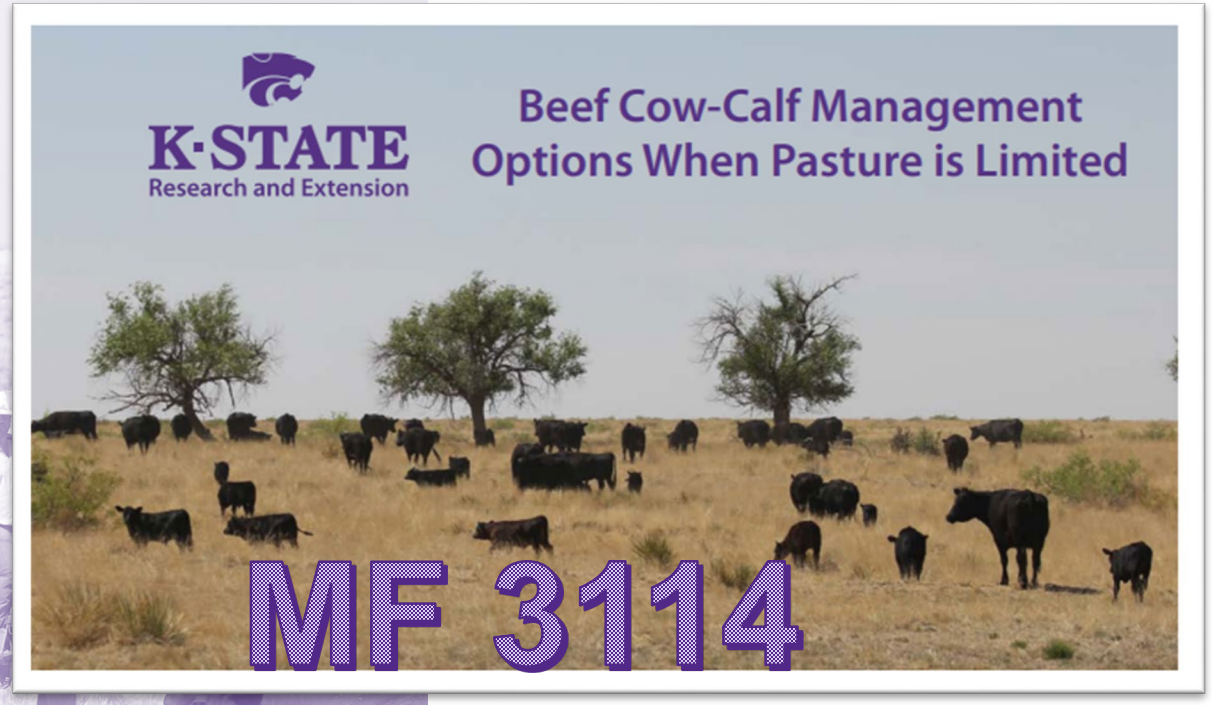
DM lb.	Alf. Hay	Distillers/Straw	CS/Straw/Alf. Hay	Corn/Alf. Hay
Alfalfa Hay	20.0		6.0	5.8
Wheat Straw		13.0	6.0	
WDGS		5.5		
Corn Silage			7.5	
Whole Corn				10.7
Supplement	0.25	0.25	0.25	0.25
DMI, lb/day	20.25	18.75	19.75	16.75
TDN lb/day	11.4	11.1	11.4	12.2
CP lb/day	3.40	2.13	1.83	2.10
$/cow/day	1.61	1.43	1.44	1.60

Alfalfa hay = 85/ton, Straw = 60/ton, Corn Silage = 33.73/ton, Corn = 3.55/bu

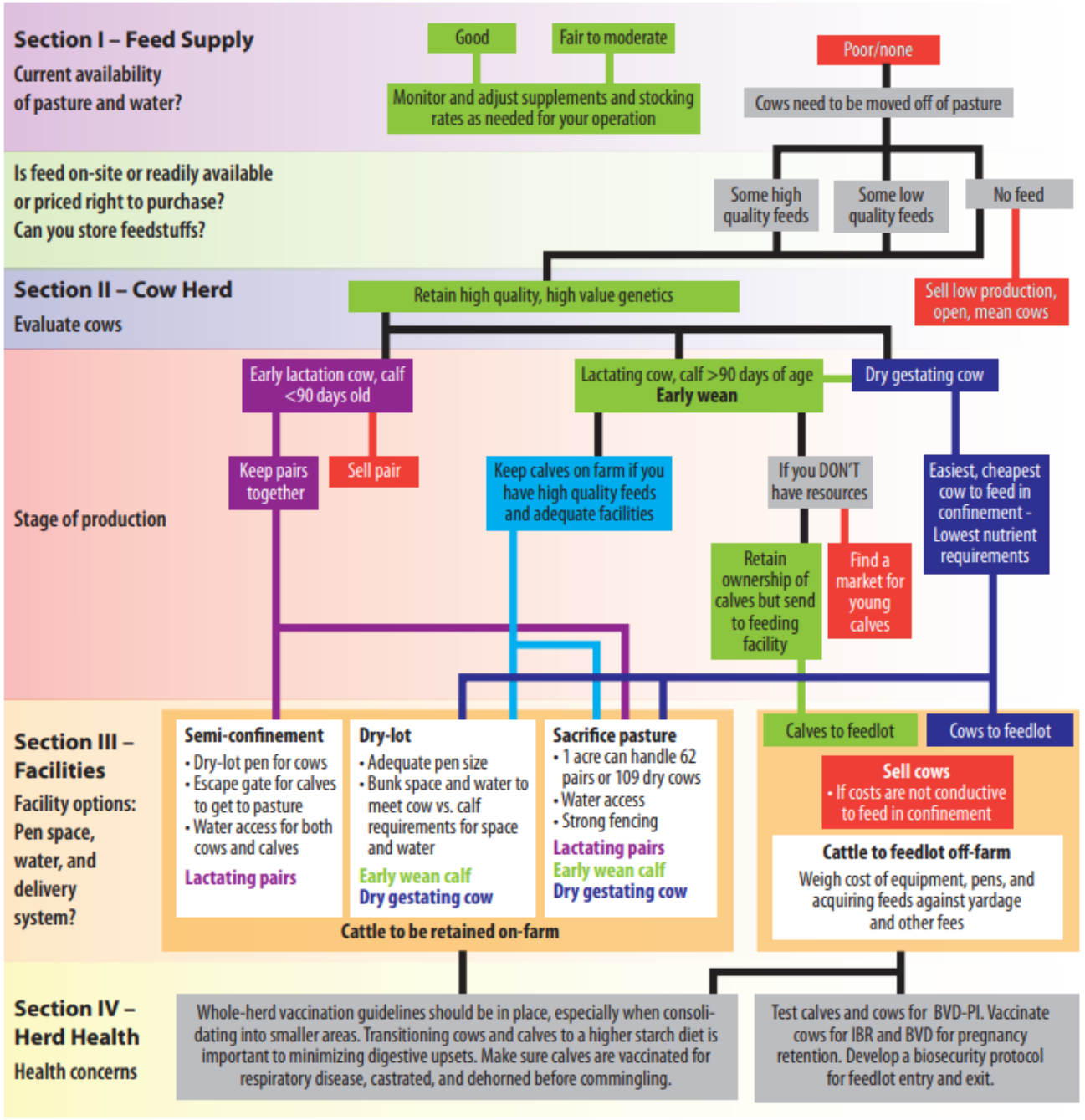
WDGS = 44/ton, Supplement = 600/ton, Delivery = 5/ton, Grinding = 12/ton

Yardage = 0.40/cow/day

K STATE BEEF KSUBeef.org



Decision Tree: Options for Management of Cows and Calves during Limited Pasture Availability



K·STATE Research and Extension

Performance of pregnant beef cows fed diets containing wheat straw treated 0.0%, 1.5% or 3.0% anhydrous ammonia (wt/wt basis) for 84 days

Item	Treatment			SEM	*P*-value
	CON	1.5A	3.0A		
Body Weight					
Initial, lbs	1265	1239	1245	16.6	0.51
Final, lbs	1395	1399	1408	19.6	0.89
Total Gain, lbs*	130[a]	160[b]	163[b]	3.9	0.01
ADG, lb/d*	1.35[a]	1.66[b]	1.69[b]	0.09	0.01
BCS					
Initial	5.86	5.87	5.92	0.07	0.78
Final	5.86[a]	5.94[a]	6.08[b]	0.07	0.09
Change	0.00	0.08	0.16	0.04	0.13

[a,b] Within a row, means without a common superscript differ ($P \leq 0.05$)

*Linear $P = 0.01$, Quadratic $P = 0.10$

K STATE BEEF KSUBeef.org

Cost per Unit of Energy

Item	AF Cost,$/ton	DM,%	NEm, Mcal/lb	Dry $/Mcal
Rolled Corn[1]	$281	85	1.00	0.17
Alfalfa Hay	$280	88	0.59	0.27
Sorghum Hay	$120	87	0.53	0.13
CRP Hay	$100	89	0.47	0.12
Dried Distillers Grain	$285	88	1.20	0.13
Corn Gluten Feed	$300	88	1.10	0.15
Wheat Midds	$275	89	0.92	0.17

[1] $7.60/bushel + $10/ton rolling and milling

K·STATE Research and Extension

Cost per Unit of Protein

Item	AF Cost,$/ton	DM,%	CP, %DM	Dry $/lb CP
Rolled Corn[1]	$281	85	10.0	1.65
Alfalfa Hay	$280	88	15.0	1.06
Sorghum Hay	$120	87	8.0	0.86
CRP Hay	$100	89	3.5	1.61
Dried Distillers Grain	$285	88	30.0	0.54
Corn Gluten Feed	$300	88	21.0	0.81
Wheat Midds	$275	89	18.0	0.86

[1] $7.60/bushel + $10/ton rolling and milling

K STATE BEEF KSUBeef.org

Nutrient Value Failed Corn

Item	Content (DM basis)
Dry Matter	27.4
Crude Protein, %	13.9
Acid Detergent Fiber, %	27.6
Neutral Detergent Fiber, %	48.5
Total Digestible Nutrients (TDN), %	71.6
Nitrate-N	1592

K·STATE
Research and Extension

K-State Beef Extension Specialist Team

Dale Blasi
dblasi@ksu.edu

A.J. Tarpoff
tarpoff@ksu.edu

Jaymelynn Farney
jkj@ksu.edu

Justin Waggoner
jwaggon@ksu.edu

Sandy Johnson
sandyj@ksu.edu

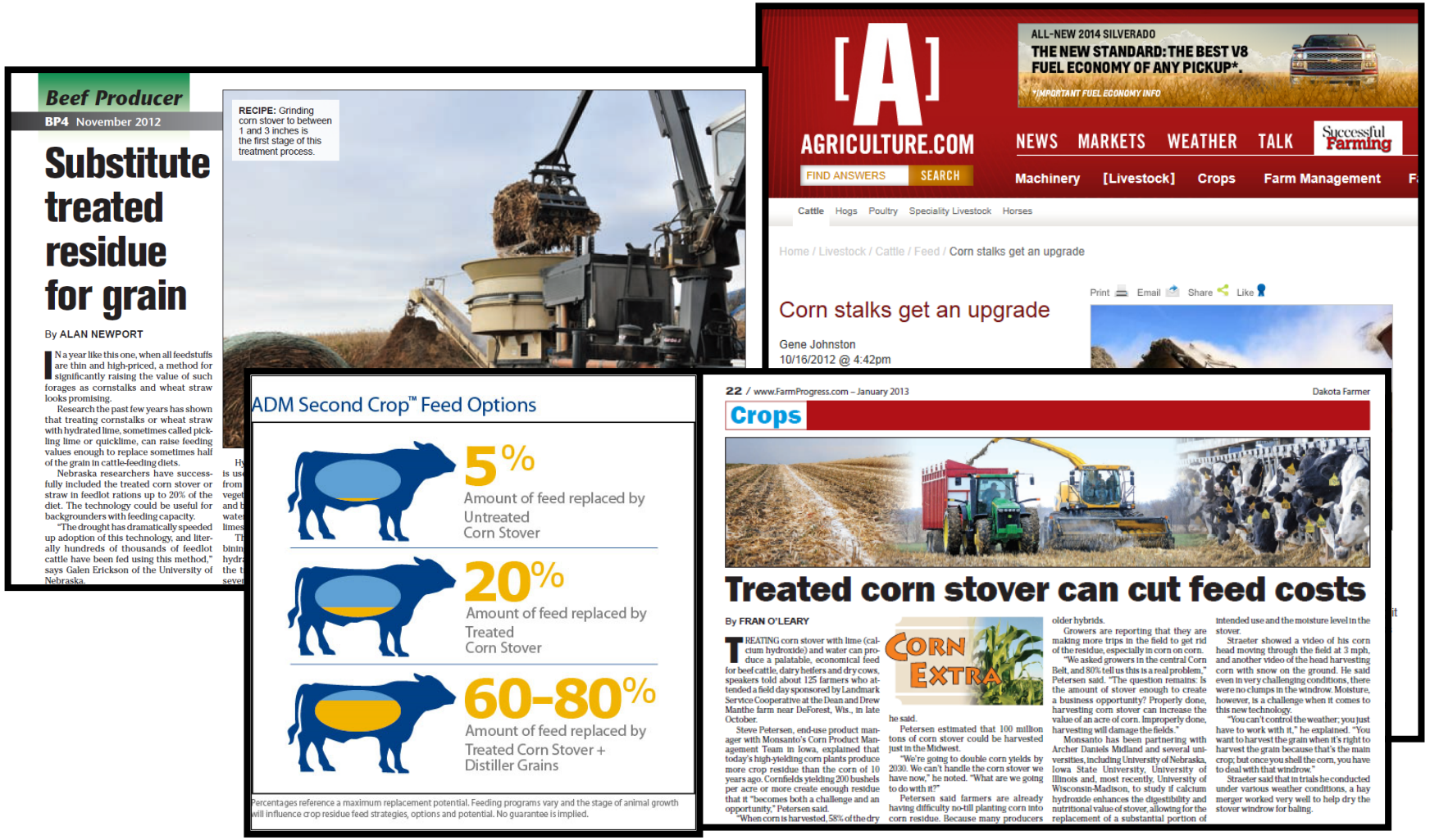
Jason Warner
jasonwarner@ksu.edu

Joel DeRouchey
jderouch@ksu.edu

K STATE BEEF
KSUBeef.org

K·STATE
Research and Extension

Enhancing the Value of Forages



Beef Producer
BP4 November 2012

Substitute treated residue for grain

By ALAN NEWPORT

IN a year like this one, when all feedstuffs are thin and high-priced, a method for significantly raising the value of such forages as cornstalks and wheat straw looks promising.

Research the past few years has shown that treating cornstalks or wheat straw with hydrated lime, sometimes called pickling lime or quicklime, can raise feeding values enough to replace sometimes half of the grain in cattle-feeding diets.

Nebraska researchers have successfully included the treated corn stover or straw in feedlot rations up to 20% of the diet. The technology could be useful for backgrounders with feeding capacity.

"The drought has dramatically speeded up adoption of this technology, and literally hundreds of thousands of feedlot cattle have been fed using this method," says Galen Erickson of the University of Nebraska.

RECIPE: Grinding corn stover to between 1 and 3 inches is the first stage of this treatment process.

AGRICULTURE.COM
FIND ANSWERS SEARCH
NEWS MARKETS WEATHER TALK Successful Farming
Machinery [Livestock] Crops Farm Management
Cattle Hogs Poultry Speciality Livestock Horses
Home / Livestock / Cattle / Feed / Corn stalks get an upgrade
Print Email Share Like

ALL-NEW 2014 SILVERADO
THE NEW STANDARD: THE BEST V8 FUEL ECONOMY OF ANY PICKUP*.
*IMPORTANT FUEL ECONOMY INFO

Corn stalks get an upgrade

Gene Johnston
10/16/2012 @ 4:42pm

ADM Second Crop™ Feed Options

5%
Amount of feed replaced by Untreated Corn Stover

20%
Amount of feed replaced by Treated Corn Stover

60-80%
Amount of feed replaced by Treated Corn Stover + Distiller Grains

Percentages reference a maximum replacement potential. Feeding programs vary and the stage of animal growth will influence crop residue feed strategies, options and potential. No guarantee is implied.

22 / www.FarmProgress.com – January 2013 Dakota Farmer
Crops

Treated corn stover can cut feed costs

By FRAN O'LEARY

CORN EXTRA

TREATING corn stover with lime (calcium hydroxide) and water can produce a palatable, economical feed for beef cattle, dairy heifers and dry cows, speakers told about 125 farmers who attended a field day sponsored by Landmark Service Cooperative at the Dean and Drew Manthe farm near DeForest, Wis., in late October.

Steve Petersen, end-use product manager with Monsanto's Corn Product Management Team in Iowa, explained that today's high-yielding corn plants produce more crop residue than the corn of 10 years ago. Cornfields yielding 200 bushels per acre or more create enough residue that it "becomes both a challenge and an opportunity," Petersen said.

"When corn is harvested, 58% of the dry he said.

Petersen estimated that 100 million tons of corn stover could be harvested just in the Midwest.

"We're going to double corn yields by 2030. We can't handle the corn stover we have now," he noted. "What are we going to do with it?"

Petersen said farmers are already having difficulty no-till planting corn into corn residue. Because many producers older hybrids.

Growers are reporting that they are making more trips in the field to get rid of the residue, especially in corn on corn.

"We asked growers in the central Corn Belt, and 80% tell us this is a real problem," Petersen said. "The question remains: Is the amount of stover enough to create a business opportunity? Properly done, harvesting corn stover can increase the value of an acre of corn. Improperly done, harvesting will damage the fields."

Monsanto has been partnering with Archer Daniels Midland and several universities, including University of Nebraska, Iowa State University, University of Illinois and, most recently, University of Wisconsin-Madison, to study if calcium hydroxide enhances the digestibility and nutritional value of stover, allowing for the replacement of a substantial portion of intended use and the moisture level in the stover.

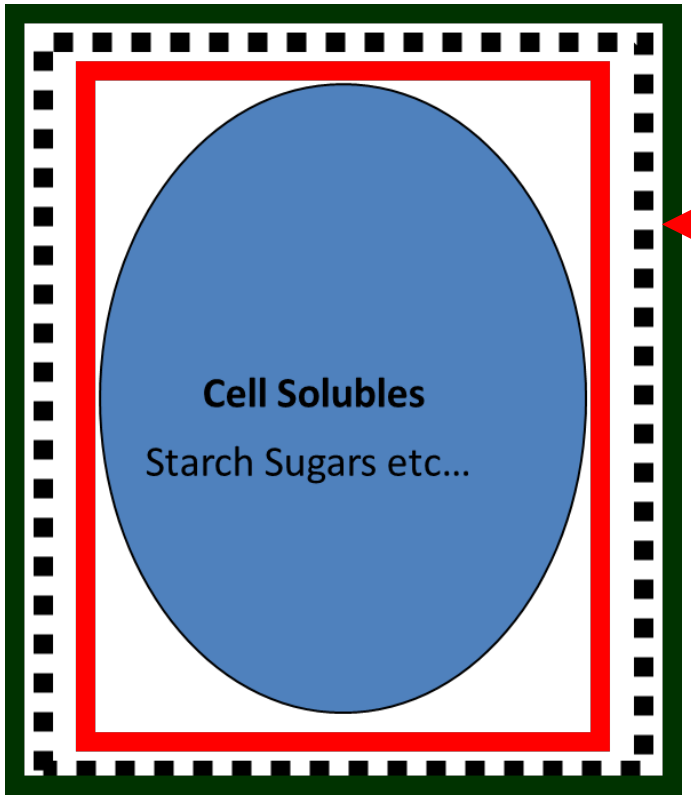
Straeter showed a video of his corn head moving through the field at 3 mph, and another video of the head harvesting corn with snow on the ground. He said even in very challenging conditions, there were no clumps in the windrow. Moisture, however, is a challenge when it comes to this new technology.

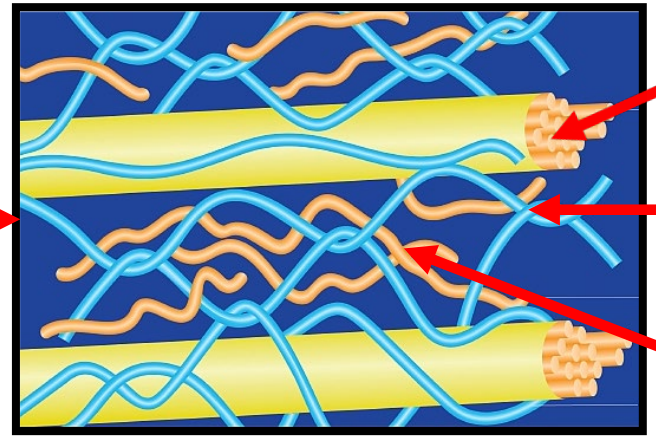
"You can't control the weather; you just have to work with it," he explained. "You want to harvest the grain when it's right to harvest the grain because that's the main crop; but once you shell the corn, you have to deal with that windrow."

Straeter said that in trials he conducted under various weather conditions, a hay merger worked very well to help dry the stover windrow for baling.

K STATE BEEF
KSUBeef.org

Plant Cell Wall Components





http://www.scidacreview.org

- Lignin
  - hydrophobic and presents a barrier to water, enzymes, rumen microbes etc.
  - covalently bound to hemicellulose

Van Soest, 1984; Liyama et al., 1994

Alkali Treatment of Forage

- Disrupts the lignin-hemicellulose linkage improves microbial access

Control **Ammoniated**

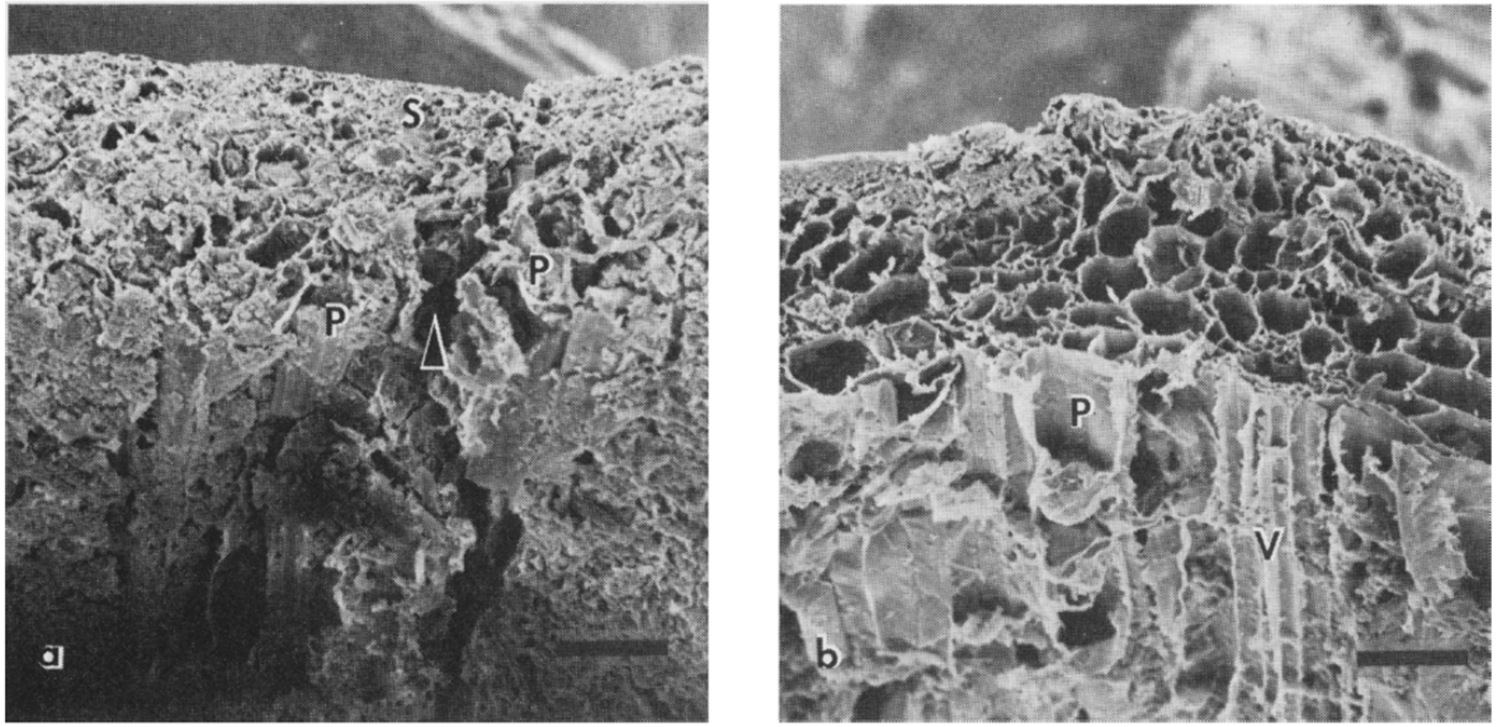


Figure 5. Remnants of wheat straw after 12 h ruminal digestion. Bars = 100 μm. (a) Control wheat stem shows cracks (▲) through parenchyma (P) to sclerenchyma (S). (b) Ammoniated wheat stem shows eroded parenchyma (P) and partially exposed vascular tissue (V).

Harbers et al., 1982

K·STATE
Research and Extension

K·STATE
Research and Extension

Length of time stack needs to remained covered

Temperature, ºF	Weeks of Treatment
Below 40	8 plus
40-60	4 to 8
60-80	2 to 4
Above 80	2

Keeping the plastic in one piece is the greatest challenge of ammoniating hay…treating during warmer temperatures is best

K STATE BEEF
KSUBeef.org

K·STATE Research and Extension

Effect of Anhydrous Application Rate on Nutrient Composition

		Application Rate[1]			
Item, % DM	Pre	1.5%	3.0%	SEM	*P*-value
Crude Protein*	3.3[a]	8.6[b]	10.8[c]	1.01	< 0.01
ADF	51.0	51.9	52.1	1.34	0.84
TDN	33.2	32.5	32.3	1.90	0.93
IVDMD[†]	31.0[a]	42.0[b]	46.2[c]	1.60	< 0.01
Est. TDN	39.6	47.8	50.9		

[1]Treatment with 1.5 or 3.0% anhydrous ammonia dry basis
*Linear $P > 0.01$, Quadratic $P = 0.02$
[a,b,c] Within a row, means without a common superscript differ ($P \leq 0.10$)
[†] Linear $P > 0.01$, Quadratic $P = 0.10$
Estimated TDN = 16.7 + (0.74*IVDMD)

K STATE BEEF KSUBeef.org

K·STATE Research and Extension

Performance of pregnant beef cows fed diets containing wheat straw treated 0.0%, 1.5% or 3.0% anhydrous ammonia (wt/wt basis) for 84 days

Item	Treatment			SEM	*P*-value
	CON	1.5A	3.0A		
Body Weight					
Initial, lbs	1265	1239	1245	16.6	0.51
Final, lbs	1395	1399	1408	19.6	0.89
Total Gain, lbs*	130[a]	160[b]	163[b]	3.9	0.01
ADG, lb/d*	1.35[a]	1.66[b]	1.69[b]	0.09	0.01
BCS					
Initial	5.86	5.87	5.92	0.07	0.78
Final	5.86[a]	5.94[a]	6.08[b]	0.07	0.09
Change	0.00	0.08	0.16	0.04	0.13

[a,b] Within a row, means without a common superscript differ ($P \leq 0.05$)

*Linear $P = 0.01$, Quadratic $P = 0.10$

K STATE BEEF KSUBeef.org

K·STATE Research and Extension

Effects of anhydrous ammonia on wheat straw nutrient composition (Waggoner et al., 2014)

		Ammoniation Rate[1]	
Item	Pre-Treat	1.5%	3.0%
Cost of NH_3 applied/ton of forage[1]	$0.00	$21.00	$42.00
Crude protein, %	**3.3**	**8.6**	**10.8**
Cost per lb of CP added	-	**$0.198**	**$0.280**
IVDMD, %	**31.0**	**42.0**	**46.2**
Cost per lb of IVDMD added	**-**	**$0.095**	**$0.138**

[1]Assuming $1400/ton NH_3

K STATE BEEF KSUBeef.org

K·STATE Research and Extension

Effects of anhydrous ammonia on wheat straw nutrient composition (Waggoner et al., 2014)

Item	Pre-Treat	Ammoniation Rate[1] 1.5%	3.0%	SEM	*P* - value
Dry matter, %	92.1	91.0	91.1	1.01	0.68
Crude protein, %[2]	**3.3**	**8.6**	**10.8**	0.50	≤ 0.01
Acid detergent fiber, %	51.0	51.9	52.1	1.34	0.84
TDN, %	33.2	32.5	32.3	1.90	0.93
IVDMD, %[3]	**31.0**	**42.0**	**46.2**	1.60	≤ 0.01

[1]Treatment with 1.5% (HALF) or 3.0% (FULL) of anhydrous ammonia on a dry weight basis.

[2]Linear effect, $P \leq 0.01$; quadratic effect, $P = 0.02$.

[3]In vitro dry matter disappearance; linear effect, $P \leq 0.01$; quadratic effect, $P = 0.10$.

K STATE BEEF KSUBeef.org