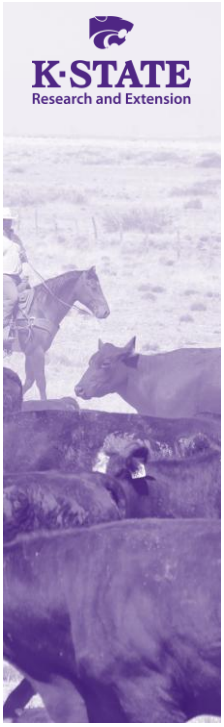
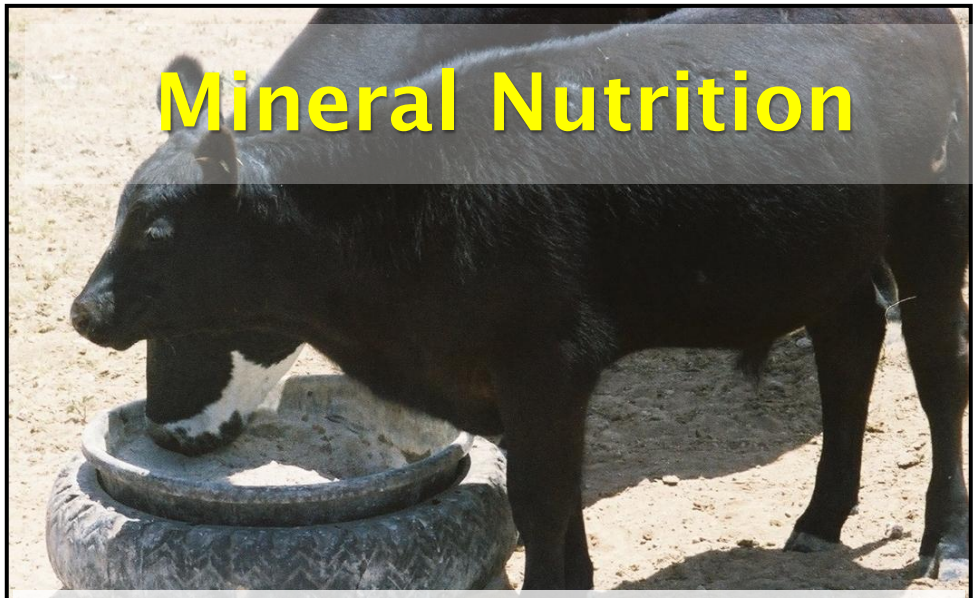
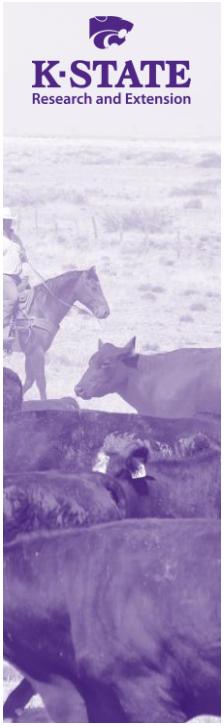


Mineral Nutrition

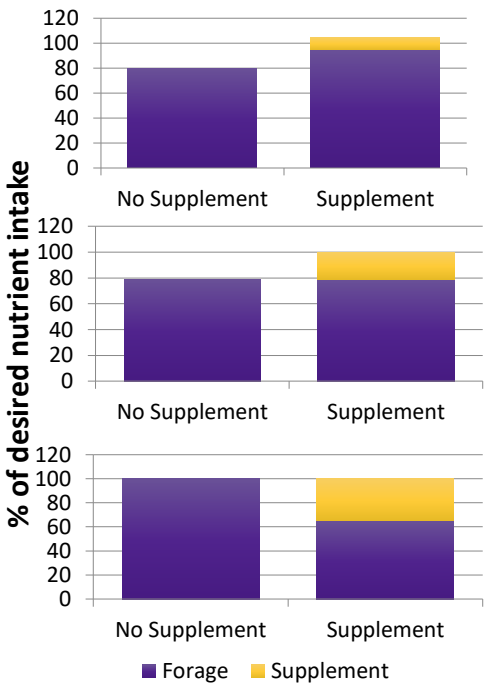


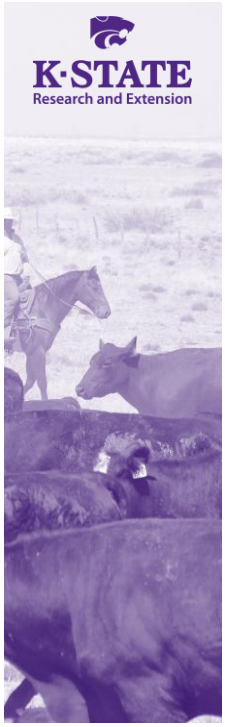
Jaymelynn Farney
Extension Beef Specialists
Kansas State University



Why need to supplement cattle

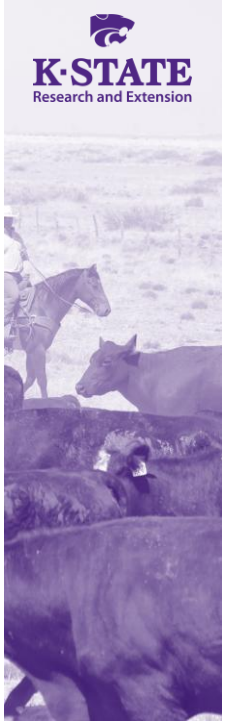
- Increase forage intake
- Forage could be lacking in energy or protein
- Lack of adequate forage
- Requirements exceed that offered by forage base
- Inadequate ratio of protein to energy





Why do we feed mineral?

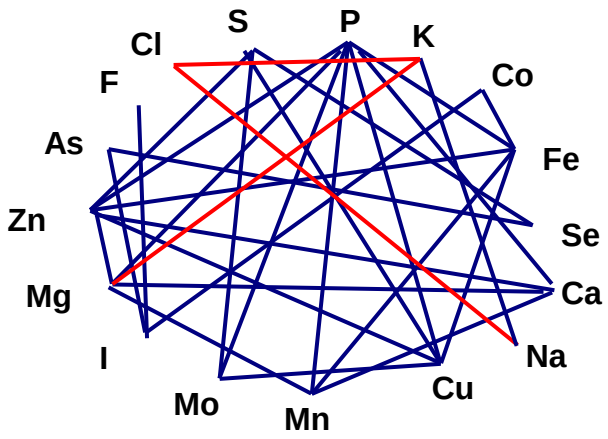
1. Phosphorus
2. Other
    1. Calcium
    2. Potassium
    3. Magnesium (sometimes)
3. Trace minerals
4. Vitamins



Minerals

- Most complicated & least understood components of nutrition
    - Forage mineral content varies
    - Mineral supplement intake also varies
- Recent interest has been fueled by:
    - Increased mineral cost
    - Cost reducing strategies

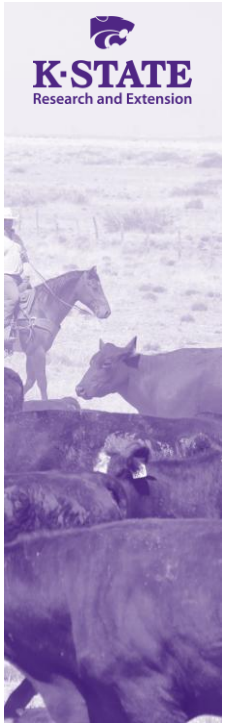
Mineral Interactions



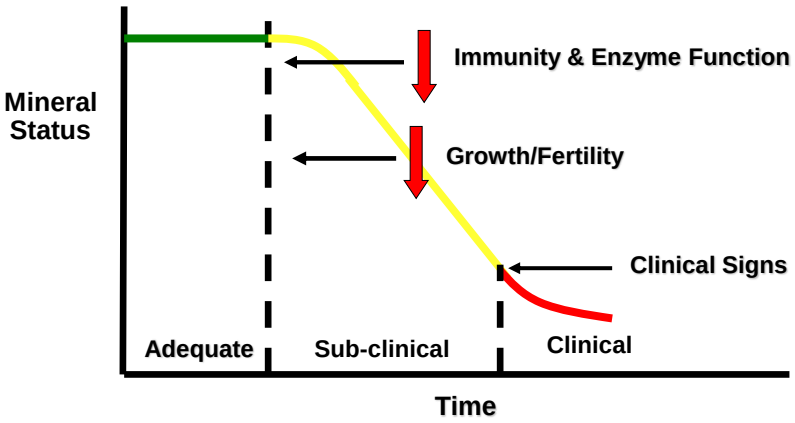
Key Interactions

Zn	⟷	Cu
Fe	→	Zn, Cu
Mo, S	→	Cu
K	→	Mg
Ca	⟷	P

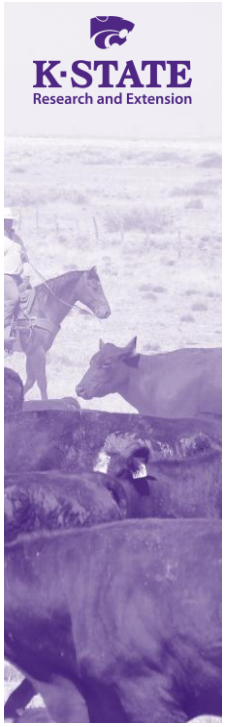
Adapted from Greene, 1998



Model of a Decline in the Trace Mineral Status of Cattle



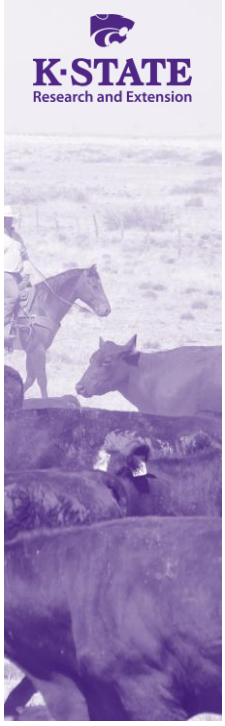
Wikse, 1992



Minerals

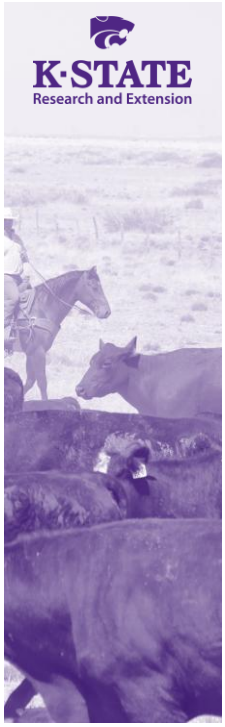
- *Macrominerals*
- Expressed % of diet (part per hundred)
  - Calcium
  - Phosphorus
  - Magnesium
  - Potassium
  - Sulfur
  - Sodium
  - Chlorine

- *Microminerals (trace)*
- Expressed as ppm
  - copper
  - zinc
  - selenium
  - manganese
  - cobalt
  - iodine
  - iron
  - chromium
  - molybdenum

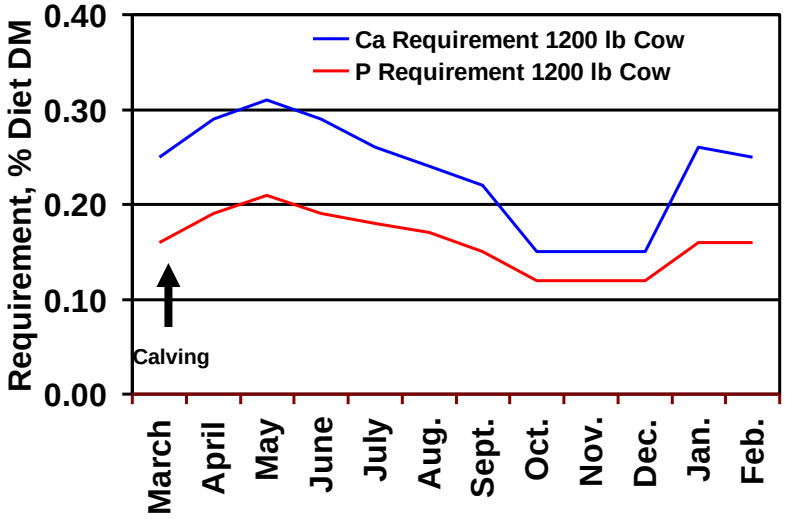


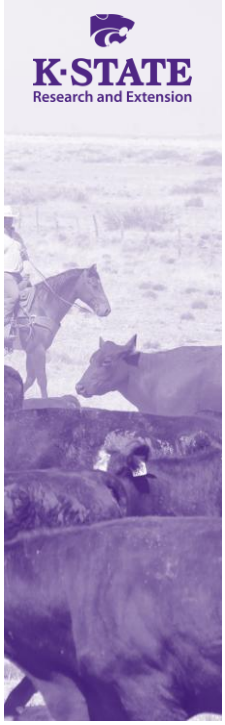
Developing a Mineral Program

1. Assess animal need
2. Dietary (forage + feed) mineral supply
3. Selecting an appropriate supplement
   - Supplementation Strategy

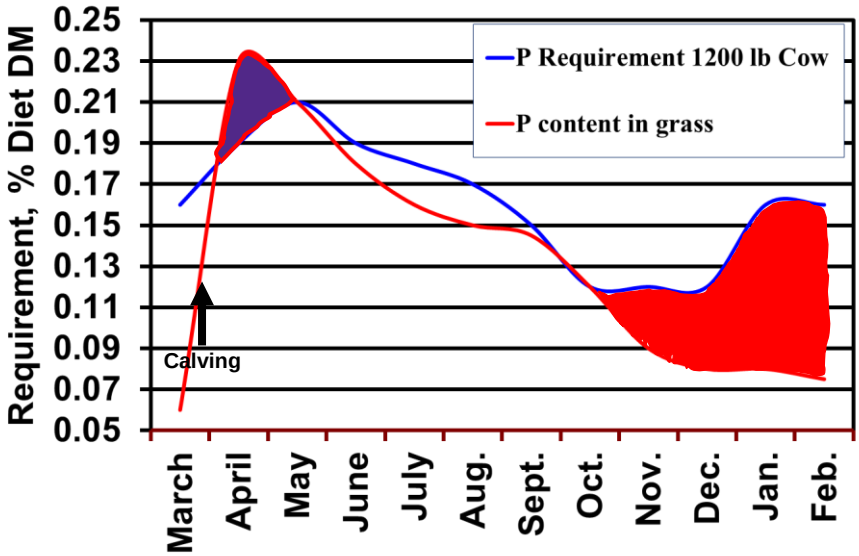


Ca and P Requirements

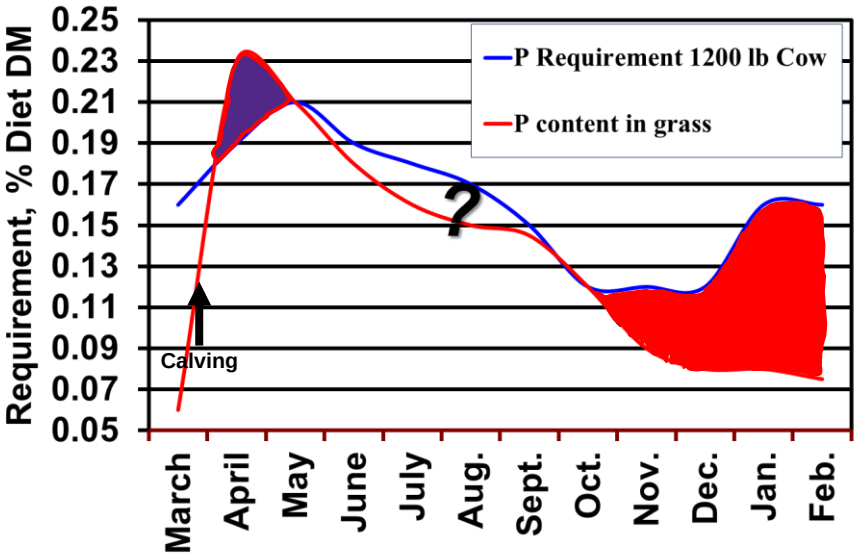


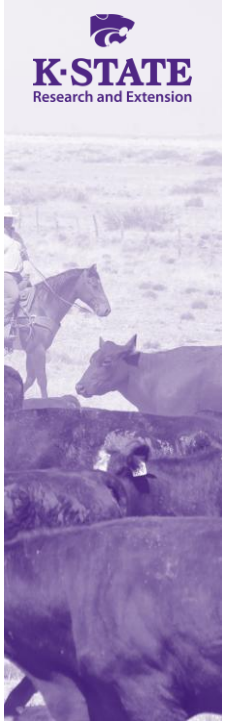


P Needs

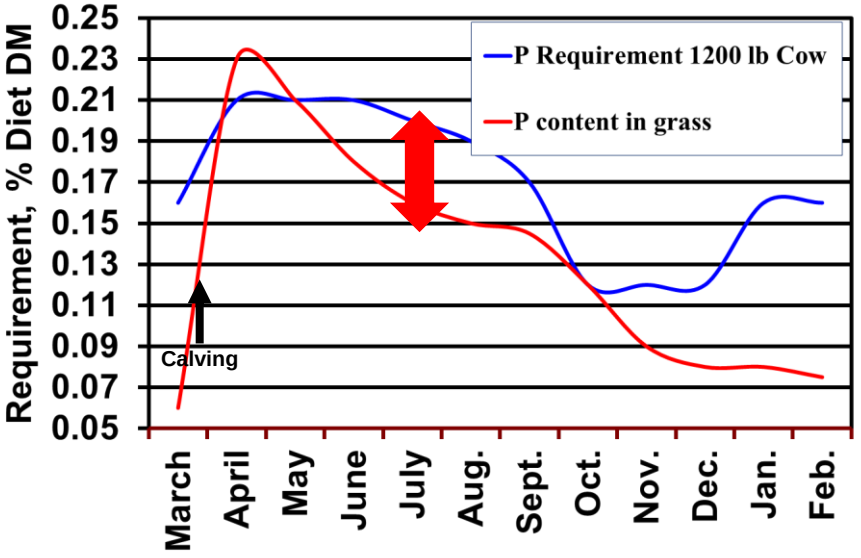


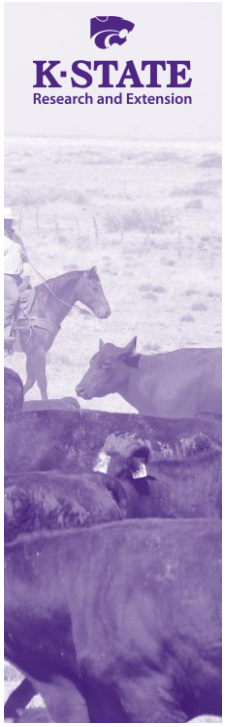
P Needs



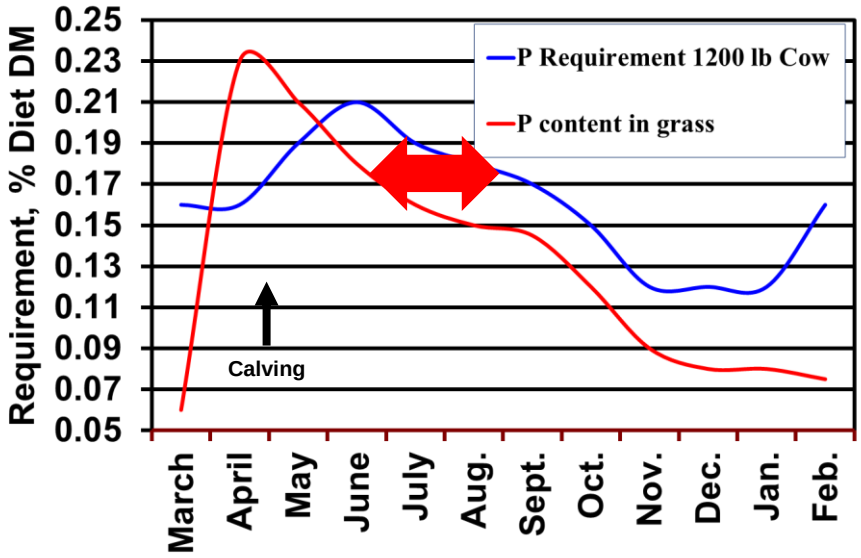


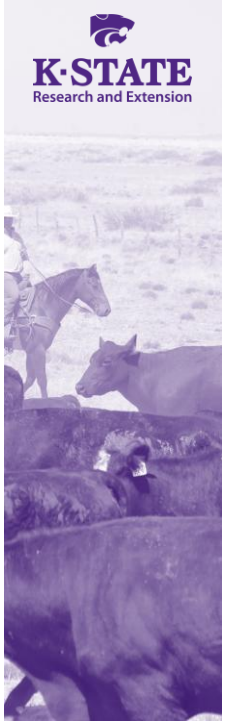
Higher milking cow…



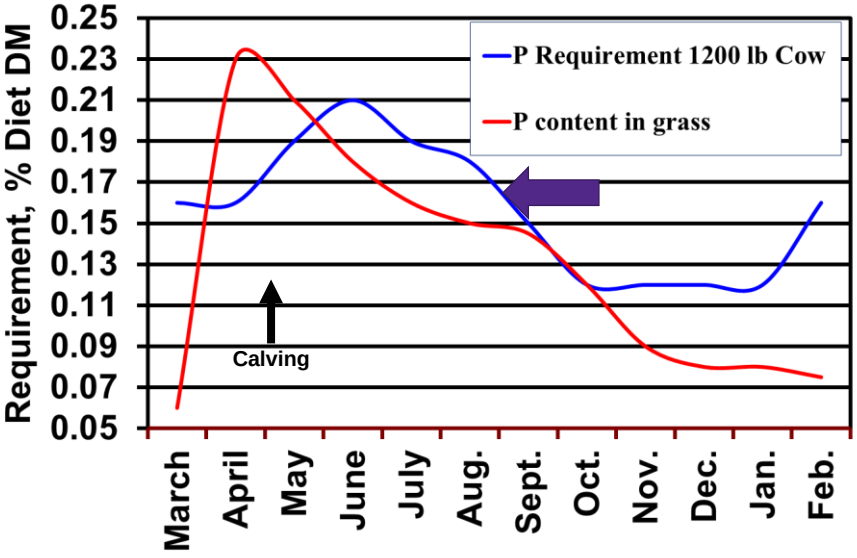


Later calving…

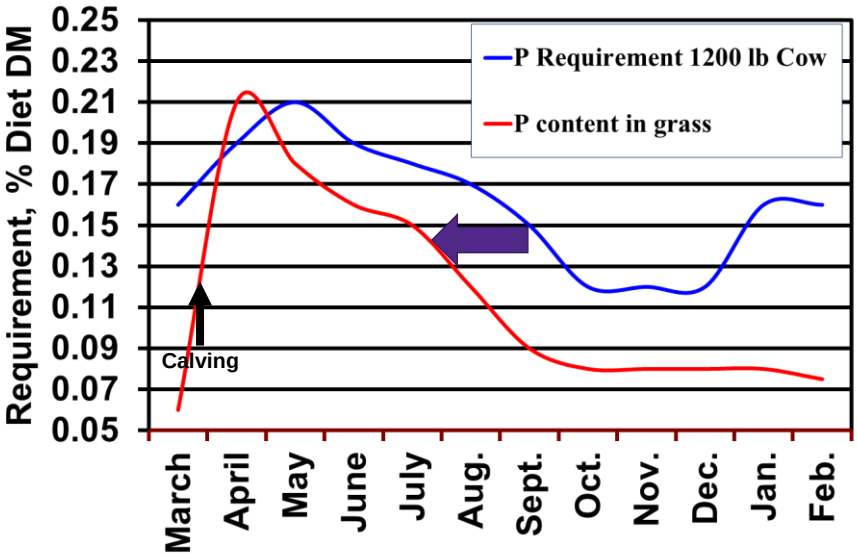


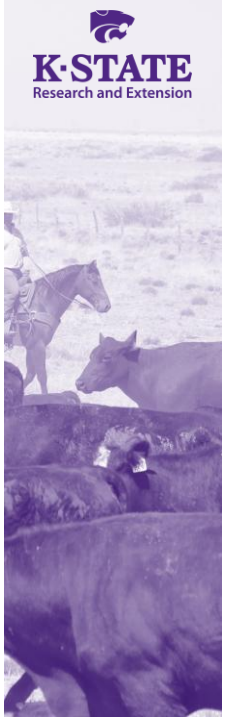


Later calving…+ early weaning…



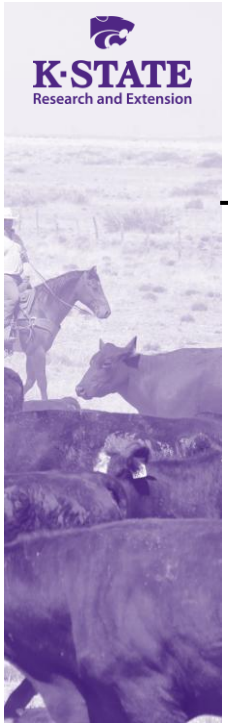
No rain…





So…

- Cows req. = gestation +/- lactation
- (Requirement) – (grass + feed) = supplement needed



Supplemental Feed

Feedstuff	% P
Native pasture	*0.06 – 0.30*
Soybean Meal	**0.71**
Cottonseed Meal	**0.76**
DDG	**0.83**
Corn Gluten Feed	**0.95**
Wheat Midds	**1.00**

Wright, 2003

Distiller's Grains and Sulfur

Feedstuff	Sulfur, % DM
Alfalfa	**0.28**
Corn	**0.14**
Wheat Midds	**0.19**
Cottonseed Meal	**0.26**
Soybean Meal	**0.46**
Corn Gluten Feed	**0.47**
Dried Distiller's Grains	***0.77 (0.44 – 1.72)***

NRC, 2000; Buckner et al., 2008

Supplemental Feed

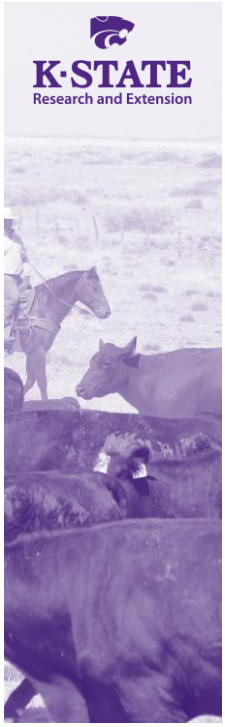
- 1200 lb mature beef cow
  - Peak lactation P requirement = 26.5 g/d

	% P	P, g/d
Dry Matter Intake		
27.6 lbs Native Grass	**0.10**	**12.5**
3.0 lbs DDGS	**0.83**	**11.3**
	Total	**23.8**

90% of Lactation requirement!

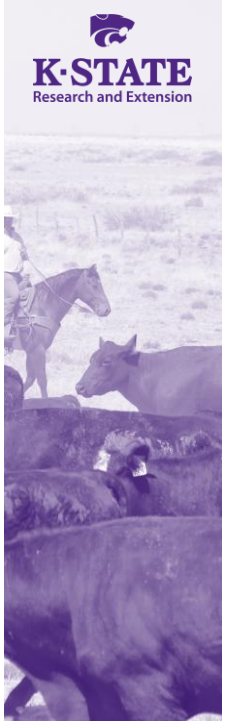
Be aware of mineral imbalances!

Water Sources

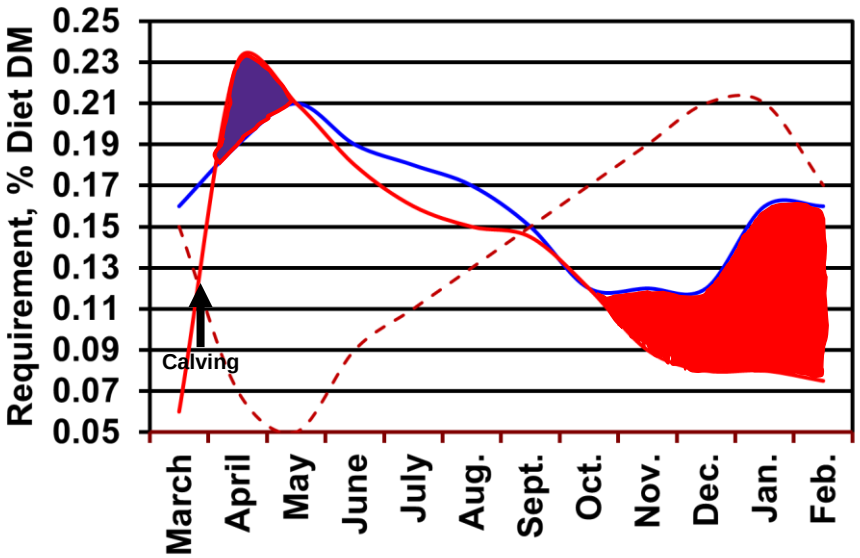


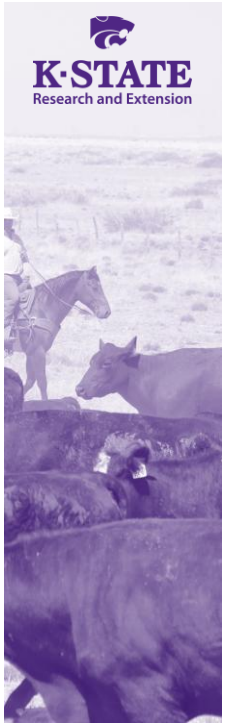
Supplementation Strategies

1. Continuous
   A. Same mineral year round
      A. Consumption will vary w/ grass phos
   B. Forage base determines mineral specs
      A. Easier to achieve target consumption
2. Strategic Supplementation
   - Altered in response to animal need + dietary supply

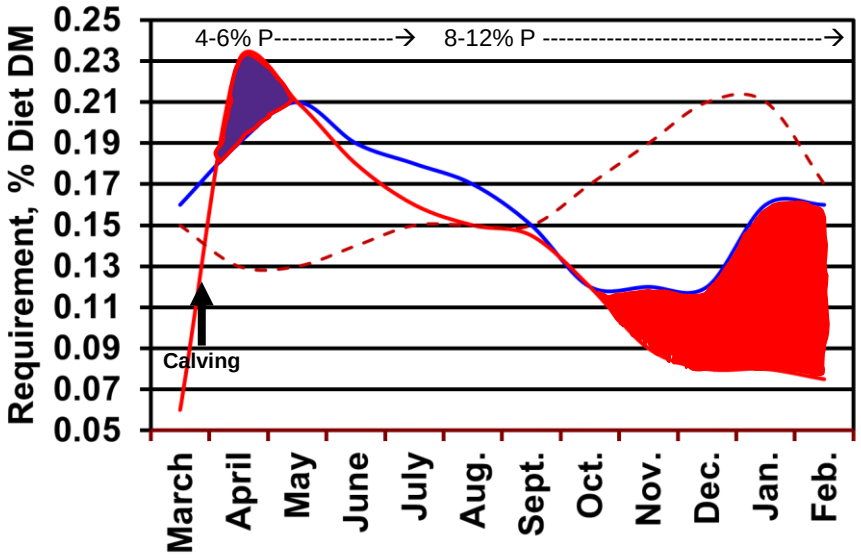


Same mineral all year

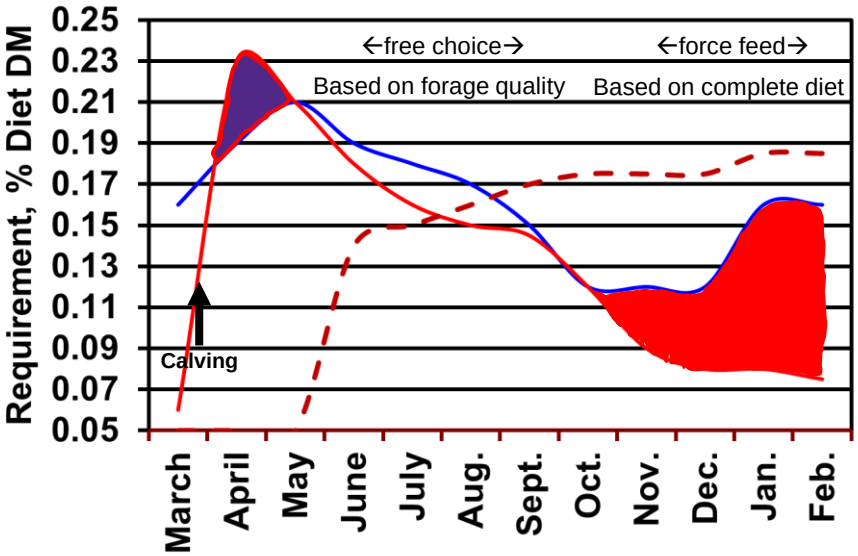


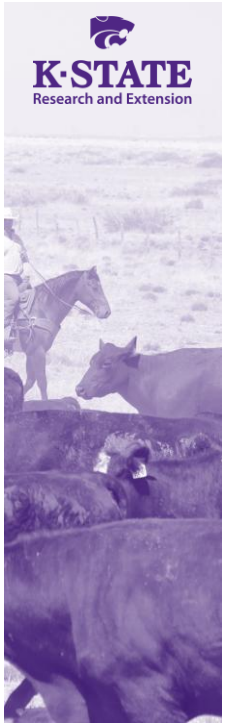


Match formula to needs through the year



Feed strategically

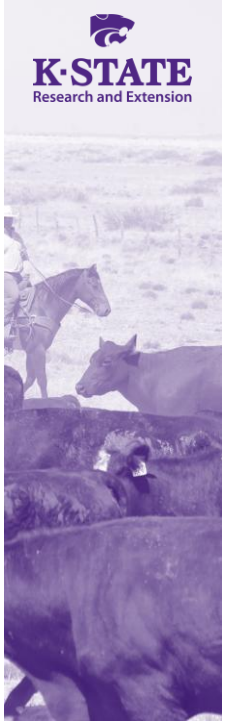




Microminerals (trace minerals)

- Outside of selenium, many of the important microminerals are deficient in forages
  - Selenium deficient areas of the country
  - Kansas has fairly good soil selenium which correlates to adequate selenium in forages – in general

SALT and trace minerals need to supplemented on a regular basis



Profit Tips

- Minerals: important component of nutrition
  - Reproduction, growth, health = Profit

- Keep program simple but:
  - Animal needs
  - Dietary supply

Lets complicate mineral nutrition even more….

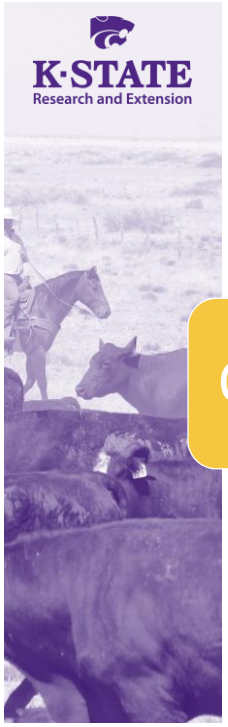
NOW

Breeding – trace mineral

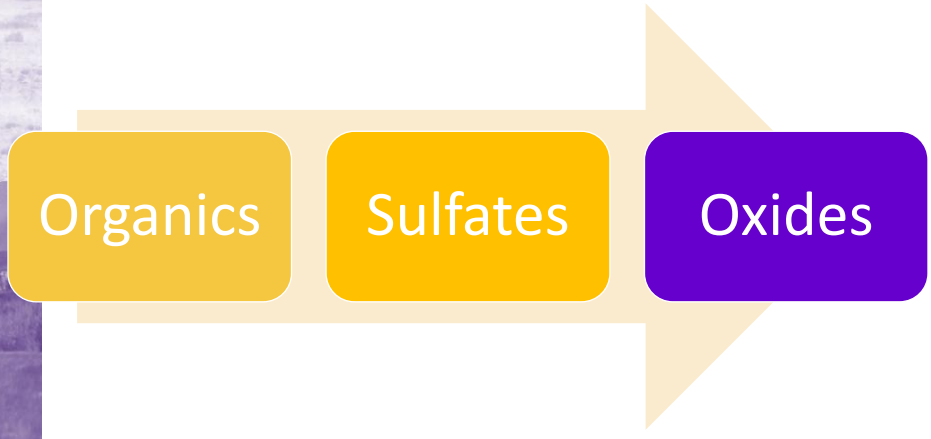
- Trace minerals become very important from a breeding perspective
  - Cu, Zn, Se, Mn, Mg??
- Many forms of trace minerals
  - Organic
    - Chelated, Complexes, proteinate, polysaccharide, hydroxy analogue chelate, metal proprionate
  - Non-organic
    - ZnO, ZnS04, MnO, etc

Organic vs non (inorganic)

- Yes to organics if issues with….
  - Breeding
  - Foot rot (especially Met-Zn)
  - Scours
  - Grass tetany (amino acid-Mg)
  - Weaning
  - Calving
  - AI or embryo work
- No if herd seems healthy and productive



Bioavailability of trace minerals

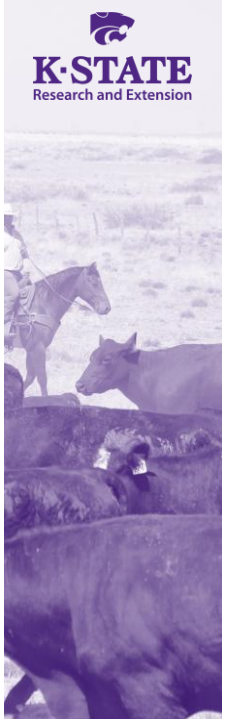


Bioavailability of organic trace minerals

Chelates

Proteinates – sometimes chelate sometimes complex

Complexes



Brand X Mineral

Guaranteed Analysis

Calcium, not less than……..11.5%
Calcium, not more than…….13.5%
Phosphorous, not less than…..12.0%
Salt, not less than……..11.0%
Salt, not more than……13.0%
Potassium, not less than……1.0%
Cobalt, not less than……14.0 ppm
Copper, not less than…….1300 ppm
Iodine, not less than……0.0088%
Selenium, not less than…..4000 ppm

Ingredients

Dicalcium Phosphate, Processed Grain By-Products, Salt, Calcium Carbonate, Yeast Culture, Potassium Chloride, Manganous Oxide, Zinc Sulfate, Iron Oxide, Manganese Sulfate, Copper Oxide

Directions for use:

Beef Cattle- Brand X Mineral is recommended for free choice feeding to all cattle grazing grass pastures. Optimum intake is 2-4 ounces per head daily

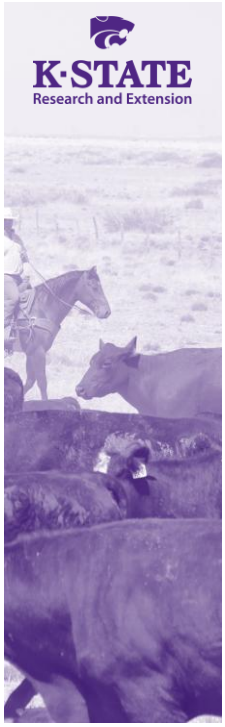
Mineral Tag

if it's not on the label it may not be in the product!

Ingredients differ in bio-availability

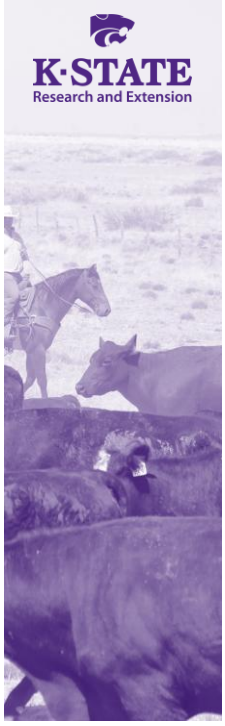
Sulfate forms are generally more available

Be aware of target intake



Injectable trace minerals

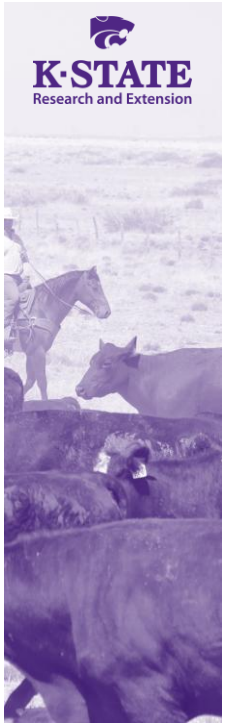
- Varying results – all based on whether animals were in deficiency or not prior to injection
- 5 studies in Nebraska (thesis of Carmen J Brasche)
  - Injectable did increase liver and serum levels of Cu, Se, Zn, Mn in cows and calves
  - However, no difference in animal performance measures including growth, AI rates, or preg rates
- All animals were in adequate mineral status prior to injection



Injectable trace minerals

- K-State Study with cows in Manhattan and Hays, KS
- Injected ~105 d before calving and 30d before Timed AI
  - Calves from dams that were injected also received injections at birth and ~71 DOA

Mundell et al., 2015



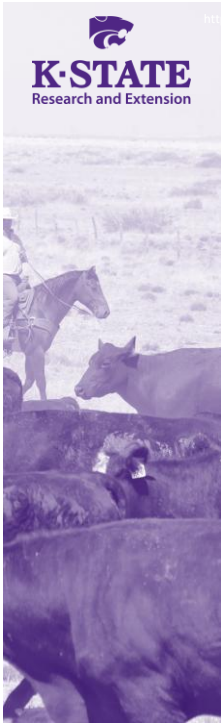
Injectable trace minerals

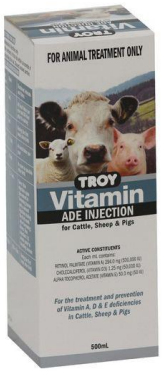
- No difference in cow weight and BCS from initiation of study to calving and AI to weaning
  - BCS increased in TM injected cows between calving and AI
- % of cows cycling and overall preg rate not different
  - TM injection increased TAI preg 11%
- Calf BW at birth, ADG, weaning, and adj 205d weights not different
- All cows had free-choice mineral – thus potentially all cows had adequate status

Mundell et al., 2015

Trace minerals and foot rot

- Organic iodine and Zn have been found to help with prevention of foot rot
- Organic iodine – EDDI (ethylenediamine dihydriodide)
  - 20-25 mg/hd/d
  - FDA regulates how much EDDI can be used so be careful if formulating your own mineral mix – follow regs
- Organic Zn – ZnMet
- Organic forms of Cu and Se ??



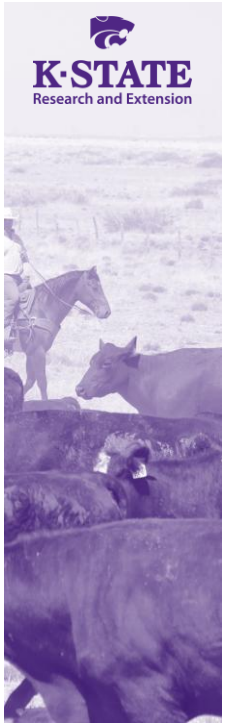


Vitamins

Importance of vitamins

- A
  - Minimize calf scours, retained placenta
- E
  - Immune function, antioxidant, absorption of vitamin A and selenium
- D
- K
- B
- C

We don't need to feed to mature ruminants because the rumen microbes will synthesize!!



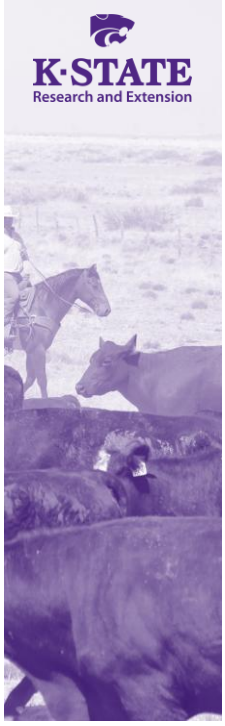
Dietary requirements

Vitamin A

- Dry pregnant cow
  - 1270 IU/lb DMI
  - 27.2 IU/lb of body weight
- Lactating cow and breeding bull
  - 1769 IU/lb DMI
  - 38.1 IU/lb body weight
- Feedlot calves
  - 998 IU/lb DMI
  - 21.3 IU/lb body weight
- Prevention of scours
  - 30,000-45,000 IU/day

Vitamin E

- Nonstressed mature beef cattle
  - Diet usually meets requirements
- Newly received stressed calves
  - 182-227 IU/ day
- Feedlot cattle that have been straightened
  - 12-16 IU/lb DMI
  - 0.24-0.33 IU/lb body weight



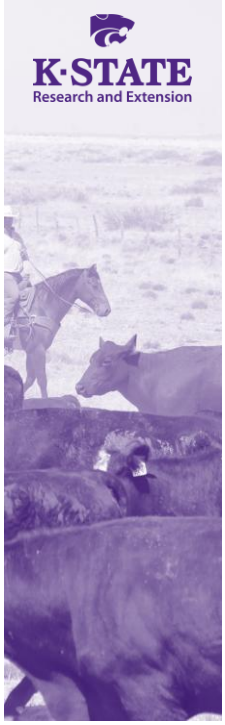
Vitamin A story

- Sources
  - Legumes
    - Alfalfa
  - Lush leafy green forage
  - Cover crops
  - Yellow corn
- Stored in liver for 2-4 months (NRC, 2017)
  - Fill gaps in low dietary vitamin A periods

Vitamin A Story

- Old hay that has been stored for a long time, degrades Vit. A
- Dormant forages low in Vit. A
- Ensiling destroys Vit A (Airado-Rodiquez, 2011)
- Mature plants lower Vit A (Maynard, 1979)
- Vitamin A in mineral mix degrades with heat, moisture, trace minerals
- Transplacental transfer in minimal
  - Colostrum consumption and absorption necessary for neonates (Swanson, 2000)

Protein, phosphorus, zinc, iodine deficiencies during pregnancy impairs Vit. A metabolism and reduces colostrum concentration (Zanker, 2000)



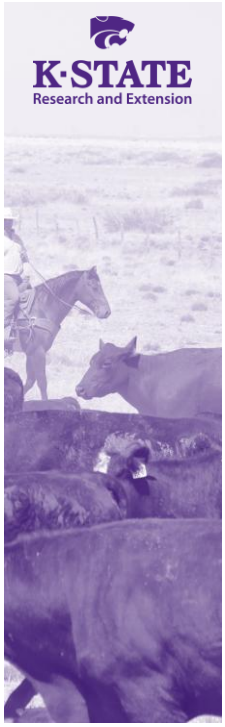
Stability of Commercial Vitamins

External factors Influencing Commercial Vitamin Stability

Vitamin	*Elevated temperature*	*Humidity*	*Light*	*Oxygen*	*Acid pH*
Vit. E	●	●	●	★	●
Vit. A	★★	★	★★	★★	★
Vit. D_3	★	★	★	★★	★
Biotin	★	●	●	●	●

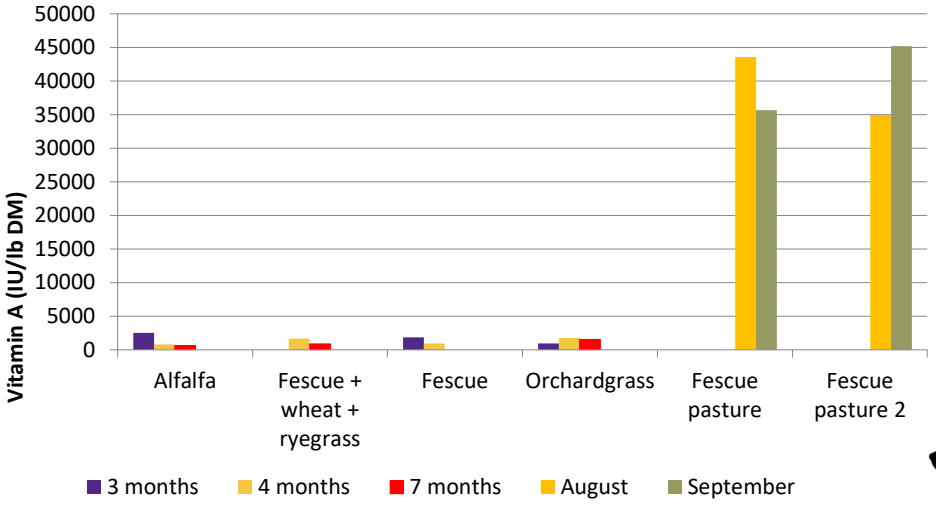
● = stable ★ = slightly sensitive ★★ = very sensitive

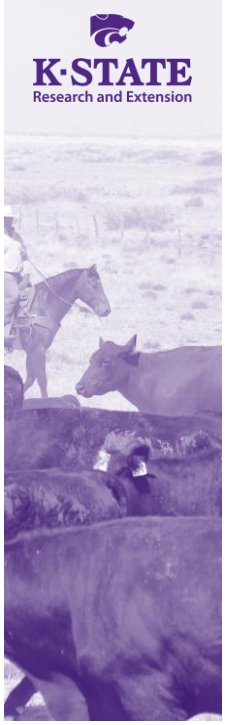
Source: DSM, 2021



Vitamin A degradation

Pickworth et al., 2012





Vitamin E story

Good things

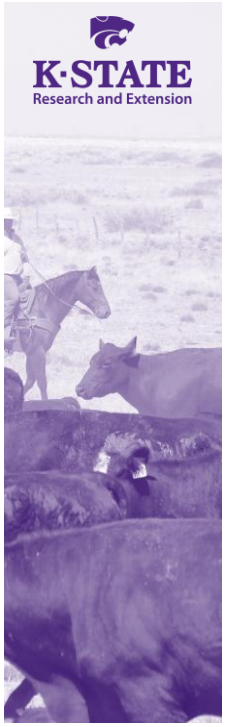
- Sources
  - Alfalfa
  - Lush leafy green forage
  - Alfalfa meal
  - Whole grains with oil

Issues

- Diets high in sulfur containing amino acids, selenium, corn oil, linseed oil, or soybean oil needs more vitamin E
- Long storage reduces E potency
- Vitamin E in mineral mix degrades with heat

KEEP vitamin A in supplement

- At least 45 days prior to calving to help with calf scours
- Early lactation
- Not supplementing something such as alfalfa in dormant grass season
- Feeding only harvested forages



What has been seen in Operations

Vitamin A results: KSVDL

Sample	Number	Deficient
Serum	368	95.1%
Liver	109	53.2%

Normal: serum (0.3-0.7 ppm); liver (1-4 ppm)

Hanzlicek

Dietary Requirements

Daily requirement

Dry heifer or cow

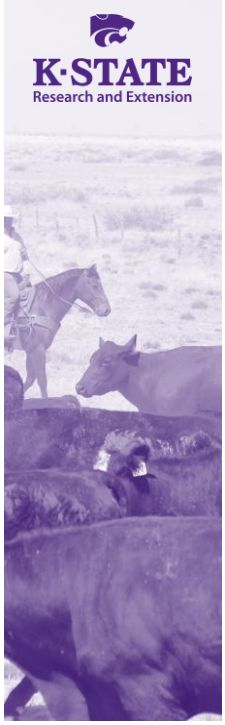
27 IU/lb. b.w./day

- 1,200 lb. cow = 32,400 IU/day
- 1,400 lb. cow = 37,800 IU/day
- 1,600 lb. cow = 43,500 IU/day

NRC, 2017

Needed Vitamin A Concentration 1,400 lb. cow	
Mineral Consumption	Concentration (IU)/lb. mineral
2 oz./day	302,400
3 oz./day	201,600
4 oz./day	151,200

Remember the non-eaters



What about Injectables?

Estimated length of time injectable vitamin A effectiveness	
Source	*Effective time estimate*
Canada	2-4 weeks
OSU	2-3 months
KSU	4 weeks
MU	4 weeks
Texas	1-3 months, depending on age and stage of gestation

Jaymelynn Farney, PhD
jkj@ksu.edu
620-820-6125