The Importance of Copper in Beef Cattle Diets

LEG Virtual Field Day

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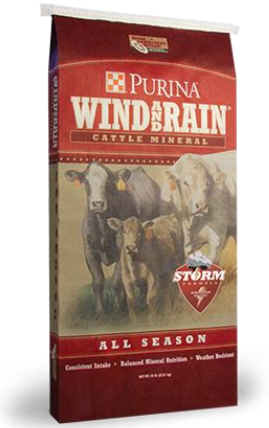
Minerals: Macro vs. Micro

- Macrominerals: Ca, P, Mg, S, Na/Cl
  - Needed in larger quantities
- Microminerals: Cr, Co, **Cu**, I, Mn, Mo, Se, Zn
  - Needed in trace amounts
- **Regardless of amount required, ALL are necessary for normal body function and efficient production.**

Mineral Sources for Beef Cattle



Following phosphorus, copper is often the 2nd most limiting mineral nutrient in grazing cattle nutrition

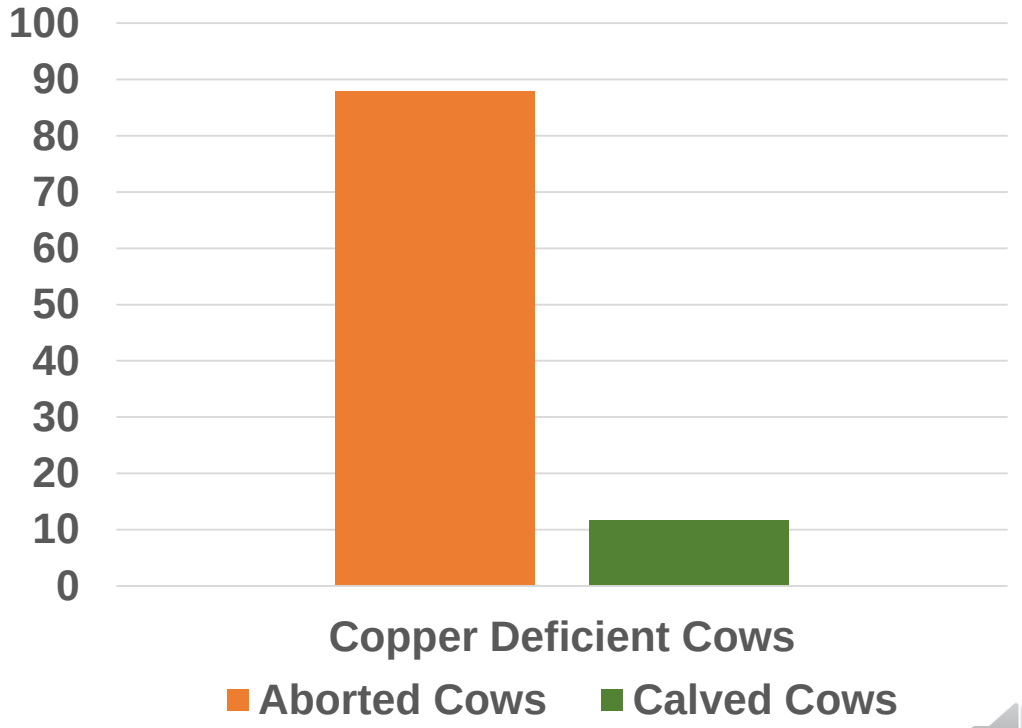
Role of Copper

- Enzyme function
- Cardiovascular function
- Immune function
- Iron absorption
- Reproduction
- Bone Formation

McDowell, 2003

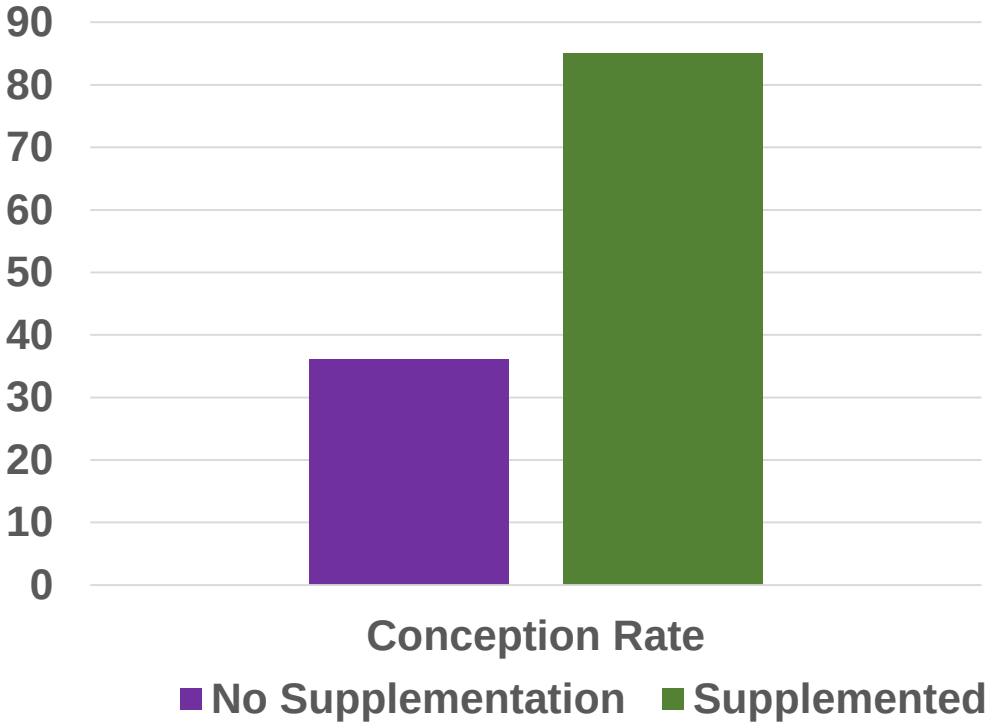
Copper and Reproduction

<u>Summary:</u> 87% of cows which aborted calves were Cu deficient whereas only 12% of the cows which produced live calves were Cu deficient



Sakhaee E. and S. Kazeminia, 2011

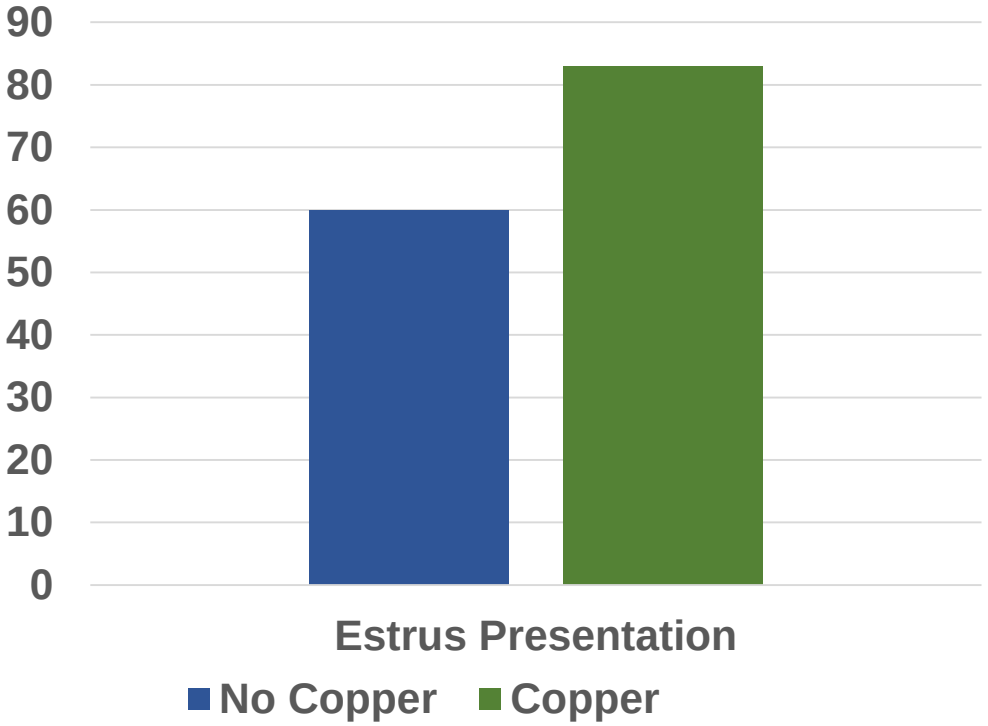
Copper and Reproduction



<u>Summary:</u> Cows treated with copper sulfate (injected) had greater (85%) conception rates vs cows which received no copper supplementation (36%)

Garcia, J. D. et al., 2006

Copper and Reproduction



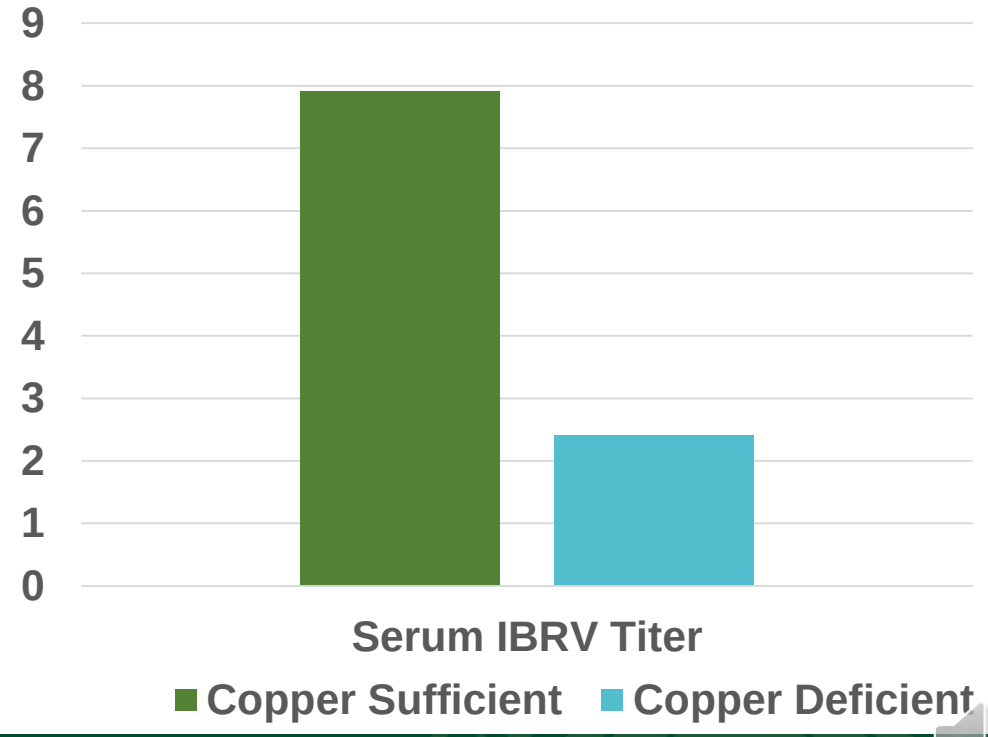
<u>Summary:</u> Cows treated with copper sulfate displayed estrus more effectively (83%) than those not provided copper (60%)

Garcia, J. D. et al., 2006

- **Copper deficiency can impact:**
  - **Calving rates**
  - **Conception rates**
  - **Ability to express estrus**
  - **Limited data on cattle specific impacts, but many studies report reproductive failure during copper deficiency**

Copper and Immunity

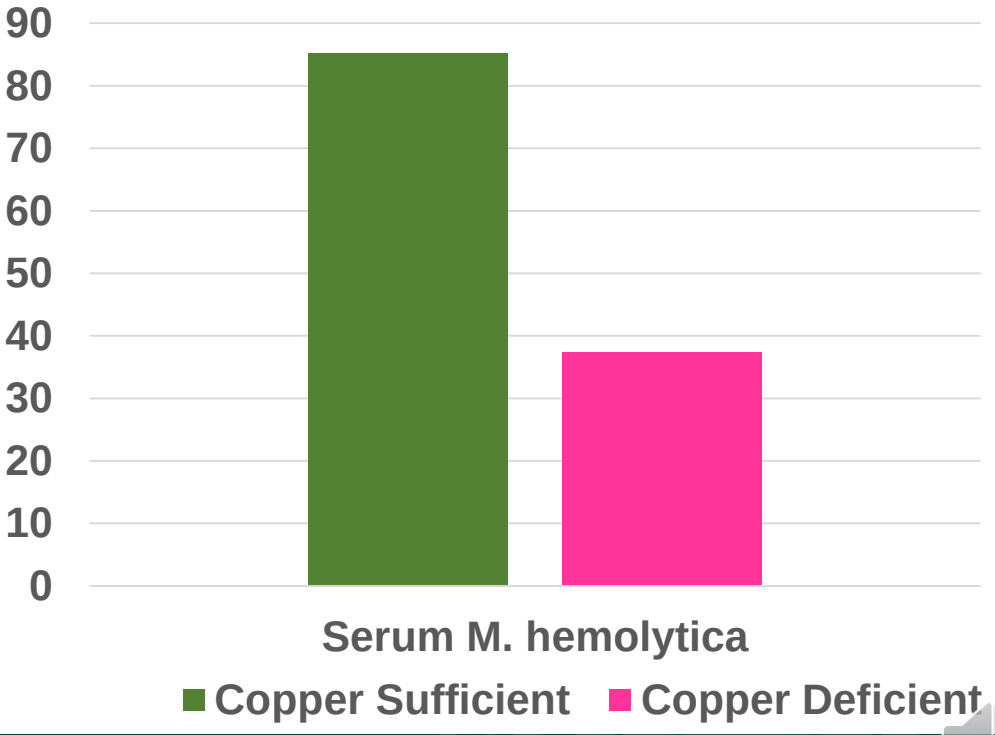
<u>Summary:</u> After an immune challenge from infectious bovine rhinotracheitis virus (IBRV), calves fed a copper-sufficient diet had numerically greater serum titers.



Stabel et al., 1993

Copper and Immunity

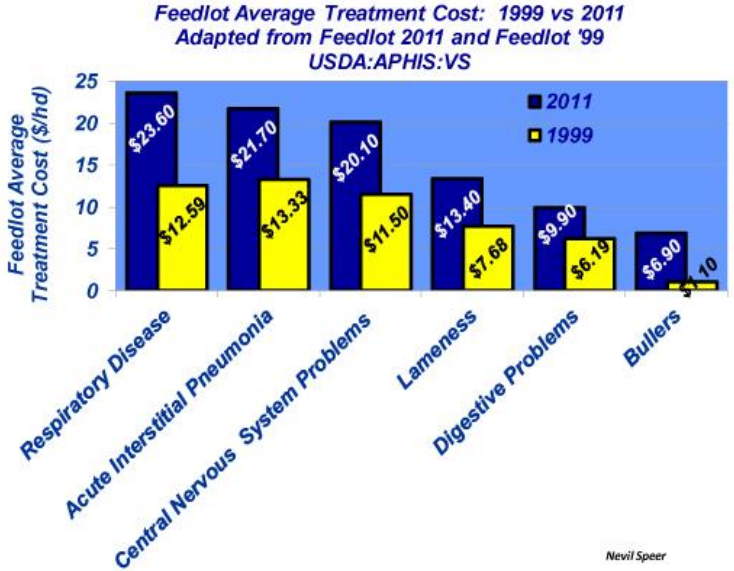
<u>Summary:</u> After an immune challenge from *Mannheimia hemolytica*, calves fed a copper-sufficient diet had numerically greater serum titers.

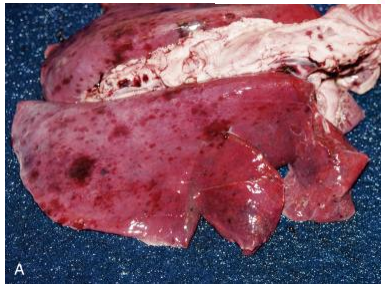


Stabel et al., 1993

Copper and Immunity

- **Copper deficiency impacts:**
  - **Initial immune response**
  - **Efficacy of vaccines**
  - **Future immune responses**
  - **Immune cell regulation**
  - **Inflammatory response**





Types of Copper Deficiency

- **Primary**
  - **Insufficient copper in the diet, i.e. forage, grain, mineral, etc. not providing ~ 10 ppm Cu**
- **Secondary**
  - **Insufficient copper due to antagonists in the diet**
    - **Examples: Sulfur, iron, and molybdenum**

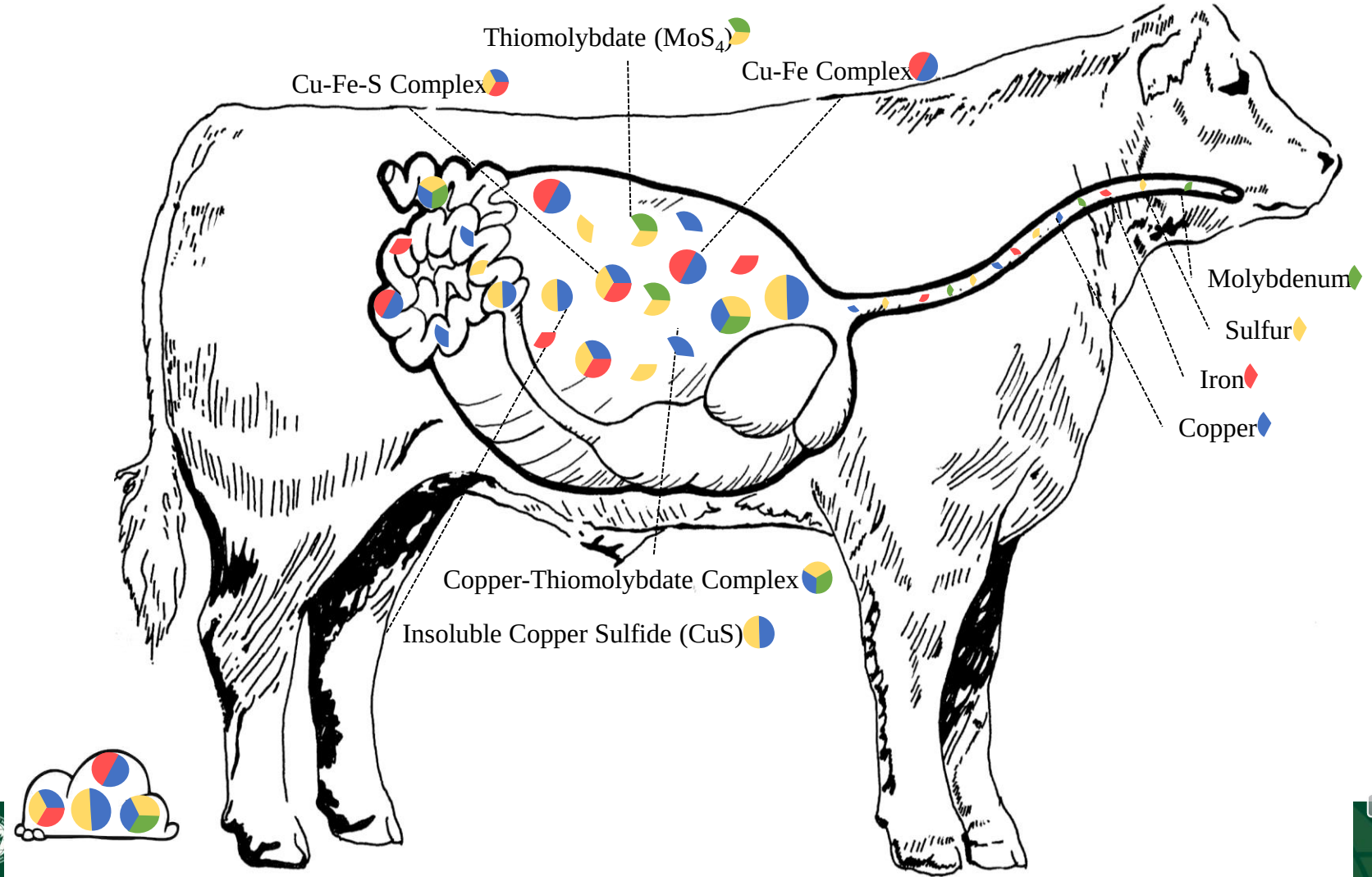
Copper Antagonists

When it comes to minerals and ruminants, what goes in isn't always useable by the animal

- **Copper & Iron**
  - **Cu=Fe absorption but…**
  - **Impedes Cu at 200 ppm**

- **Copper & Molybdenum**
  - **Often associated with sulfur**
  - **Thiomolybdate-copper complexes**

- **Copper & Sulfur**
  - **Copper sulfide & copper bound thiomolybdates**


Thiomolybdate (MoS_4)
Cu-Fe-S Complex
Cu-Fe Complex
Molybdenum
Sulfur
Iron
Copper
Copper-Thiomolybdate Complex
Insoluble Copper Sulfide (CuS)

Copper Antagonist	Deficient	Ideal	Antagonistic Level**		MTC*
			Marginal	High	
Iron (ppm)	< 50	50-200	> 200 -400	> 400	1000
Molybdenum (ppm)	Not Established	< 1	1-3	> 3	5
Sulfur (% DM)	< 0.10	0.15 – 0.20	> 0.20 – 0.30	> 0.30	0.40

*Maximum Tolerable Concentration

** Levels above these can potentially adversely affect copper availability.

Characteristics of Hawaii's Forages

Season	Sample Size	% DM	% CP	% Ca	% P	% Mg	% K	% Na	Fe ppm	Zn ppm	Cu ppm	Mn ppm	Mo ppm	% S	Ca:P	Cu:Mo
10.11-11.11 Fall	**n=9**	**23.0**	**15.3**	**0.3**	**0.4**	**0.3**	**3.0**	**0.1**	**458.0**	**48.3**	**8.9**	**144.7**	**0.3**	**0.2**	**0.9**	**69.6**
		2.1	2.3	0.0	0.1	0.0	0.6	0.0	327.3	7.4	0.8	43.0	0.1	0.0	0.2	33.7
12.11-2.12 Winter	**n=9**	**24.1**	**20.4**	**0.4**	**0.4**	**0.3**	**2.3**	**0.1**	**492.7**	**38.4**	**11.2**	**127.6**	**0.9**	**0.2**	**1.1**	**13.4**
		6.7	2.6	0.0	0.0	0.0	0.1	0.1	298.0	8.9	1.4	46.7	0.3	0.1	0.1	3.1
3.12-5.12 Spring	**n=6**	**28.8**	**20.1**	**0.4**	**0.3**	**0.3**	**2.3**	**0.1**	**810.8**	**36.7**	**10.5**	**130.5**	**0.5**	**0.3**	**1.2**	**29.0**
		1.7	1.7	0.0	0.0	0.0	0.5	0.0	855.3	11.5	1.9	83.9	0.3	0.0	0.1	20.6
6.12-8.12 Summer	**n=9**	**23.8**	**18.9**	**0.3**	**0.3**	**0.3**	**2.7**	**0.1**	**180.8**	**38.1**	**11.3**	**225.1**	**0.1**	**0.2**	**1.0**	**101.0**
		5.2	1.1	0.0	0.0	0.0	0.4	0.1	49.3	5.9	1.3	63.0		0.0	0.2	39.4

Management Strategies

- Forage testing
  - At a MINIMUM – Annually
  - Seasonally
- Develop a supplementation strategy
  - Salt alone is NOT the answer
- Determine the best supplement for your cattle and available forage
  - Organic vs inorganic minerals
  - Delivery methods

Thank you!

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