Water Intake in Beef Cattle

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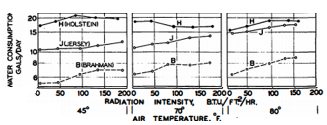
Beef Cattle Water Intake

- Water is an essential nutrient needed for regulation of body temperature, growth, reproduction, digestion, metabolism, and many other biological processes (NRC)
- Cattle directly consume an estimated 760 Billion L per year (Beckett and Oltjen, 1993)
- Influenced by physiological parameters
  - Size/weight (i.e. Meyer et al. 2004)
  - Lactation status (i.e. Brody et al. 1954)

Lvstk. Production Science 90:117-121 Mo. Agric Expt. Stn. Bull. 556 J. Anim Sci 1993 71:818-826

Beef Cattle Water Intake

- Also influenced by environmental parameters
  - Ambient temperature and solar radiation (i.e. Arias and Mader 2011)



  - Other environmental factors

Mo. Agric Expt. Stn. Bull. 556 J. Anim. Sci. 89:245-251

Beef Cattle Water Intake

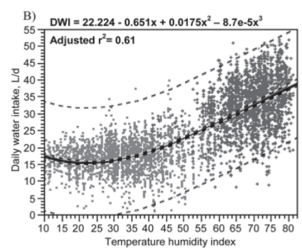


Figure 1. Observed and predicted daily water intake (DWI) of finishing cattle as a function of daily minimum temperature and temperature-humidity index among seasons. Closed squares represent winter season points, and plus signs represent summer season points. Outer dashed lines represent the 95% confidence interval for mean and individual values, respectively.

Season	DWI
Summer	32.4 L
Winter	17.3 L
Overall	24.6 L

Arias and Mader 2011 JAS, pen-DWI extrapolated to individual animals

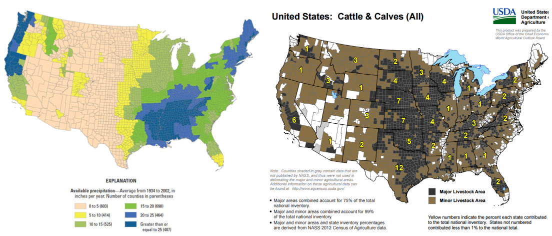
Water and dry matter intake

- Dry matter intake (i.e. Meyer et al. 2004, Holter and Urban 1992, Brew et al. 2011)
  - Not all studies show consistent, high relationships between these 2 traits
  - Ration type (high vs. low moisture)
  - Salt content
  - Restricting either feed or water intake restricts the other trait
    - Increases digestibility
    - Lowers passage rate

Livestock Science 140:297-300 J. Dairy Sci. 91(9):3385-3394 J. Dairy Sci. 75(6):1472-1479

Water for Consumption

- Drinking water use in the beef industry
  - Not important on a LCA scale
    - ~95% Irrigation of pre-harvest water
      - Underscores importance of feed efficiency
  - Critical for an individual farmer

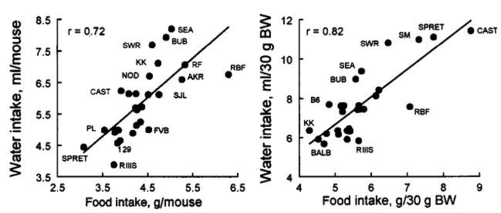


Figures from Agcensus.usda.gov and Ne.water.usgs.com

How much variation in intake?

- Sexson et al. 2012 estimated individual WI from 8,000 pen records over 4 years
  - Included environmental data in the model
    - Previous day temperature, daily temperature, change in temperature, wind speed, and THI were related to WI
  - R^2=0.32
    - Significant variation not explained by the model

Heritable Trait?



Behavioral Genetics 2002 32(6)435-443

What bout beef cattle?

- Ittner et al. 1951 showed that Brahman cattle drank less than Hereford cattle at similar temperatures (88 F)
- Brew et al. 2011 estimated individual animal WI in growing cattle utilizing 146 growing calves with a GrowSafe system
  - Mean WI ~30 L/hd/day

Breed Composition	Gross WI, L/head/d	WI/kg metabolic BW, L/head/d
Charolais X Angus	42.8[a]	0.58[a]
Angus X Brangus	30.8[b]	0.42[b]
Brangus	30.8[b]	0.32[c,d]
Charolais X Brangus	29.7[b]	0.38[c,b]
Brangus X Romosinuano	24.1[c]	0.28[d]
Charolais X Romosinuano	20.7[d]	0.32[c,d]

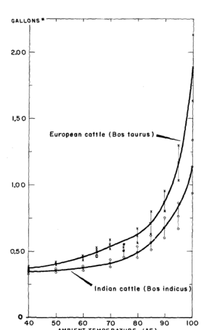


Figure 1. Water intake expressed as a function of dry matter consumption and ambient temperature.

Winchester and Morris J. Anim. Sci. 1956 15(3):722-740, mostly small numbers of individual animals

Large-Scale Individual Animal WI

- Now have the tech to collect large numbers of WI phenotypes on individual animals
  - GrowSafe and Insentec systems
- Meyer et al. 2004 (60 dairy cows)
  - WI range from 14-171 kg/day, DMI 1.8-36.8 kg/day
- Meyer et al. 2006 (62 Holstein bulls)
  - WI up to 78.7 kg/day

OSU Project Overview

- 5 year integrated USDA project
  - Adaptability to abiotic stresses
    - Water availability and quality, temperature-related stresses
  - Includes research and extension components
- Goal: Develop beef cattle selection and management tools that address conservation of water resources and adaptation to climate variability (drought)

Insentec System

- 21 Day acclimation period
- Commence test protocol

Study Design

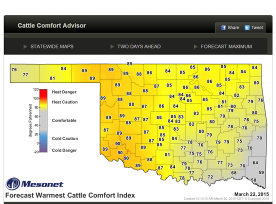
- 70 day baseline feed and water intake test
  - Individual animal (n=840, n=120 each round)
    - Water intake
    - Feed intake
    - Periodic weights (ADG)
    - Behavioral data (temperament, posture, social interactions, shade use, motion index, etc.)
    - Health status (blood cell counts, treatment data for health interventions, electrolyte balance, hematocrit, etc.)
    - Heat and cold stress measures (respiration rates, subset with rumen boluses, behavioral data)
    - Rumen and fecal samples
    - Pedometers on a subset of animals in each pen
  - Second testing phase for adaptation

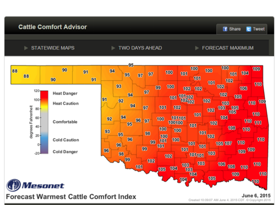
More Still to Come!

- 6 more rounds of calves (Group 3 testing now)
- 80K genotyping data (GGP-HD)
  - Water intake and efficiency
  - Feed efficiency
  - Adaptability to abiotic stresses
  - Heritability estimates and GWAS for these traits
  - Other traits with data collected
- Metagenomic sequencing
  - How is the rumen affected by water quality and availability?
    - >60% of protein requirement generated by microbes (Church 1993)
- GHG emissions predictions through modeling
- Tissue collections and (maybe) GHG emissions data on a subset

Tools for Producers

- Cattle water demand tool
- Expansion of the cattle comfort advisor





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USDA United States Department of Agriculture National Institute of Food and Agriculture

Texas Cattle Feeders Association

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http://www.ansi.okstate.edu/research/labs/genetics/rolf/home