HEAT STRESS ABATEMENT

Heat Stress Abatement
• Need to slow Heat Gain and/or Speed up Heat Loss

Heat Transfer Methods
• Radiation
• Conduction
• Convection
• Evaporation

Increase in Production

Radiation
Radiation
- Direct sunlight to cow (Heat stress)
- Cow directly to night sky (Cooling)

Convection

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Convection is Dependent on ...
- Temperature of air around the cow
- Speed of air around cow

Increase Convective Cooling
- Air Exchange in Natural Ventilation
  - \( Q = E \times A \times V_w \)
    - \( Q \) = air exchange rate
    - \( E \) = effectiveness factor
    - \( A \) = area of inlet
    - \( V_w \) = wind velocity

Goal is have inlet to be 7 to 11 ft\(^2\)/cow

Don’t forget the endwall

At Cow Level!!!
Higher Air Velocity
• Increases cow’s cooling ability by carrying away hot air close to the skin
• Must create “turbulence” around the cow
• 308 to 440 fpm (3.5 to 5 mph)

Circulation Fans
• Circulation fans added to increase Air velocity

Circulation Fans
• Space fans 10 - 12 X diameter
  – 36” diameter - 30 to 36 ft
  – 48” diameter - 40 to 48 ft
• Approximately 6 to 10 ft high
• Tilt 10° to 20° from vertical

Circulation Fans
• Located over every row of stalls & the feed alley
• Positioned to move air over the cows back

Maintenance
HVLS
• High Volume Low Speed

HVLS Recommendations
• Mount fans over cows at ~ 2X fan diameter

HVLS Recommendations
• Watch out for height & clearance issues

Evaporation

Moisture & Heat Production

Based on 1500-pound dairy cow
ASABE EP270.5

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Evaporative Heat Removal
• BTU's to Evaporate water
  – ~ 1,000 BTU per 1 pound of water
  – ~ 8,300 BTU per 1 gallon of water

Add Evaporative Cooling
• 1st increase water space
• Consumption can be 2X in hot weather

Evaporative Cooling
• MUST have the air exchange and velocity first
  • Decrease air temperature
    or
  • Remove heat directly from cow

Evaporation
• Increases with
  – Higher temperatures
  – Lower humidity
  – Higher air speed

In-direct Evaporative Cooling
• Lower ambient air temp by evaporating water
• Then cool the cow with this ‘cooler’ air
  – i.e. increase convective cooling by lowering temp of ambient air
In-direct Evaporative Cooling

- Large water droplet wets the cow to the skin.
- When water dries it removes heat directly from the cow (~75% to 80%)

Direct Evaporative Cooling

- Total water usage
- Efficiency of heat removal
- Two different systems with two different methods

Sprinkler Design

- Apply .03 inches per ft²
- Cover 5ft to 6ft area behind the feed barrier
- Repeat every 5 to 15 minutes dependent on temperature

Evaporative Cooling Caution

- Need to be careful to not coat the cows with a fine layer of water trapping air close to the skin.
- Trapped air layer will actually insulate the cow & slow convective cooling!!

Heat Abatement Steps

- Decrease solar load
  - Shade
- Increase Convective Cooling
  - Larger air exchange rate
  - Faster air velocity w/in the shelter (at cow level)
- Increase Evaporative Cooling Capability
  - Added drinking water
  - In-direct evaporative cooling
  - Direct evaporative cooling
Questions?

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