Heat Stress in Dairy Cattle

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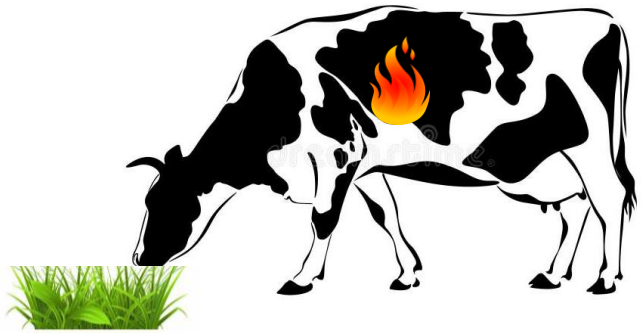
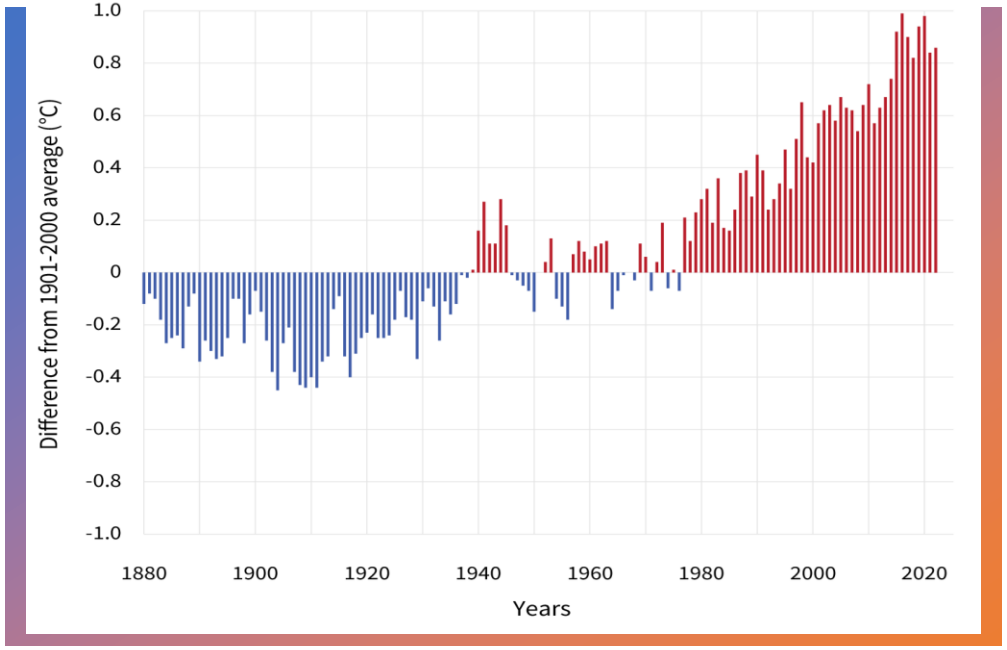
Heat Stress in Dairy Cattle

- Refers to environmental and metabolic conditions that increase body temperature

- Triggers a range of behavioral and physiological responses to minimize heat production and increase heat dissipation

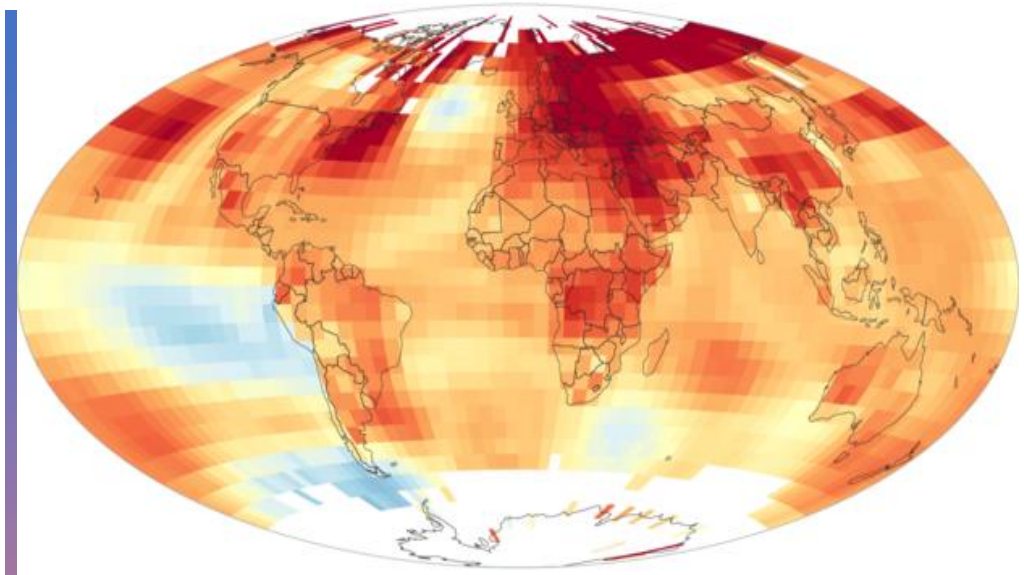


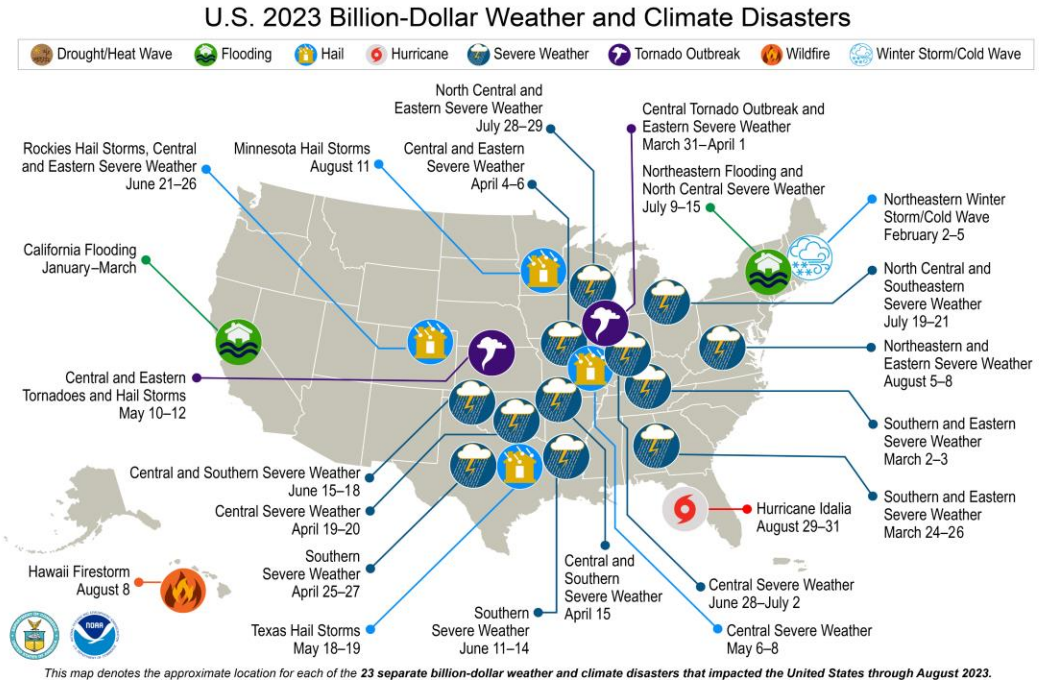
Kenefick (2011)



Global Average Surface Temperature

- Change in temperature is accelerating (~0.14° Fahrenheit (0.08° Celsius) per decade since 1880, or about 2° F in total)
- The rate of warming since 1981 is more than twice as fast: 0.32° F (0.18° C) per decade
- Most of the planet is warming (yellow, orange, red)





Selected Significant Climate Changes and Events in 2022

Extra heat

- Regional and seasonal temperature extremes
- Reducing snow cover and sea ice
- Intensifying heavy rainfall
- Changing habitat ranges for plants/animals

How will it impact farm profitability and animal production?

Heat Stress: Economics

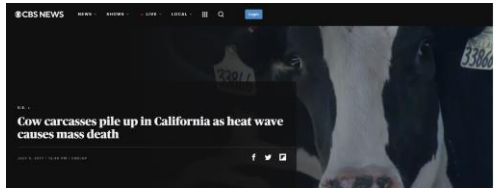
Cost: lost productivity, mortality, health, etc.

- US dairy industry: $810 million to $1.5 billion/year
- Potential future losses could reach as high as $2.2 billion by 2080 (USD)

The New York Times, July 27th2006

Thousands of livestock are also dying from the intense heat. Dairy farmers are using sprinkler systems and shaded barns to try to keep the cows cool.

CBS NEWS, July 5th2017



It will get worse in the future if:

- Climate change continues as predicted
- Genetic selection only for milk yield

By MICHELLE ROOK June 15, 2022

Cattle Losses Reported Due to Heat Stress

Ferreira et al., 2016

TEMPERATURE-HUMIDITY INDEX (THI)

Determines when a cow may start feeling heat stressed

THI = Tdb–[0.55 –(0.55 X RH/100)] X Tdb–58)

1 Kg = 2.20 lbs

Stress- 4hr/d
68-71
1.1kg/cow/d

Mild-Moderate- 9hr/d
72-79
2.7kg/cow/d

Moderate-Severe- 12hr/d
80-89
3.9kg/cow/d

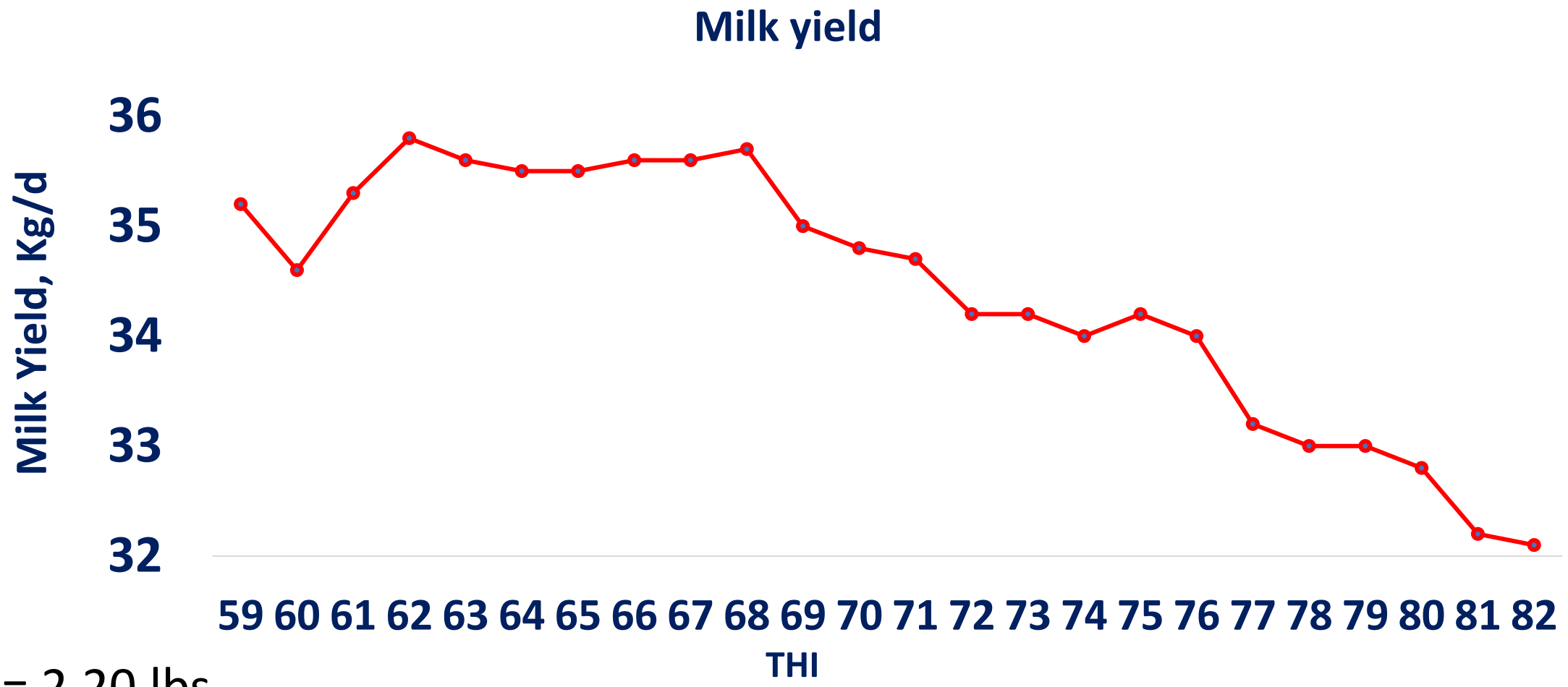
DAIRY COW TEMPERATURE HUMIDITY INDEX (THI)

	Humidity %																			
Temp °F	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
72	64		65	65	66	66	67	67	67	68	68	69	69	69	70	70	70	71	71
74	65		66	67	67	67	68	68	69	69	70	70	70	71	71	72	72	73	73
76	66	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
78	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76
80	68	69	69	70	70	71	72	72	73	74	75	75	76	76	77	78	78	79	79
82	69	69	70	70	71	72	73	73	74	75	75	76	77	77	78	79	79	80	80
84	70	70	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	83
86	71	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	84
88	72	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86
90	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88
92	73	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90
94	74	75	76	77	78	79	80	81	82	83	84	86	86	87	88	89	90	91	92
96	75	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94
98	76	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95
100	77	78	79	81	82	83	84	85	86	87	88	90	91	92	93	94	95	96	98
102	78	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98	100
104	79	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98	99	100	101
106	80	81	82	84	85	87	88	89	90	91	93	94	95	97	98	99	101	102	103
108	81	82	83	85	86	88	89	90	92	93	94	96	97	98	100	101	103	104	105
110	81	83	84	86	87	89	90	91	93	95	96	97	99	100	101	103	104	106	107

High-producing cows can begin to experience heat stress with 68 THI

Severe
90-99

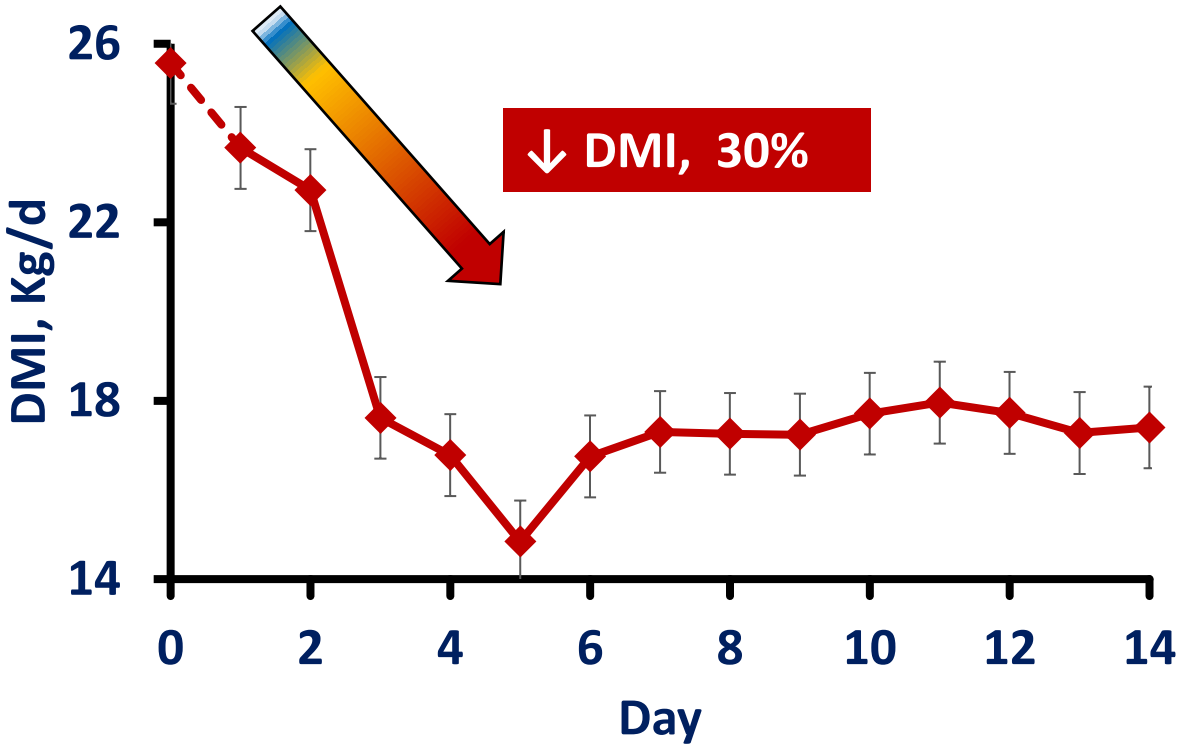
Common Effects of Heat Stress on Dairy Cows

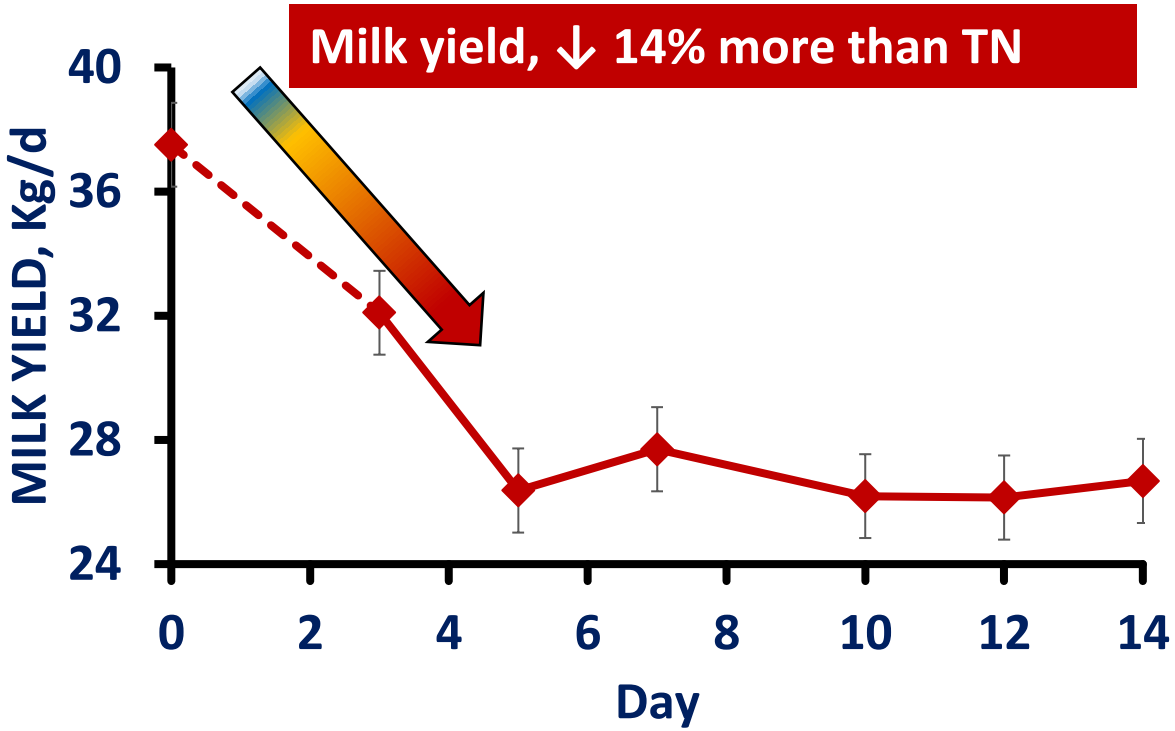


1 Kg = 2.20 lbs

Common Effects of Heat Stress on Dairy Cows

Heat stress





1 Kg = 2.20 lbs

Similar for milk components

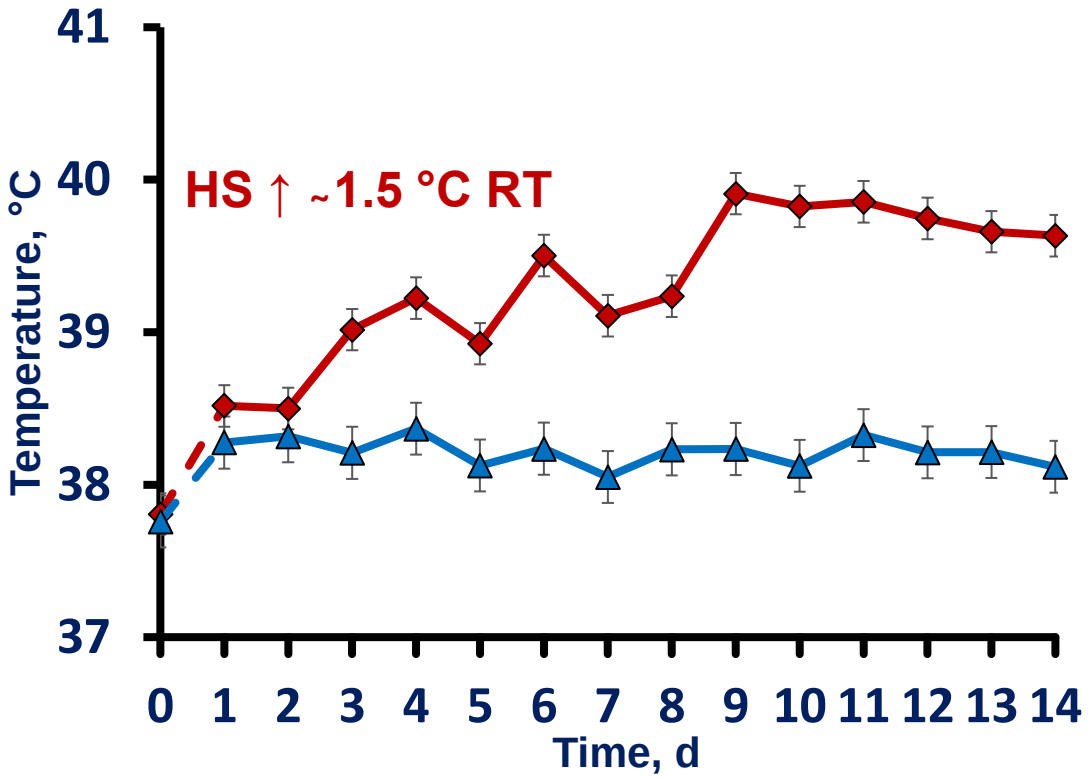
Modified from Ruiz et al., 2020

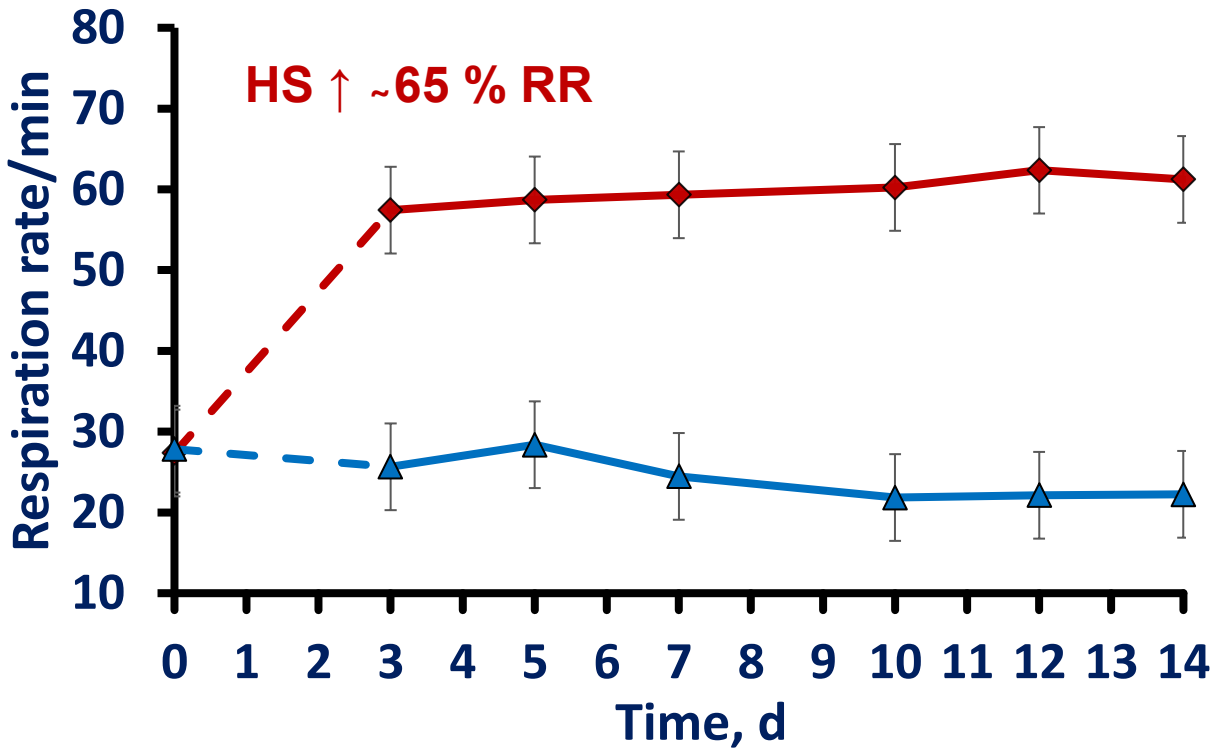
Heat Stress Induces Increased Body Temperature and Respiration Rates

Rectal temperature

***HS *vs* TNPF**

Respiration rate/min





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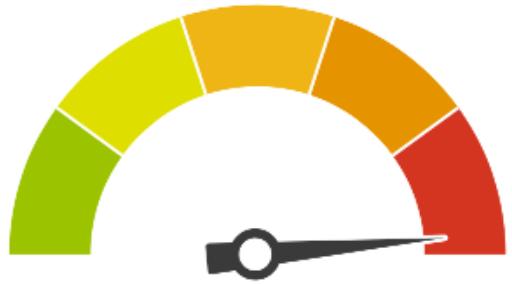


Heat Abatement Strategies

Water- Keep cows hydrated

Practical recommendation:

Provide 1.5 to 2 inches of water tank perimeter per cow, maintaining at least 3 inches of water depth and a water flow of 3-5 gallons/minute.

Heat Abatement Strategies

Water

Cool Season (56°F)		Warm Season (81°F)	
Milk yield (kg/d)	Water intake (L/d)	Milk yield (kg/d)	Water intake (L/d)
0	47.7	0	59.8
18	77.9	18	90.8
27	90.4	27	102.2
36	102.9	36	112.0
45	115.0	45	121.9
54	127.2	54	131.7

When the temperature increases, water intake increases as well

Heat Abatement Strategies

Shade

Roofs and shade structures

Barns with galvanized metal or aluminum roofs can help deflect sun light

Avoid direct solar radiation to lower body temperature and respiration rates

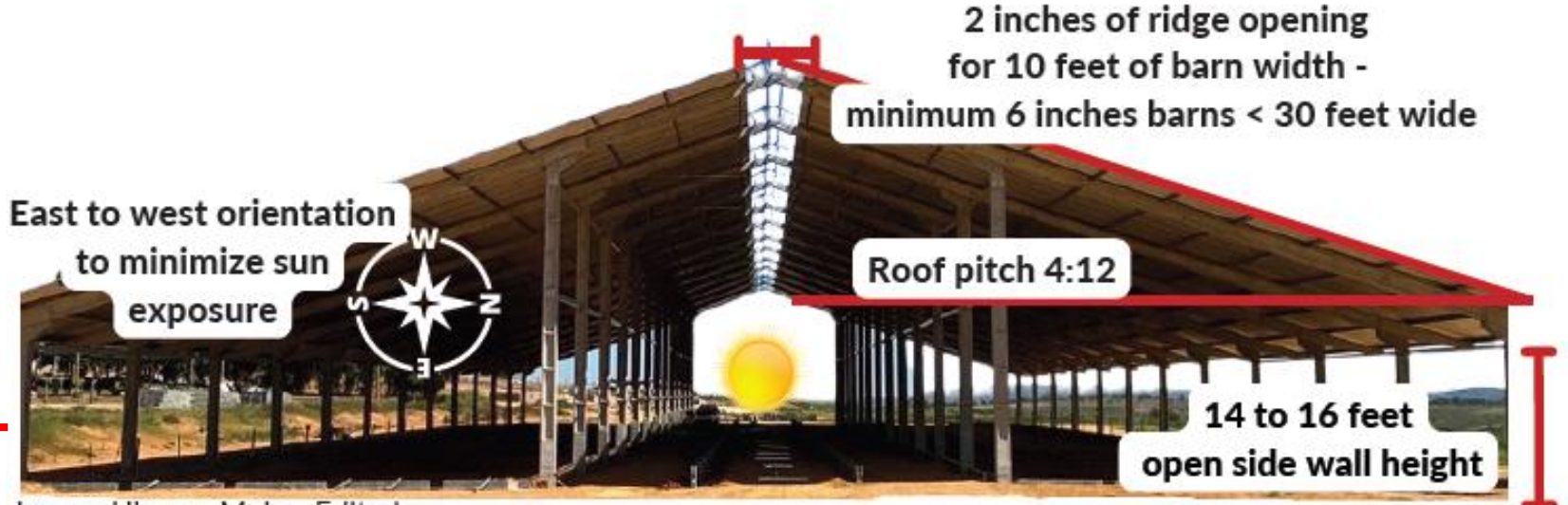


Image: Ulysses Melo - Edited

Adapted from Beede, 1994

Heat-Abatement Strategies

Fans- air movement

Typical free stall barn with fans over beds and fans and sprinklers over feedline.
Not to scale. Information is intended as a guide.

Practical recommendations:

Distance between fans = 24 - 30 feet

Tilt fans 20 - 24 degrees - aim at the stall below the next fan in line

Air speed should be 3-5 mph during periods of heat stress in resting area, feeding area, and holding pens

Keep it clean and maintain fans before warm season

Heat Abatement Strategies

Evaporative Cooling- Soakers

Set soaker system to initiate at a temperature of 66 to 68ºF

Heat Abatement Strategies

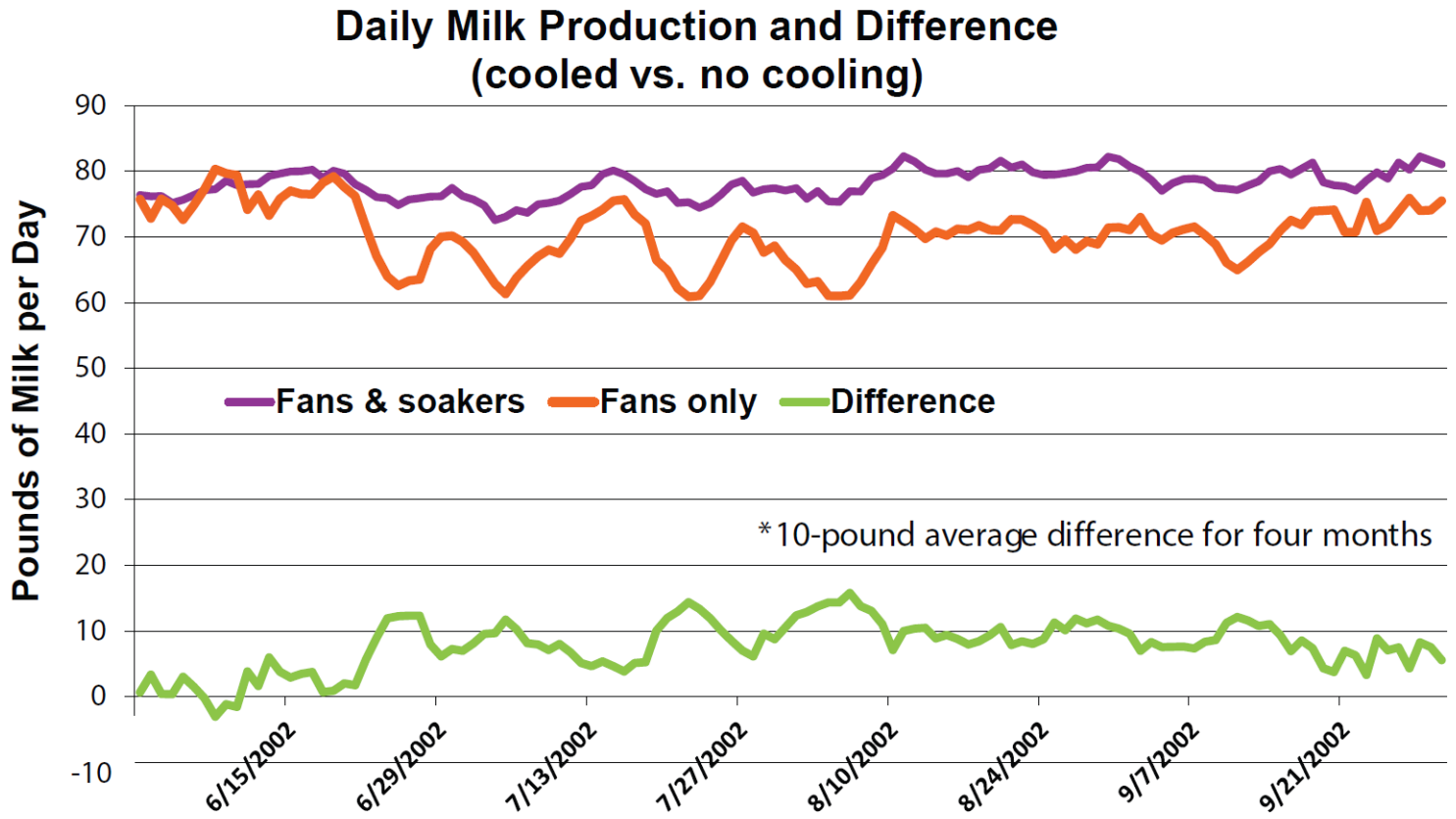
Evaporative Cooling- Soakers

Soakers in the Feed Bunk:

- **Effect on Cows:** Cows seek out the cooling effect of soakers and spend more time both eating and standing without eating
- **Benefit:** Soakers help lower cows' core body temperature
- **Positive Impact:** Improved feed intake and milk yield due to the cooling effect

Heat Abatement Strategies

Seasonal milk production in heard with fans or fans and soakers



Harner, Smith, Brouk, and Murphy. 2002. Unpublished field data from Midwestern Dairy. Kansas State Cow Comfort consortium

Heat Abatement Strategies

Feeding and Ration Formulation

Decrease in feed intake

Feed bunk management
Provide palatable feed
High forage quality (more energy)

Rumen inert fat
- reduces rumen fermentation

Feed schedules

Feed 2x/d

Increase frequency of pushing up feed

Stocking density
Fresh
High production cows

Heat Abatement Strategies

Feeding and Ration Formulation

Increase in water consumption

Loss of minerals/electrolytes like sodium and potassium through urination and sweating

Decrease in feed intake

→ Increasing mineral levels

Use of Salt Blocks:

- **Purpose:** Having salt blocks in the feed bunk allows animals with lower intakes to regulate their electrolyte consumption

Solution: Recommendations

Sodium: Adjust levels up to 0.4-0.6% of Dry Matter (DM)

Potassium: Adjust levels up to 1.5-1.6% of DM

Magnesium: Increase to 0.35-0.4% of DM, especially with higher potassium levels due to reduced magnesium absorption

What is the impact of maternal hyperthermia during late gestation on offspring performance over generations and lactations, and how does it affect the profitability of the US dairy industry?

Late gestation dry cow

CL Group (Cooled)

HT Group (Not Cooled)

Daughter

HT Group (Not Cooled)

Milk production

1st lactation = 4.8 lbs/d

2nd lactation = 5 lbs/d

3rd lactation = 14.3 lbs/d

culled before first calving

productive life (4.9 mo)

Laporta et al. 2020

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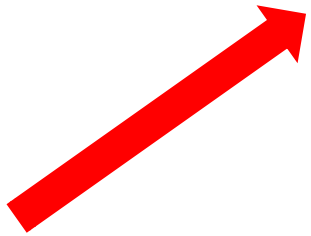


HT Group (Not Cooled)

Daughter

- Milk production
  - 1st lactation = 2.2 kg/d
  - 2nd lactation = 2.3 kg/d
  - 3rd lactation = 6.5 kg/d
- culled before first calving
- productive life (4.9 mo)

Granddaughter

- Milk production
  - 1st lactation = 2.9 lbs/d
  - 2nd lactation = 26 lbs/d
  - 3rd lactation = 10.8 lbs/d
- culled before first calving

Laporta et al. 2020

What is the impact of maternal hyperthermia during late gestation on offspring performance over generations and lactations, and how does it affect the profitability of the US dairy industry?

Daughter

HT Group (Not Cooled)

Milk production
1st lactation = 2.2 kg/d
2nd lactation = 2.3 kg/d
3rd lactation = 6.5 kg/d

culled before first calving

productive life (4.9 mo)

Granddaughter

Milk production
1st lactation = 1.3 kg/d
2nd lactation = 12 kg/d
3rd lactation = 4.9 kg/d

culled before first calving

HT Group (Not Cooled)

Annual Milk Loss:

- Each cow loses an average of 264 lbs/y due to in utero heat stress.
- In utero heat stress results in annual losses of $595 million for the dairy sector.

Laporta et al. 2020

Areas for Cooling Intervention

1. Milking center and holding pen, milk parlor and exit lane
2. Dry cows
3. Maternity pens
4. Fresh cow and heifer groups
5. High production lactating group
6. Hospital pen

What About Cows on Pasture?

Heat Abatement Strategies on Pasture

Provide Water

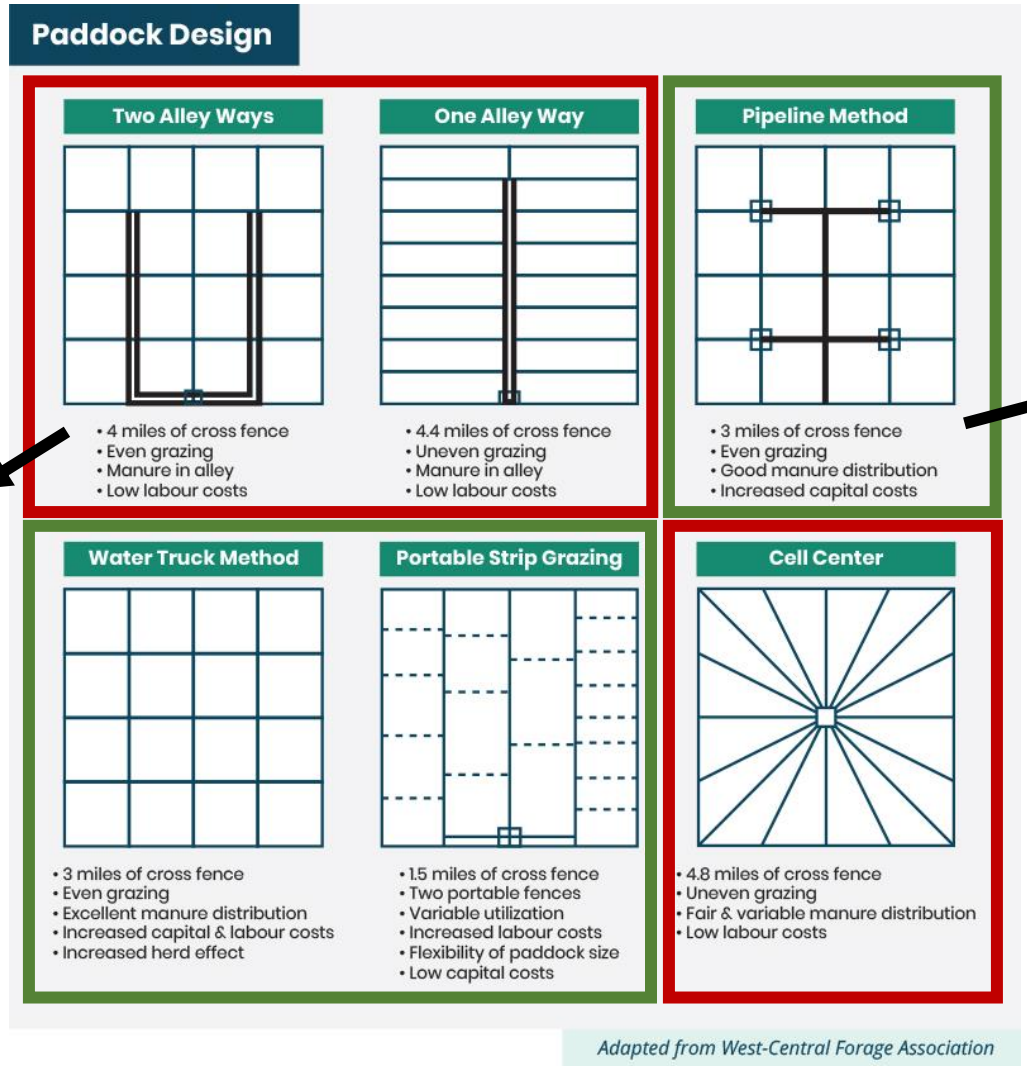
Enough space – 2-4 inches perimeter/cow
Enough volume – 1-2 gal/100 lb BW/day
Enough flow – 3-5 gallons/minute

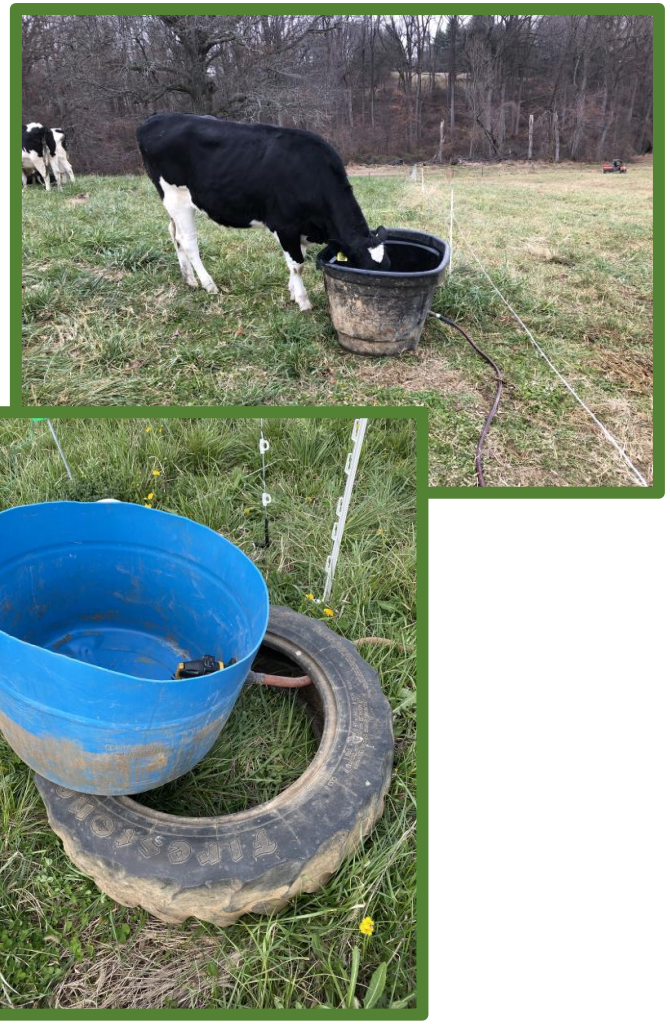
Heat Abatement Strategies on Pasture

Provide Water

Heat Abatement Strategies on Pasture

Provide Water





<u>Proximity to grazing</u>:

< 800 ft to water is ideal

Heat Abatement Strategies on Pasture

Provide Shade

- Cattle will naturally seek shade sources and will spend time seeking shade vs. resting or eating
- Can lead to bunching – makes heat stress worse

Heat Abatement Strategies on Pasture

Provide Shade

<u>Options for shade</u>:

- Trees
- Wooded edges
- 3-sided shelter
- No-sided shelter
- Shade cloth
- Silvopasture

Take Home Messages

Effective Heat Stress Management:	**Achievable through careful planning and proactive measures**
Heat Stress Abatement Strategies:	**Proper** cooling methods **Attention to** all animals
Benefits of Heat Stress Management:	**Ensures cows receive adequate nutrition despite heat stress** **Enhancing** milk **production,** health **and** reproduction
Positive Impact on Productivity:	Effective **heat stress management leads to higher milk yield**
Well-being of the Herd:	**Promotes** herd health and contributes **to** the **well-being of the entire herd**
Sustainability and Profitability:	**Ensures a sustainable and profitable dairy** farm **environment long term**

Water – keep cows hydrated

Shade – offer shade options

Fans – provide air movement

Soakers – provide evaporative cooling

Thank You!

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