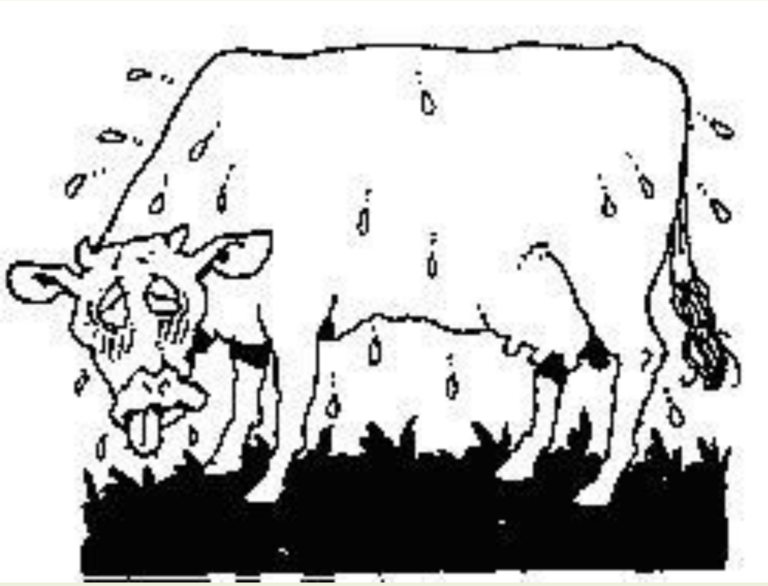
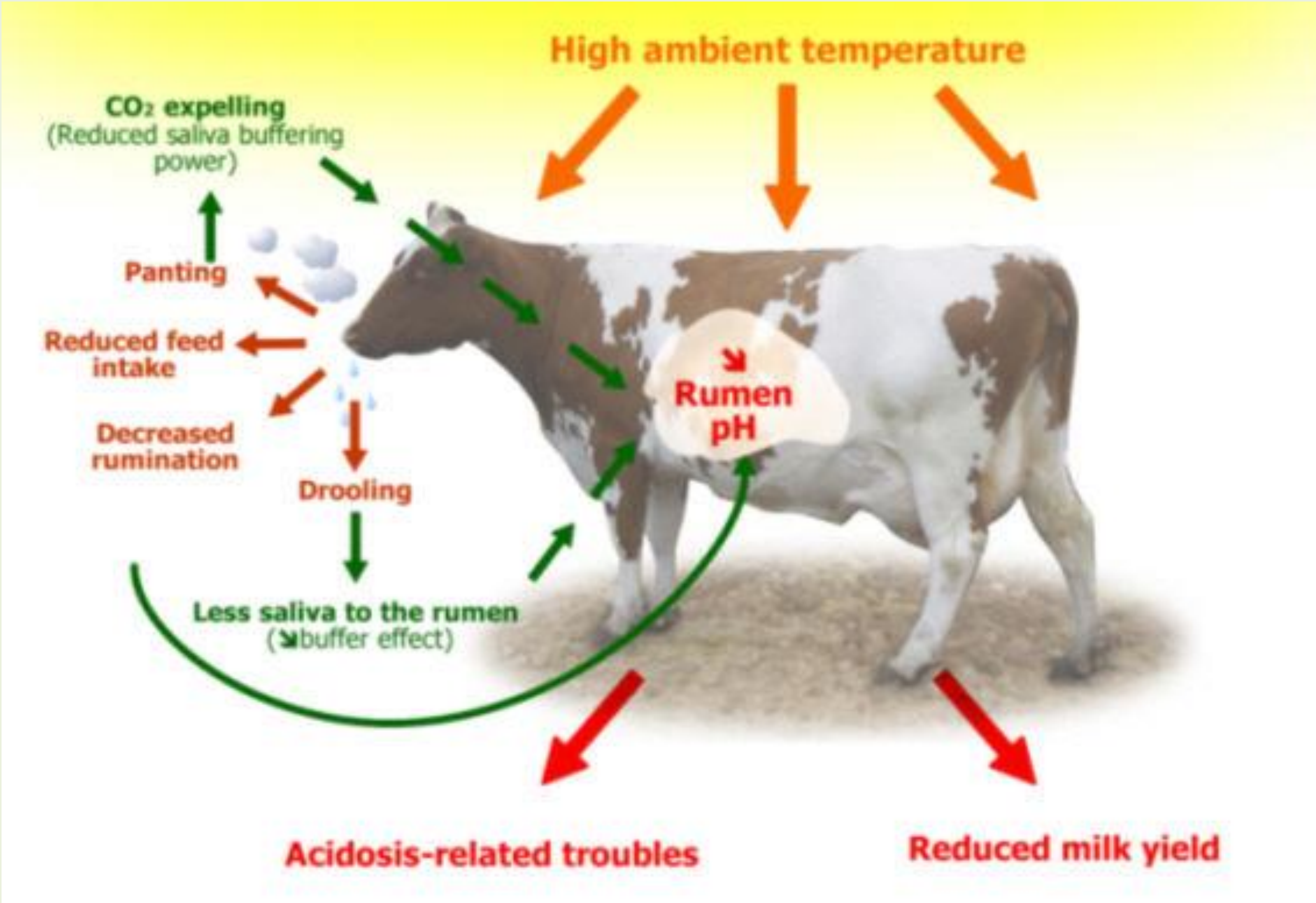
Heat Stress and Reproduction in Dairy Cows



Source: Paul Fricke, William Thatcher Ph.D.

University of Wisconsin – University of Florida



Source: http://www.thecattlesite.com/articles/1053/heat-stress-in-dairy-cows-implications-and-nutritional-management/

Heat Stress & THI

- Cattle aim to maintain their internal core body temperature within a narrow range.
- To regulate body temperature, they exchange heat with their environments, both gaining and losing heat.
- The air temperature and relative humidity surrounding the animals are important factors affecting cows' ability to lose heat.
- **A commonly used term within the dairy industry, Temperature Humidity Index (THI), combines both air temperature and relative humidity to approximate the level of heat stress cattle experience.**

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Important caveats to keep in mind about THI:

THI does not account for the effects of solar radiation, which contributes further to heat stress

The THI cutoff of 72, and more recently 68

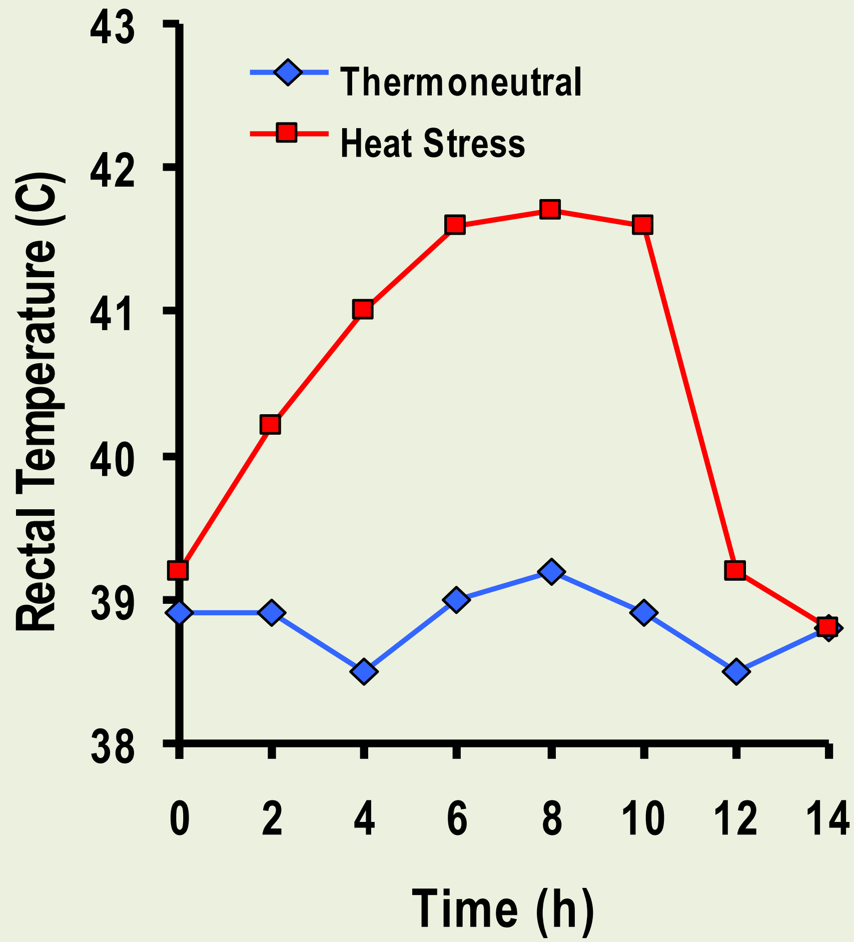
Lastly, individual animals can respond differently, within the same environments. This is why it is important to look for animal-based signs of heat stress and not rely solely on THI.

Air Temperature (°F)	Relative Humidity (%)																				
	0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
65	61	61	62	62	62	62	62	62	63	63	63	63	63	64	64	64	64	64	65	65	65
70	63	64	64	64	65	65	65	66	66	66	67	67	67	68	68	68	69	69	69	70	70
75	66	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
80	68	69	69	70	70	71	72	72	73	73	74	74	75	76	76	77	78	78	79	79	80
85	70	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84	84	85
90	72	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88	89	90
95	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
100	77	78	79	80	82	83	84	85	86	87	88	90	91	92	93	94	95	97	98	99	100
105	79	80	82	83	84	86	87	88	89	91	92	93	95	96	97	99	100	101	102	104	105
110	81	83	84	86	87	89	90	91	93	94	96	97	99	100	101	103	104	106	107	109	110

Effects of Heat Stress

Body Temperature

- Mean rectal temperature of a heifer throughout the imposition of thermoneutral or heat environmental temperatures
- Rectal temperatures can approach 107 F during severe heat stress

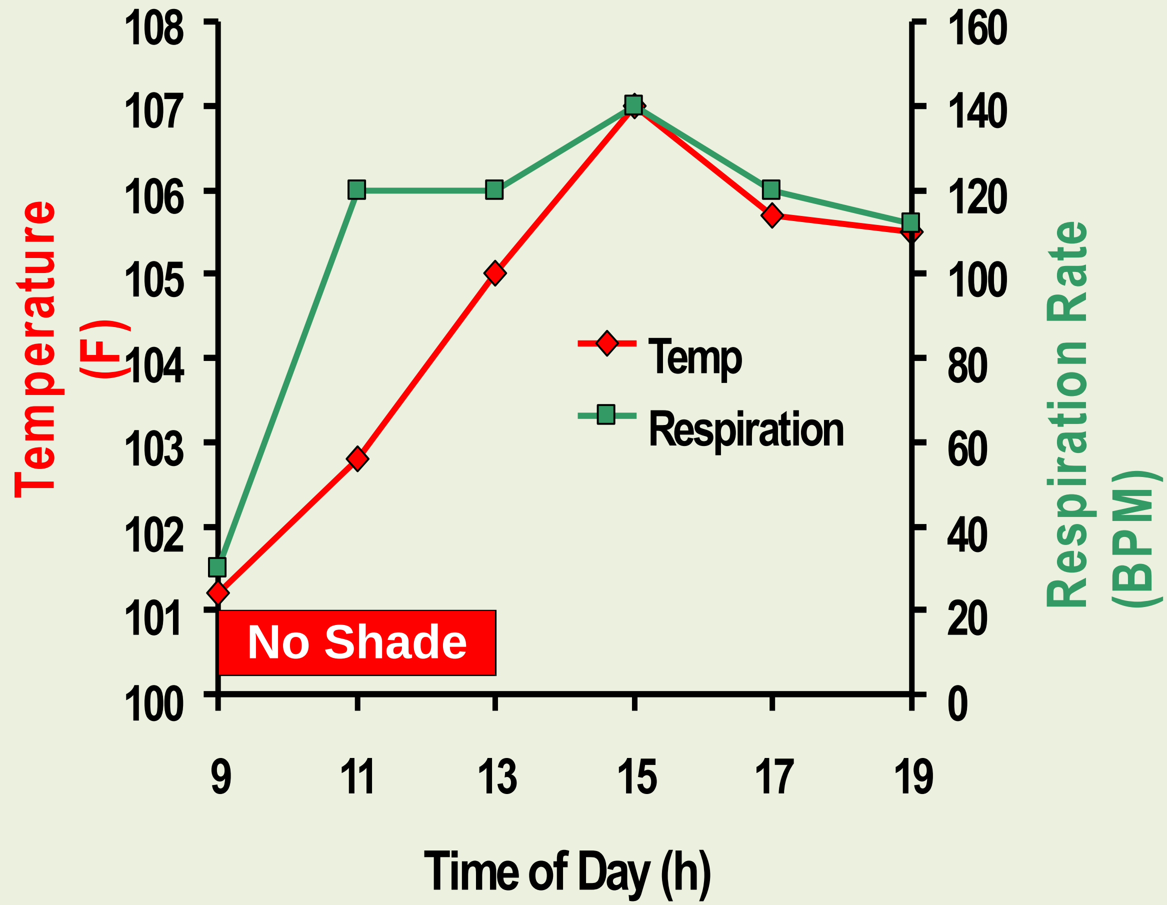


Data from Putney et al., 1989

Respiration Rate and Heat Stress

- There is a direct relationship between elevated Rectal temperature and respiration rates from in lactating dairy cow

- Heat Stress: direct sunlight without access to shade in Florida



Cole and Hansen, Unpublished

How Hot is Too Hot?

- ✓ Rectal temperatures are above 102.5 F
- ✓ Panting in excess of 80 breaths per minute
- ✓ Dry matter intake drop of 10% or more associated with hot weather
- ✓ Milk production drop of 10% or more associated with hot weather

You need to consider cooling strategies for your cows if any of these conditions exist!

Heat Stress and Milk Loss

- **Milk production decreases as the level of heat stress increases.**
- **Mild heat stress results in a production decrease of about 2.5 lbs. per head per day.**
- **Mild to moderate heat stress results in a production decrease of about 6 lbs./head/day.**
- **Moderate to severe heat stress results in a production decrease of about 9 lbs./head/day.**

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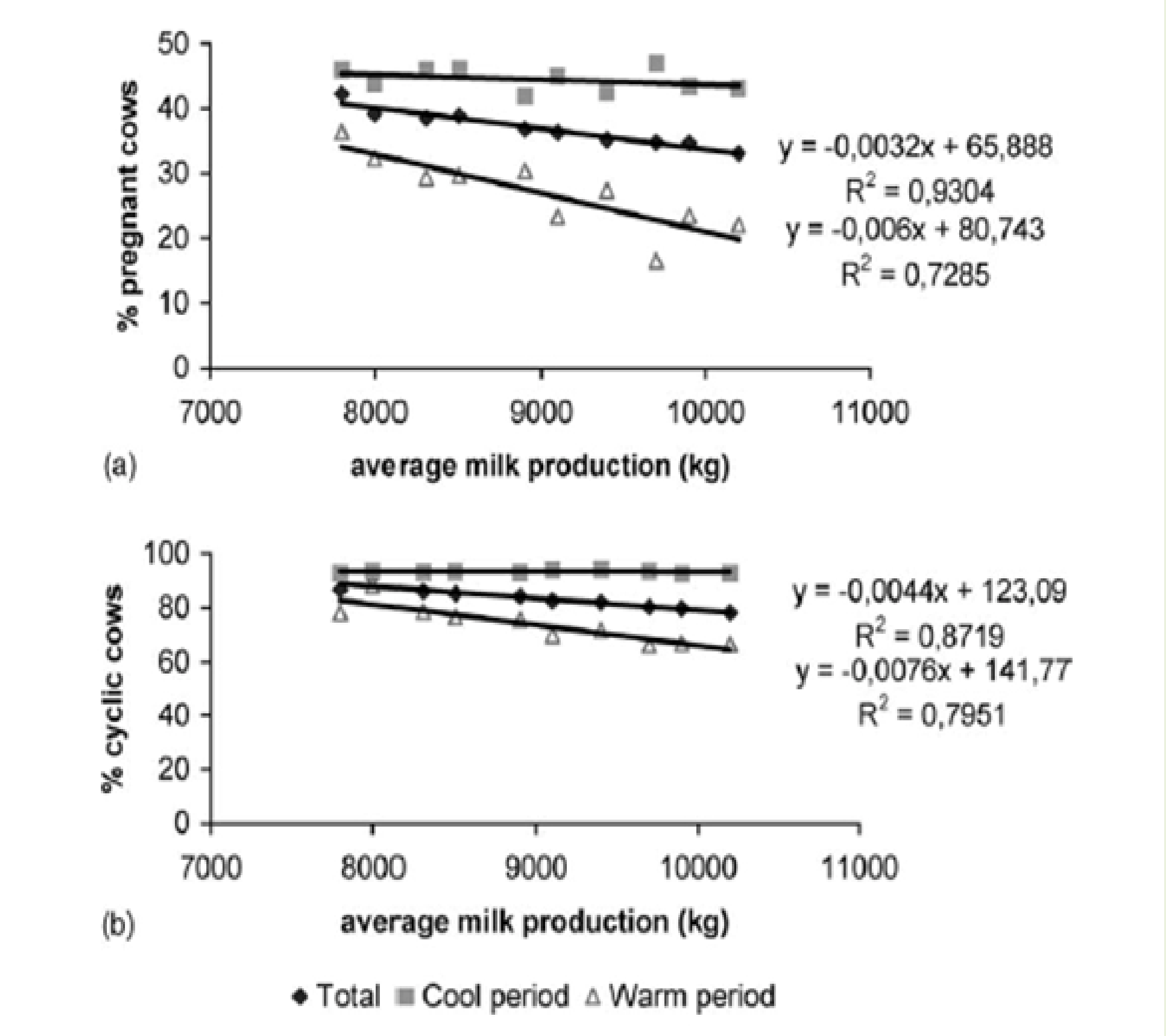
Season, milk and fertility

The P/AI during the warm season had a greater decrease per 1000 kg increase in milk production than that observed for all cows

this relationship was examined in cows only during the cool season, there appeared to be no change in P/AI with increases in milk production (Figure 3).



(Lopez-Gaitus et al., 2001; Lopez-Gaitus, 2003)

J. Dairy Sci. 86:3941–3950

Fertility of Dairy Cows after Resynchronization of Ovulation at Three Intervals Following First Timed Insemination

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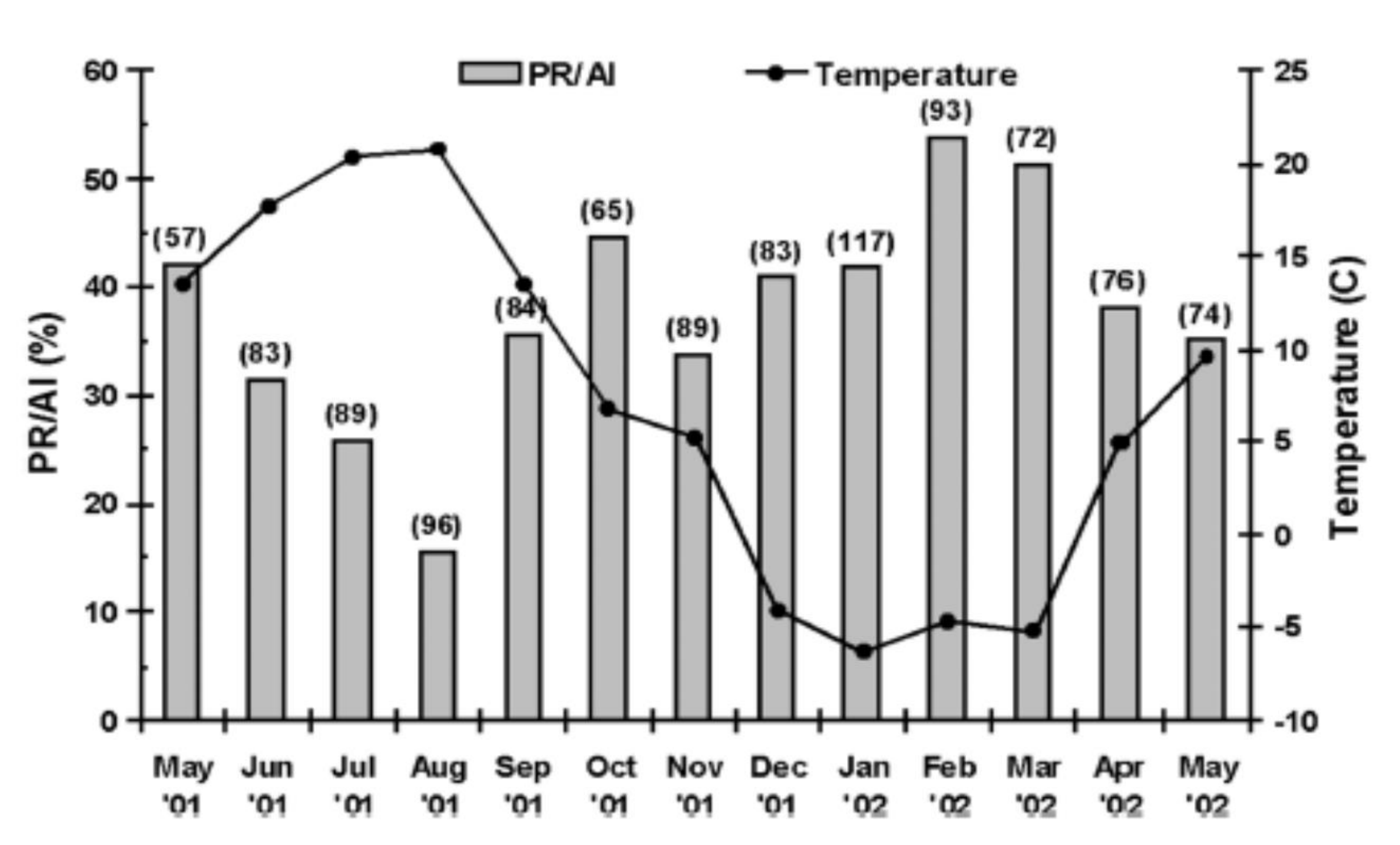
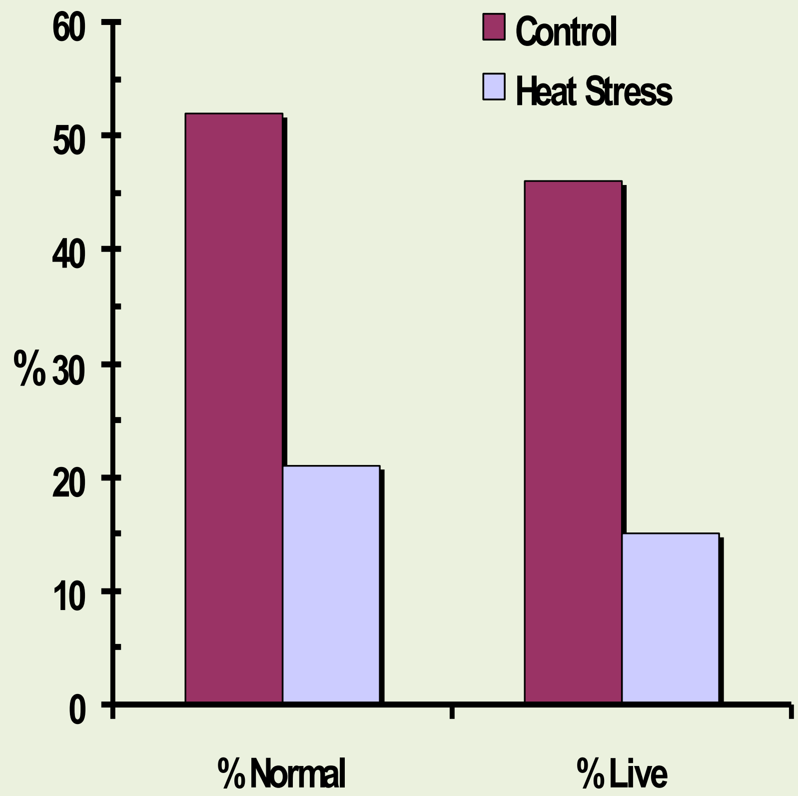


Figure 1. Effect of mean high ambient temperature on pregnancy rates to timed AI (TAI) by month. Pregnancy rate per artificial insemination (PR/AI) represents all Ovsynch and Resynch TAI services during each respective month. Numbers above bars are the total number of TAI services for each month. Temperature data represents the mean high daily temperature at the time of TAI for all TAI services occurring each month. Cows had greater (*P* = 0.05) pregnancy rates during fall and winter months compared to summer months.

Effects of Heat Stress on embryonic development

- Embryonic development in superovulated cows placed in hot environmental chambers from day 1-7 after estrus



Data adapted from Putney et al., Theriogenology 30:195; 1988

Effects of Heat Stress on Estrus Expression

	Standing Events	
Breed	Winter	Summer
Holstein	8.6	4.5
Jersey	12.1	5.3
Undetected Heat	44-65%	76-82%

Nebel et al., 1997;Thatcher and Collier, 1986

Strategies for Managing Heat Stress

4 Modes of Heat Transfer

- Evaporation – vaporization of water
  - Primary means by which cows cool themselves
  - Panting & Sweating
- Radiation – radiant energy from the sun
  - Major cause of increased heat load in lactating cows
- Convection – exchange of heat with moving air
  - Only effective when air temperature < body temperature
- Conduction – flow of heat from a hotter to a cooler surface via physical contact
  - Least important factor for cow cooling

Preventing heat stress

- Shade
- Ventilation
- Cooling with water
- Drinking water
- Holding area cooling

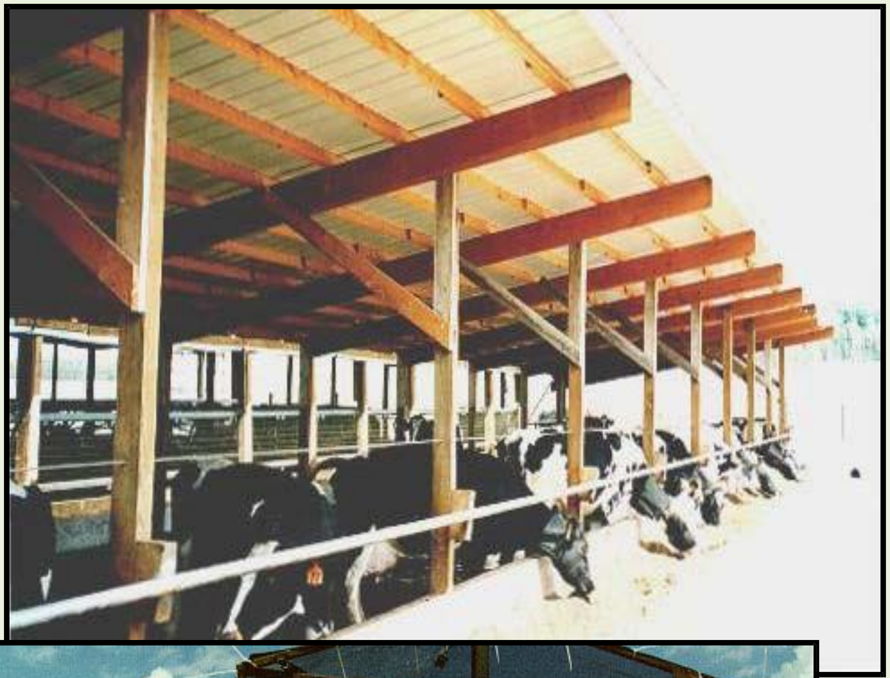
General Considerations

Water

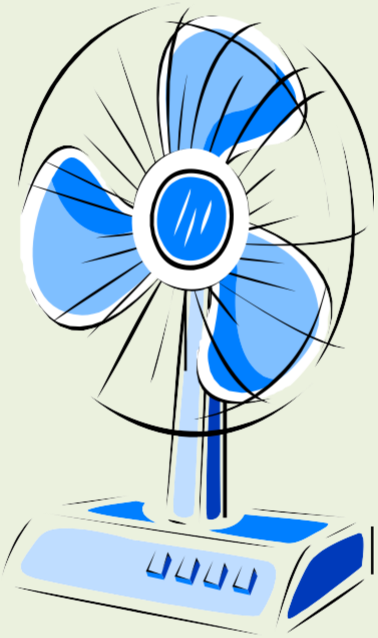
- Water intake can increase by nearly 50% during severe heat stress
- Keep water fresh and clean
- Make water available immediately to cows after returning from the parlor after milking

Shade

- ✓ Shade is a physical a barrier against solar radiation
- ✓ Shade should be provided over resting areas, parlors, and over feed and water stations
- ✓ Pregnancy rates were 44% for cows maintained in shade in the summer in Florida versus 25% for cows not given access to shade (Roman-Ponce et al., 1977)



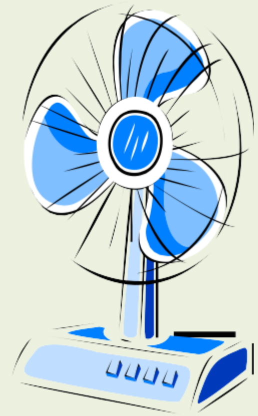
Fans



- ✓ Increase cooling by convection
- ✓ However, air temperature must be lower than the cows body temperature for effective cooling to take place

Sprinklers and Fans

+



Sprinkling systems in combination with fans improve evaporative and convective cooling of cows

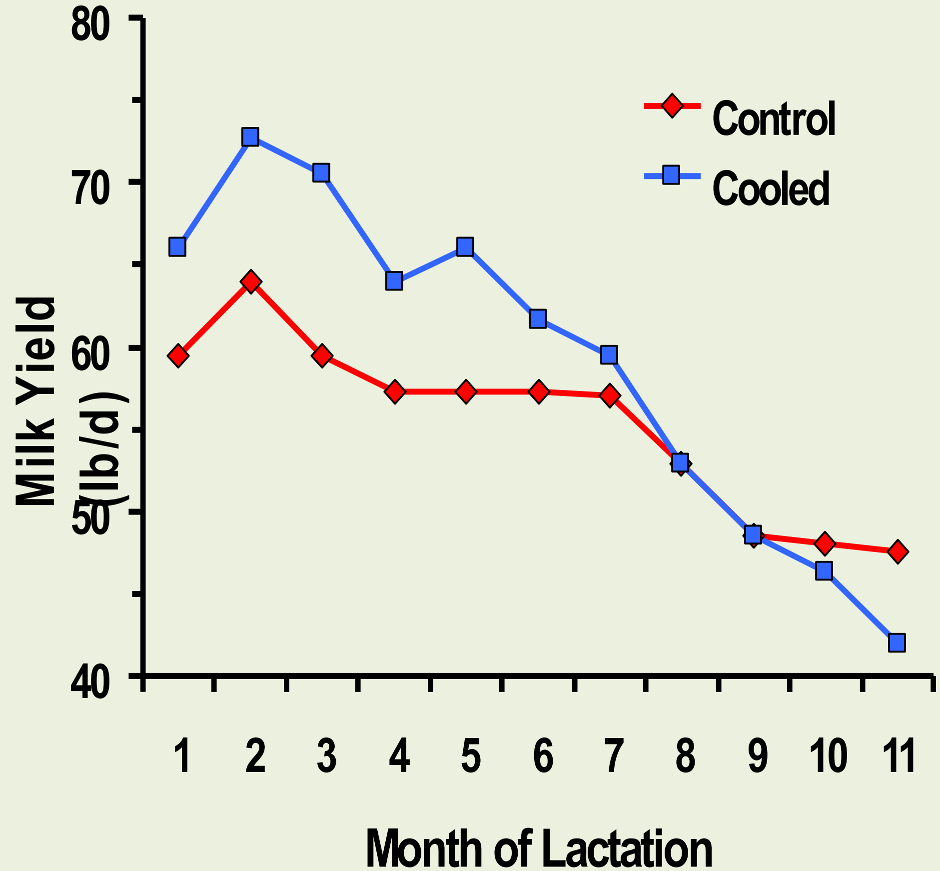
Managing Heat Stress

Cooling & Milk Production

Daily milk yield during summer (Israel) for cows offered a voluntary cooling facility (4X/day, 1h each)

Control = shade only

Cooled = shade + sprinkling



Data from Berman & Wolfenson, 1992.
In Large Herd Dairy Management

Feeding and Reproductive Management Strategies during Heat Stress

Feeding Management for Heat Stress

- Adjust diets accordingly, as dry matter intake decreases, utilizing higher quality forages and increasing the energy density of the diet.
- Make sure that there is enough effective fiber is available to maximize rumination and keep acidosis and displaced abomasum's to a minimum.
- Adjust feeding delivery to the cooler times of the day and increase the number of times feed is pushed up to minimize sorting.
- Manage the silage face to minimize spoilage and secondary fermentation starting to occur.

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Feeding Management for Heat Stress

- Manage high moisture feeds such as gluten and distillers' grains to reduce secondary fermentation.
- Maximize feed quality by removing feed refusals before the fresh TMR is delivered and by not allowing excessive wetting from misters to occur.
- May consider increasing the dietary cation-anion difference (DCAD) in lactating cows with sodium (sodium bicarbonate) and potassium (potassium carbonate).

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Timed AI and Heat Stress

De la Sota et al., Theriogenology 49:761;1998

Dynamic Economic Modeling Program

- A decision not to breed cows during the summer months decreased net revenue per cow by $30.00
- Timed AI at first service increased net revenue per cow $17.24 compared with controls
- Greatest increase in net revenue ($55.27) was for use of timed AI for all cows open in April

Repro Mgt. For Heat Stress – Timed AI

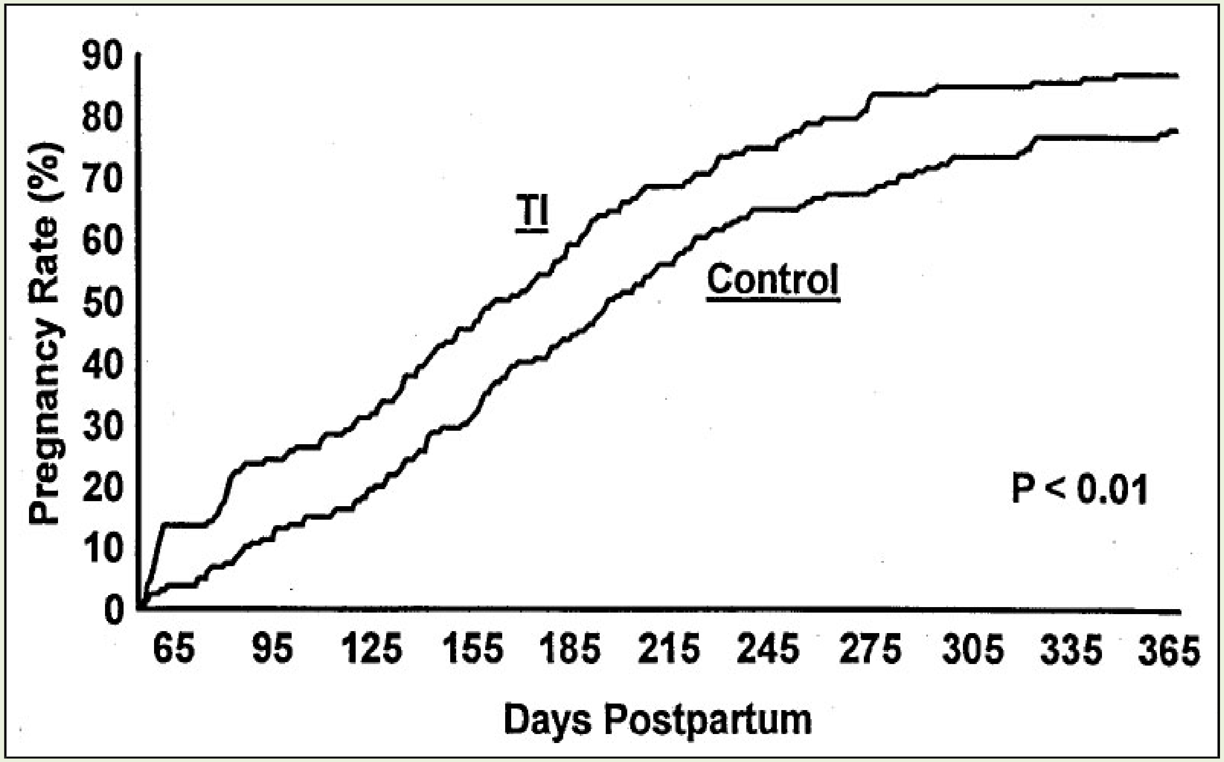
De la Sota et al., Theriogenology 49:761;1998

Response	Control AI	Timed AI	P <
Cows in study	156	148	0.05
Pregnancy rate (%)	4.8 ± 2.5	13.9 ± 2.6	0.05
Estrus detection or service rate (%)	18.1 ± 2.5	100.0 ± 0.0	0.05
Conception rate (%)	22.9 ± 6.4	13.2 ± 3.6	0.05
Overall pregnancy rate to 120 d (%)	16.5 ± 3.5	27.0 ± 3.6	0.05
Days open	90.0 ± 4.2	77.6 ± 3.8	0.05
Services per conception	1.27 ± 0.11	1.63 ± 0.10	0.05
Days to first AI	91.0 ± 1.9	58.7 ± 2.1	0.05

Timed AI and Heat Stress

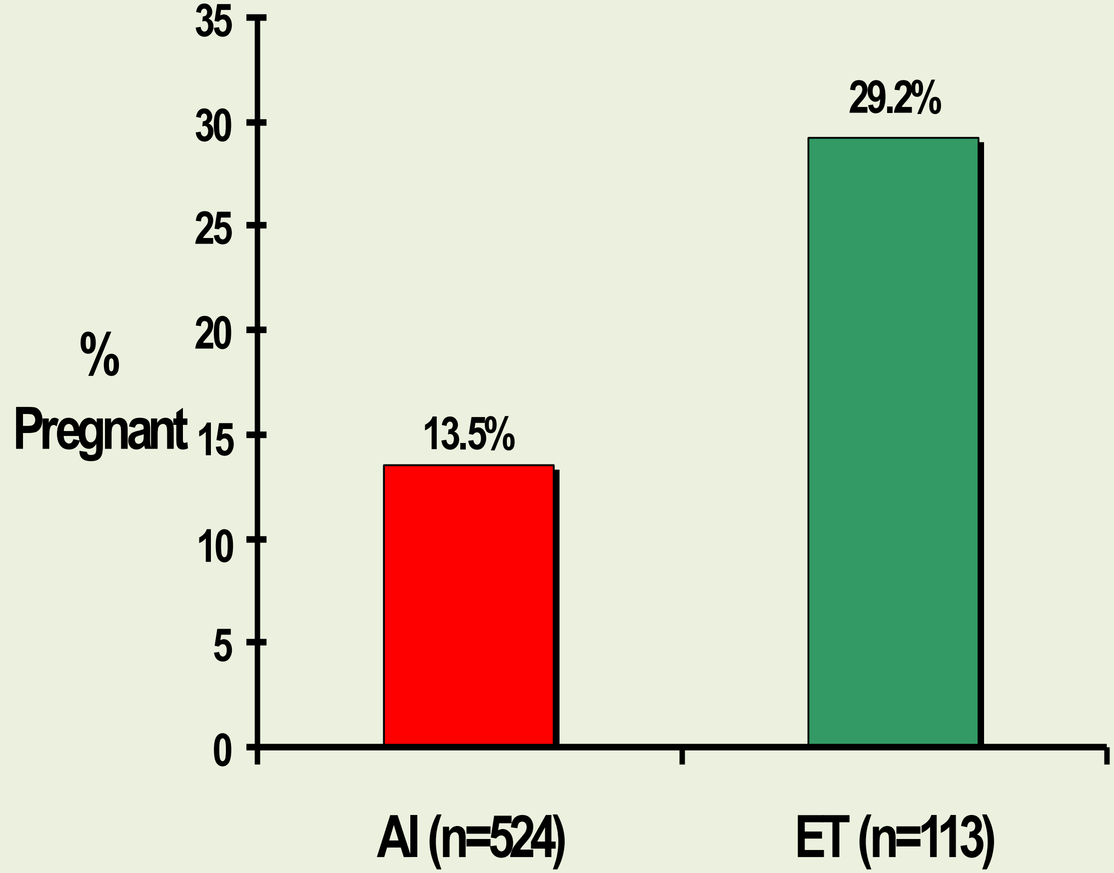
De la Sota et al., Theriogenology 49:761;1998

Cumulative pregnancy rates in lactating dairy cows receiving their first postpartum insemination in summer (Florida) as a timed AI or an AI to a detected estrus



Embryo Transfer

% of cows pregnant after artificial insemination or embryo transfer on day 7 during summer in Florida



Data adapted from Putney et al., Theriogenology 31:765; 1989