LATE GESTATION HEAT STRESS: EFFECTS ON DAM & DAUGHTER

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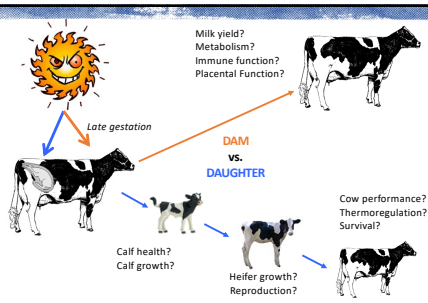
Form-A-Feed Dairy Conference
January 16, 2025

1



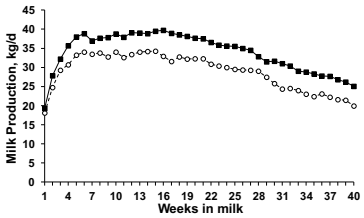
2

Gainesville, Florida, USA

- Sand bedded free stalls
- Fans over stalls
- Soakers over feedline
- Fans on at 70° F (21.1°C)
- Soakers on 1 min every 5 min at 72° F

3

Cooling Dry Cows Increases Milk



Tao et al., *J. Dairy Sci.* 94:5976–5986

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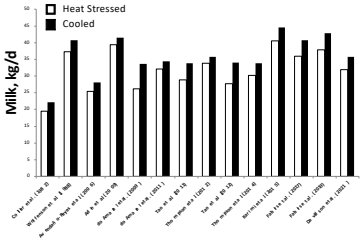
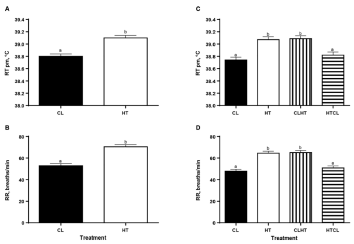
COOLING DRY COWS INCREASES MILK



5

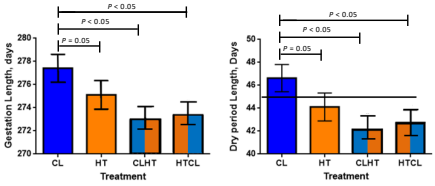
HEAT STRESS INCREASES RECTAL TEMPERATURE AND RESPIRATION RATE



Fabris et al., *J. Dairy Sci.* 102:5647-5656.

6

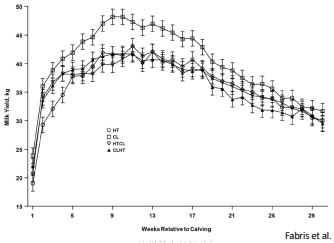
HEAT STRESS AT ANY TIME DECREASES GESTATION LENGTH AND DRY PERIOD LENGTH



Fabris et al., *J. Dairy Sci.* 102:5647-5656.

7

HEAT STRESS AT ANY TIME WHEN DRY REDUCES MILK YIELD



Fabris et al., *J. Dairy Sci.* 102:5647-5656.

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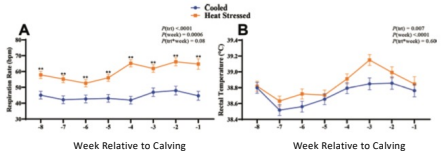
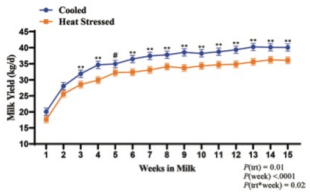
HEAT STRESS EFFECTS ON FIRST CALF HEIFERS: COOLING DECREASES RR AND RT



Davidson et al, *J. Dairy Sci.* 104:2357-2368

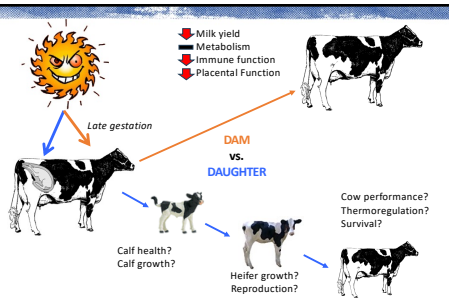
9

HEAT STRESS EFFECTS ON FIRST CALF HEIFERS: COOLING INCREASES MILK YIELD



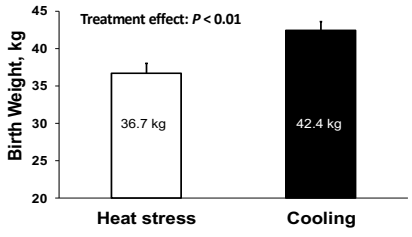
Davidson et al, *J. Dairy Sci.* 104:2357-2368

10



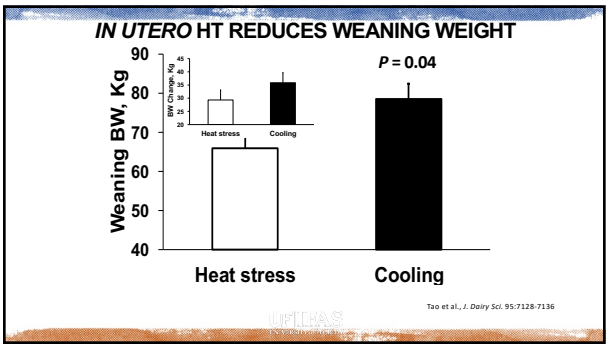
11

COOLING INCREASES CALF BIRTH WEIGHT



Tao et al., *J. Dairy Sci.* 95:7128-7136

12


IN UTERO HT REDUCES WEANING WEIGHT
Weaning BW, Kg
90
80
70
60
50
40
P = 0.04
BW Change, Kg
Heat stress
Cooling
Heat stress
Cooling
Tao et al., J. Dairy Sci. 95:7128-7136

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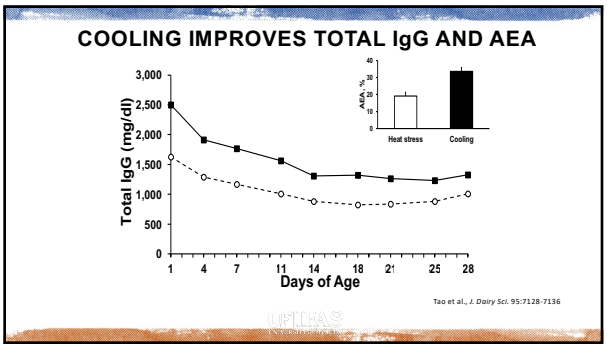
COOLING IMPROVES TOTAL IgG AND AEA
Total IgG (mg/dl)
3,000
2,500
2,000
1,500
1,000
500
0
1
4
7
11
14
18
21
25
28
Days of Age
AEA, %
Heat stress
Cooling
Tao et al., J. Dairy Sci. 95:7128-7136

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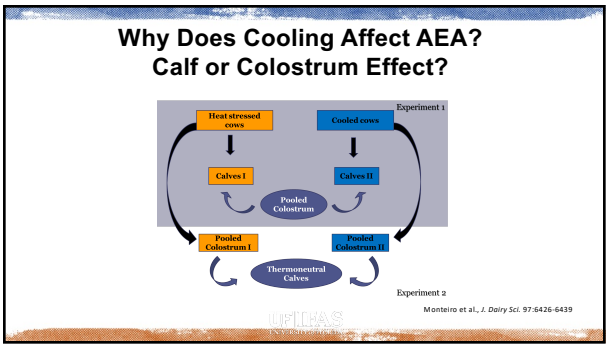
Why Does Cooling Affect AEA?
Calf or Colostrum Effect?
Experiment 1
Heat stressed cows
Cooled cows
Calves I
Calves II
Pooled Colostrum
Pooled Colostrum I
Pooled Colostrum II
Thermoneutral Calves
Experiment 2
Monteiro et al., J. Dairy Sci. 97:6426-6439

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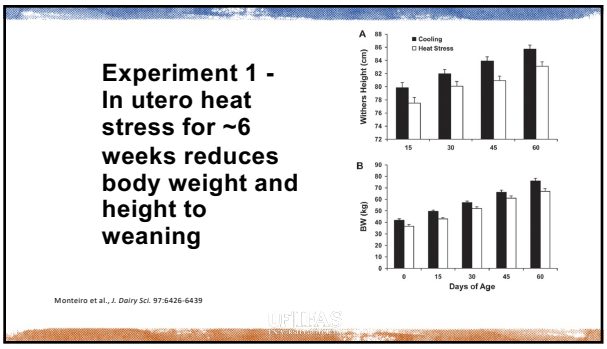
Experiment 1 -
In utero heat stress for ~6 weeks reduces body weight and height to weaning
A
Cooling
Heat Stress
Withers Height (cm)
B
BW (kg)
Days of Age
Monteiro et al., J. Dairy Sci. 97:6426-6439

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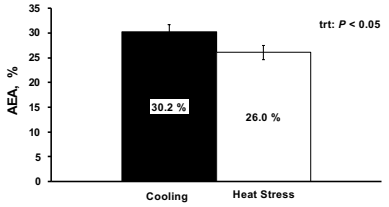
COOLING INCREASED APPARENT EFFICIENCY OF IgG ABSORPTION*



* AEA = [Serum [IgG] (g/L) * birth weight (kg) * 0.091 / IgG fed (g)] x 100

Monteiro et al., *J. Dairy Sci.* 97:6426-6439

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Experiment 2 – **No Effect** of Colostrum from Cooled or Heat Stressed Cows on Calf Performance

Growth performance of calves born to cows under thermoneutral conditions during the dry period and fed frozen colostrum from cows exposed to either heat stress or cooling during the dry period

Parameter	Heat Stress LSM ± SE	Cooling LSM ± SE	*P*-value
Birth Weight (kg)	38.8 ± 1.4	39.2 ± 1.5	0.8
Weaning Weight (kg)[1]	68.4 ± 2.5	64.8 ± 2.6	0.4
Preweaning BW Gain (kg)[2]	29.6 ± 2.3	25.6 ± 2.4	0.3
Avg. Daily Gain (kg/d)	0.49 ± 0.7	0.43 ± 0.8	0.2
Weaning Withers Height (cm)[1]	84.3 ± 0.8	83.0 ± 0.9	0.4
Preweaning Height Increase (cm)[2]	7.8 ± 1.1	6.2 ± 1.0	0.3

[1]Weaning weight and weaning height were measured at d 60 of age.
[2]Preweaning BW gain and height increase was calculated by individually subtracting data at d 60 of age by data at birth.

Monteiro et al., *J. Dairy Sci.* 97:6426-6439

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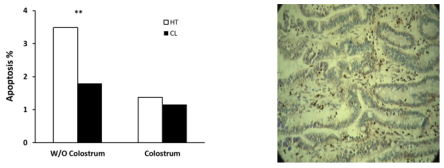
IN UTERO HT ACCELERATES GUT CLOSURE



Ahmed et al. , *JDS Commun*. 2:https://doi.org/10.3168/jdsc.2021-0098.

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J. Dairy Sci. 92:5988–5999
doi:10.3168/jds.2009-2343
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Heat-stress abatement during the dry period: Does cooling improve transition into lactation?

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J. Dairy Sci. 94:86–96
doi:10.3168/jds.2009-2004
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Heat stress abatement during the dry period influences metabolic gene expression and improves immune status in the transition period of dairy cows

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J. Dairy Sci. 94:5976–5986
doi:10.3168/jds.2011-4329
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Effect of heat stress during the dry period on mammary gland development

S. Tao, J. W. Bubolz, B. C. do Amaral,[1] I. M. Thompson, M. J. Hayen, S. E. Johnson, and G. E. Dahl[2]
Department of Animal Sciences, University of Florida, Gainesville 32611

J. Dairy Sci. 95:5035–5046
http://dx.doi.org/10.3168/jds.2012-5405
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Effect of cooling heat-stressed dairy cows during the dry period on insulin response

S. Tao,*[1] I. M. Thompson,* A. P. A. Monteiro,* M. J. Hayen,* L. J. Young,† and G. E. Dahl*
*Department of Animal Sciences, and
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J. Dairy Sci. 97:7426–7436
http://dx.doi.org/10.3168/jds.2013-7621
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Effect of cooling during the dry period on immune response after *Streptococcus uberis* intramammary infection challenge of dairy cows

I. M. T. Thompson, S. Tao, A. P. A. Monteiro, K. C. Jeong, and G. E. Dahl
Department of Animal Sciences, University of Florida, Gainesville 32611

Retrospective analysis of records of calves from 5 studies between 2007 and 2011

Monteiro et al. , *J. Dairy Sci.* 99:8443-8450.

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Heat Stress Experiments 2007 - 2011

	Bulls	Heifers	Total
Cooling	31	41	72
Heat Stress	30	44	74
Total	61	85	147

Monteiro et al. , *J. Dairy Sci.* 99:8443-8450.

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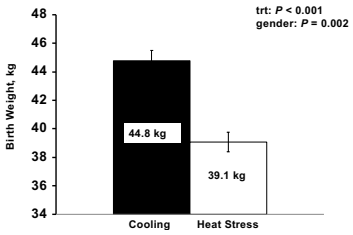
BIRTH WEIGHT



Monteiro et al. , *J. Dairy Sci.* 99:8443-8450.

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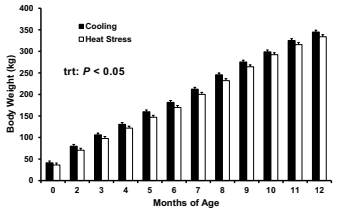
IN UTERO HEAT STRESS DECREASES CALF BODYWEIGHT TO PUBERTY



Monteiro et al. , *J. Dairy Sci.* 99:8443-8450.

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IN UTERO HS DECREASES CALF SURVIVAL

Table 1. Effect of maternal heat stress (HT) or cooling (CL) during late gestation on calf survival

	CL				HT				*P*
Parameter	AI	IVF[1]	Total	%[2]	AI	IVF	Total	%	Trt[3]
Bull calves, n	30	1	31	---	28	2	30	---	---
Heifer calves, n	29	12	41	---	29	15	44	---	---
DOA[4]	0	0	0	0.0	2	1	3	4.1	0.25
Males mortality by 4 mo of age	1	0	1	3.2	3	0	3	10.0	0.35
Heifers leaving herd before puberty	1	4	5	12.2	3	7	10	22.7	0.26
Due to sickness, malformation or growth retardation	1	0	1	2.4	3	5	8	18.2	0.03
Heifers leaving herd after puberty, before first lactation	1	0	1	2.4	3	0	3	6.8	0.62
Heifers completing first lactation	27	8	35	85.4	22	7	29	65.9	0.05

[1] IVF = in vitro fertilization.
[2] Percentage of animals (AI + IVF) affected out of total animals (males or females) in the respective treatment.
[3] Treatment.
[4] Dead on arrival. Includes male and female calves.

Monteiro et al. , *J. Dairy Sci.* 99:8443-8450.

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IN UTERO HEAT STRESS DECREASES REPRODUCTIVE PERFORMANCE

Table 2. Effect of maternal heat stress (HT) or cooling (CL) during late gestation on reproductive performance before first lactation of heifers born to HT or CL dams

Parameter	CL	HT	SEM	*P*
N	36	32	---	---
Age at first AI, mo	13.6	13.8	0.2	0.32
Services per pregnancy d[1] 30	2.0	2.5	0.2	0.05
Age at pregnancy d[1] 30, mo	16.1	16.9	0.3	0.07
Services per pregnancy d[1] 50	2.3	2.6	0.2	0.32
Age at calving, mo	24.8	25.0	0.4	0.72

[1]Days after insemination.

Monteiro et al., *J. Dairy Sci.* 99:8443-8450.

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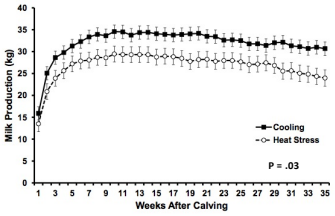
IN UTERO HEAT STRESS REDUCES MILK PRODUCTION



Monteiro et al., *J. Dairy Sci.* 99:8443-8450.

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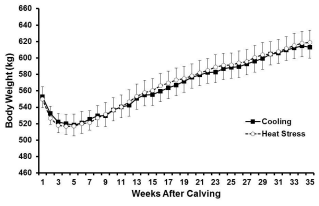
IN UTERO HEAT STRESS <u>DOES NOT</u> AFFECT MATURE BODYWEIGHT



Monteiro et al., *J. Dairy Sci.* 99:8443-8450.

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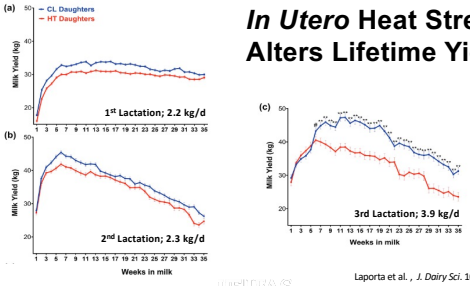
In Utero Heat Stress Alters Lifetime Yield



Laporta et al., *J. Dairy Sci.* 103:7555-7568.

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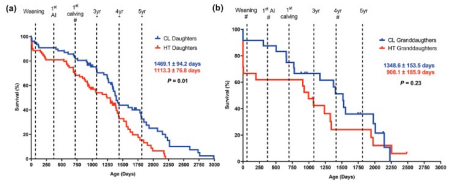
IN UTERO HEAT STRESS REDUCES SURVIVAL IN HERD



Laporta et al., *J. Dairy Sci.* 103:7555-7568.

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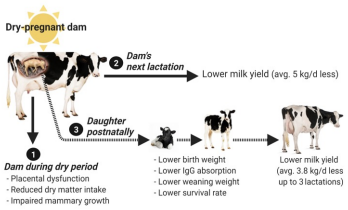
IMPACT ON LONGEVITY?



- **In utero HT induces fetal programming**
- **Alters methylation patterns in multiple tissues, ages**
- **Phenotype persists to F_2**

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FLORIDA: LONGEVITY AND BIRTH SEASON

Lactation Number	Cow Number	Birth Season	
		"Cool Season" (Dec., Jan., Feb., Mar)	"Hot Season" (Jun., Jul., Aug., Sept.)
5	968	686	282
6	423	321	102
7	129	96	33
8	47	26	21
Total Cows	**1,567**	1,129 (72%)**	438 (28%)**

**$P < 0.01$

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CALIFORNIA: BIRTH SEASON IMPACTS LONGEVITY

Lactation Number	Cow Number	Birth Season	
		Cool Season (Dec, Jan, Feb, Mar)	Hot Season (Jun, Jul, Aug, Sept)
5	908	484	424
6	507	318	189
7	204	108	96
8	50	29	21
Total Cows	1,669	939 (56.3%) **	730 (43.7%) **

**$P < 0.01$

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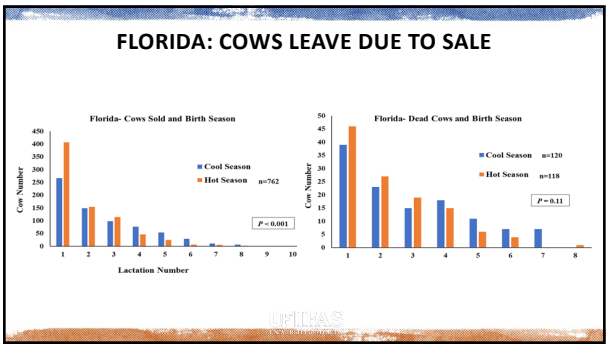
FLORIDA: COWS LEAVE DUE TO SALE
Florida- Cows Sold and Birth Season
Cow Number
Lactation Number
Cool Season
Hot Season n=762
P < 0.001
Florida- Dead Cows and Birth Season
Cow Number
Cool Season n=120
Hot Season n=118
P = 0.11

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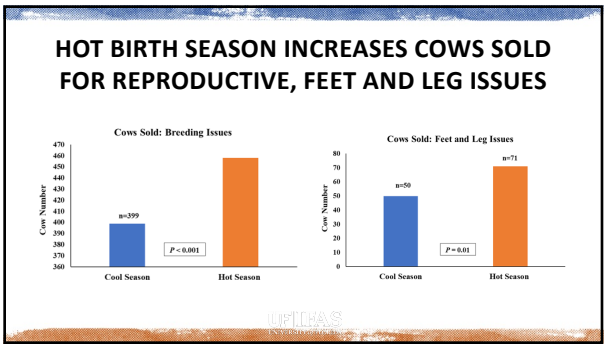
HOT BIRTH SEASON INCREASES COWS SOLD FOR REPRODUCTIVE, FEET AND LEG ISSUES
Cows Sold: Breeding Issues
Cow Number
n=399
P < 0.001
Cool Season
Hot Season
Cows Sold: Feet and Leg Issues
Cow Number
n=50
n=71
P = 0.01
Cool Season
Hot Season

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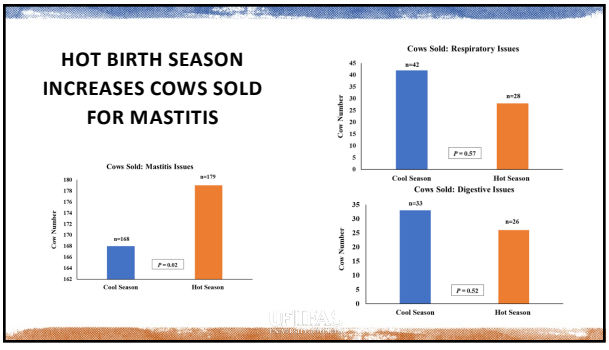
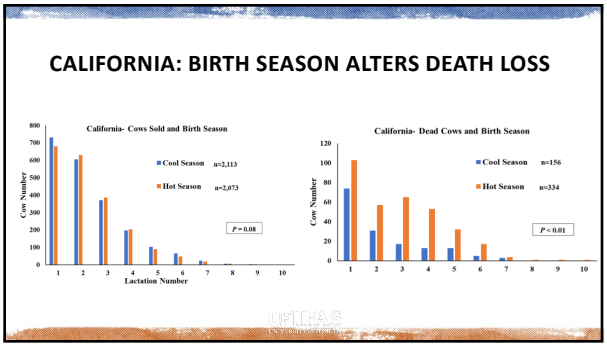

HOT BIRTH SEASON INCREASES COWS SOLD FOR MASTITIS
Cows Sold: Mastitis Issues
Cow Number
n=168
n=179
P = 0.02
Cool Season
Hot Season
Cows Sold: Respiratory Issues
Cow Number
n=42
n=28
P = 0.57
Cool Season
Hot Season
Cows Sold: Digestive Issues
Cow Number
n=33
n=26
P = 0.52
Cool Season
Hot Season

35


CALIFORNIA: BIRTH SEASON ALTERS DEATH LOSS
California- Cows Sold and Birth Season
Cow Number
Lactation Number
Cool Season n=2,113
Hot Season n=2,073
P = 0.08
California- Dead Cows and Birth Season
Cow Number
Cool Season n=156
Hot Season n=334
P < 0.01

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BIRTH IN HOT SEASON REDUCES HERD SURVIVAL

- Consistent with in utero heat stress effects
- Death and sale due to reproduction, mastitis and lameness drive early exits
- Longevity programmed by in utero and early events – esp. heat stress
- Consider in selection of heifers for future production herd

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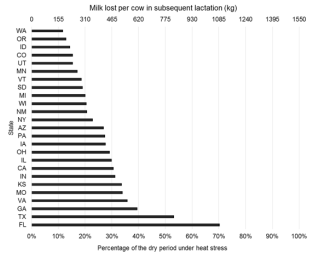

DOES IT PAY TO COOL DRY COWS?

Ferreira et al., *J. Dairy Sci.* 99:9931–9941.

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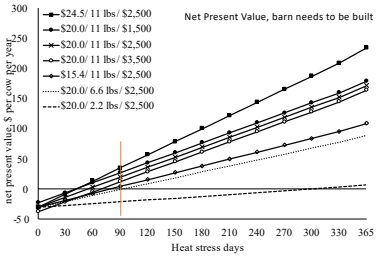

DOES IT PAY TO COOL DRY COWS?

Ferreira et al., *J. Dairy Sci.* 99:9931–9941.

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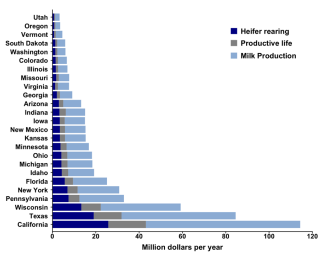

DOES IT PAY TO COOL DRY COWS?

Laporta et al., *J. Dairy Sci.* 103:7555–7568.

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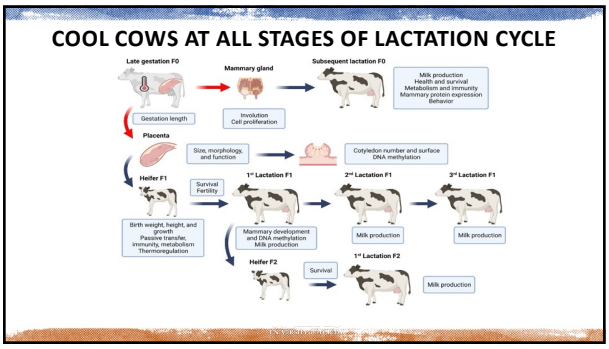
COOL COWS AT ALL STAGES OF LACTATION CYCLE
Late gestation F0
Mammary gland
Subsequent lactation F0
Milk production
Health and survival
Metabolism and immunity
Mammary protein expression
Behavior
Gestation length
Involution
Cell proliferation
Placenta
Size, morphology, and function
Cotyledon number and surface DNA methylation
Heifer F1
Survival
Fertility
1st Lactation F1
2nd Lactation F1
3rd Lactation F1
Birth weight, height, and growth
Passive transfer, immunity, metabolism
Thermoregulation
Mammary development and DNA methylation
Milk production
Milk production
Milk production
Heifer F2
Survival
1st Lactation F2
Milk production

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