

# PHOTOPERIOD MANAGEMENT OF DAIRY CATTLE: CONSIDERATIONS AND APPLICATIONS

G. E. Dahl

Department of Animal Sciences

Institute of Food and Agricultural Sciences

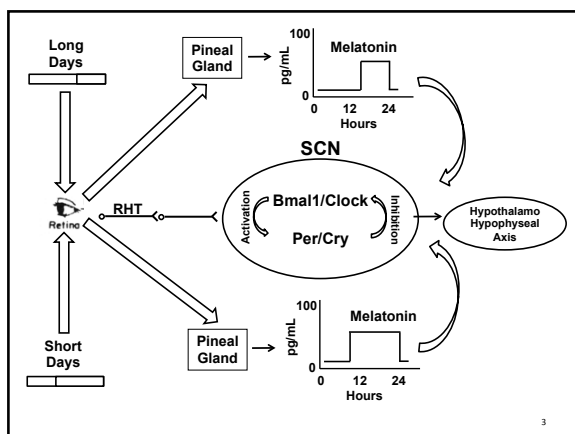
[gdahl@ufl.edu](mailto:gdahl@ufl.edu)



## Outline

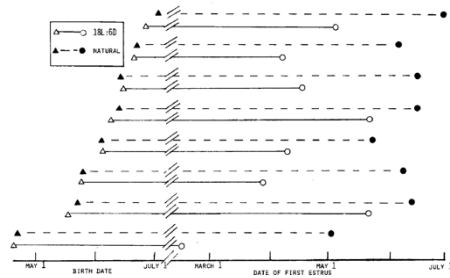
- Growing animals
  - Endocrine responses
  - Carcass, mammary growth
- Lactation response
- Dry period
  - Production, endocrine effects
- Implementation
  - Lighting types, design

2



3

### Long Days Hasten Puberty in Heifers



Hansen et al., JAS, 57:985-992

4

---

---

---

---

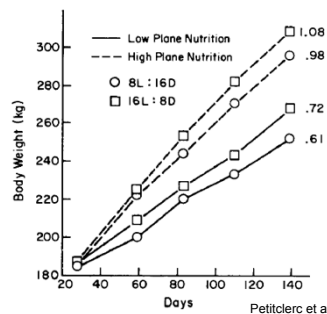
---

---

---

---

### Long Days Increase Growth – Regardless of Intake



Petitclerc et al., JAS, 57:892-898

5

---

---

---

---

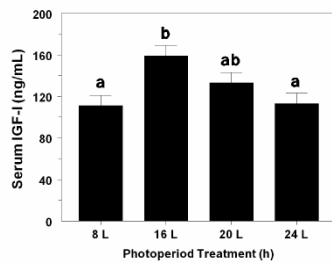
---

---

---

---

### Long Days Increase IGF-I in Heifers



Spicer et al., AJAVS, 2:42-45

6

---

---

---

---

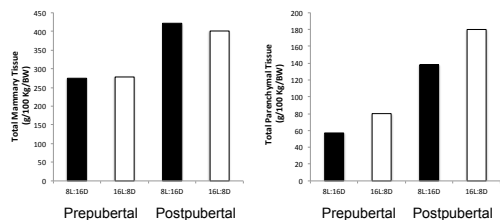
---

---

---

---

## Long Days Increase Mammary Parenchymal Growth



Petitclerc et al., JDS, 68:86-90

7

## Growth Effects of Prepubertal Long Days Persist to First Lactation

Trait	Photoperiod treatment <sup>1</sup>		Error MS	Treatment MS	P-value
	SDPP (n = 12)	LDPP (n = 10)			
Peak milk, kg	33.2 ± 1.4	33.7 ± 1.4	12.9	0.6	0.83
Projected 305 actual milk, kg	9,020 ± 273	9,428 ± 273	828,937	748,763	0.30
Projected 305 FCM, kg	9,477 ± 259	10,227 ± 299	538,282	1,930,607	0.08
Projected 305 ECM, kg	9,367 ± 250	10,044 ± 288	500,641	1,572,632	0.10
Projected 305 ME <sup>2</sup> ECM, kg	11,853 ± 463	12,754 ± 535	1,720,464	2,785,094	0.22
Lactation average SCS	2.8 ± 0.5	3.0 ± 0.5	1.7	0.2	0.72
Lactation average SCC	109 ± 53	184 ± 62	23,114	19,242	0.37
Age at calving, mo	24.3 ± 1.1	23.1 ± 1.1	115.2	2.2	0.49
BW before calving, kg	637 ± 17	692 ± 17	1,912	9,218	0.05
BW after calving, kg	603 ± 22	641 ± 22	3,402	5,076	0.24
Withers height before calving, cm	140.7 ± 0.8	143.1 ± 0.8	4.3	19.4	0.05
Hip height before calving, cm	143.8 ± 1.0	146.6 ± 1.0	6.3	24.0	0.08

<sup>1</sup>Long day (LDPP, 16 h of light) and short day (SDPP, 8 h of light).

<sup>2</sup>Mature equivalent.

Rius & Dahl, JDS, 89:2080-2083

8

## Milk Effects of Prepubertal Long Days Persist to First Lactation

Trait	Photoperiod treatment <sup>1</sup>		Error MS	Treatment MS	P-value
	SDPP (n = 12)	LDPP (n = 10)			
Peak milk, kg	33.2 ± 1.4	33.7 ± 1.4	12.9	0.6	0.83
Projected 305 actual milk, kg	9,020 ± 273	9,428 ± 273	828,937	748,763	0.30
Projected 305 FCM, kg	9,477 ± 259	10,227 ± 299	538,282	1,930,607	0.08
Projected 305 ECM, kg	9,367 ± 250	10,044 ± 288	500,641	1,572,632	0.10
Projected 305 ME <sup>2</sup> ECM, kg	11,853 ± 463	12,754 ± 535	1,720,464	2,785,094	0.22
Lactation average SCS	2.8 ± 0.5	3.0 ± 0.5	1.7	0.2	0.72
Lactation average SCC	109 ± 53	184 ± 62	23,114	19,242	0.37
Age at calving, mo	24.3 ± 1.1	23.1 ± 1.1	115.2	2.2	0.49
BW before calving, kg	637 ± 17	692 ± 17	1,912	9,218	0.05
BW after calving, kg	603 ± 22	641 ± 22	3,402	5,076	0.24
Withers height before calving, cm	140.7 ± 0.8	143.1 ± 0.8	4.3	19.4	0.05
Hip height before calving, cm	143.8 ± 1.0	146.6 ± 1.0	6.3	24.0	0.08

<sup>1</sup>Long day (LDPP, 16 h of light) and short day (SDPP, 8 h of light).

<sup>2</sup>Mature equivalent.

Rius & Dahl, JDS, 89:2080-2083

9

## Growth Summary

- Long days increase lean body and mammary mass.
- Responses to LD persist into lactation.
- Long days increase IGF-I and PRL.

10

---

---

---

---

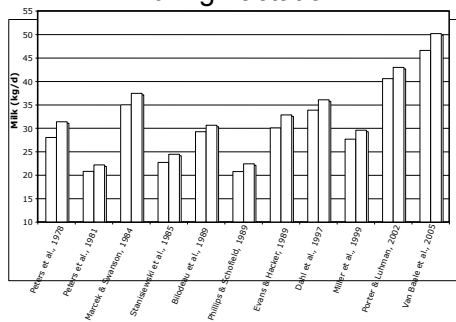
---

---

---

---

## Long Days Increase Milk Yield During Lactation



11

---

---

---

---

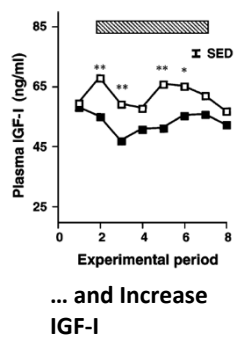
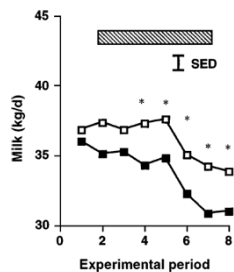
---

---

---

---

## Long Days During Lactation Increase Milk ...



Dahl et al., JDS, 80:2784-2789

12

---

---

---

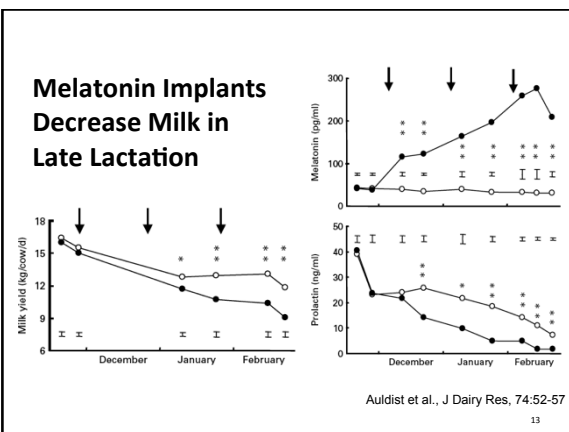
---

---

---

---

---




---

---

---

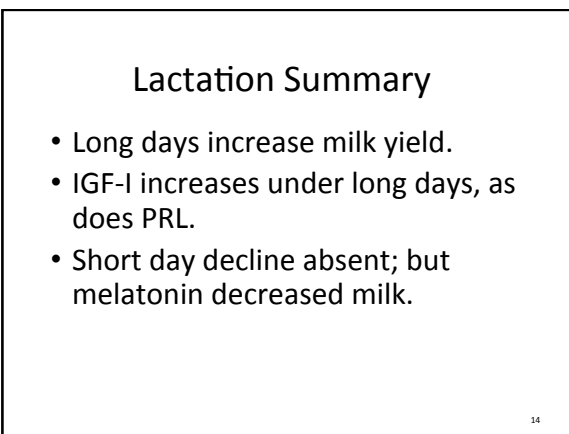
---

---

---

---

---




---

---

---

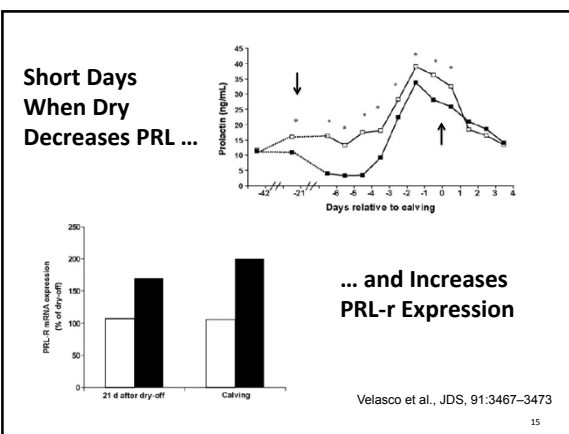
---

---

---

---

---




---

---

---

---

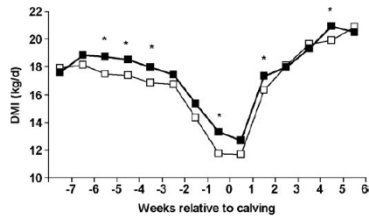
---

---

---

---

### Short Days When Dry Increase DMI



Velasco et al., JDS, 91:3467-3473  
16

---

---

---

---

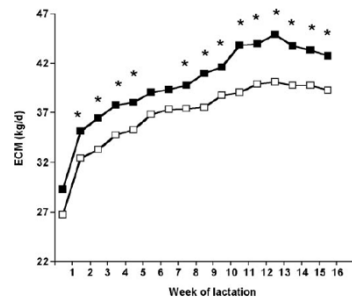
---

---

---

---

### Short Days When Dry Increase Milk Yield in Next Lactation



Velasco et al., JDS, 91:3467-3473  
17

---

---

---

---

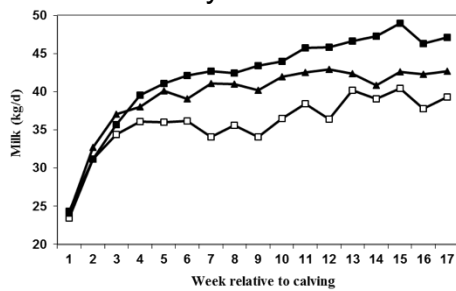
---

---

---

---

### PRL Replacement Reverses Short Day Effect - Milk



Crawford et al., Animals, 5:803-820  
18

---

---

---

---

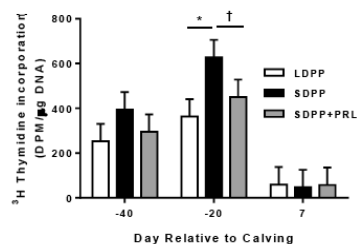
---

---

---

---

### PRL Replacement Reverses Short Day Effect - MG

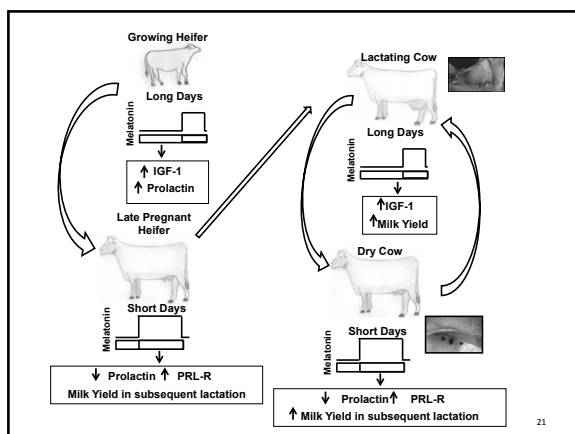


Crawford et al., Animals, 5:803-820 19

### Dry Period Summary

- Short days when dry increases subsequent yield; PRL replacement reverses.
- MG growth increases under short days.
- MG growth effects consistent with 40 to 60 day response window.

20



21

### How to....

- Type of Light
  - Fluorescent
  - Metal halide
  - High pressure sodium (HPS)
  - LED ??
- Lighting choice should be made according to efficiency and the mounting height most appropriate to the barn.

22

---

---

---

---

---

---

---

- Light intensity
  - 15 FC (i.e. ~150 lux) at 1 m from the floor of the stall
  - Dispersion of light over an area should be as uniform as possible
- Testing light intensity
  - Light meter



23

---

---

---

---

---

---

---

### Estimating Fixture Requirements

$$\text{Total Lumens} = (\text{AREA}) (\text{FC}) (k)$$

$$\text{Fixture Number} = \frac{\text{TOTAL LUMENS}}{\text{LAMP LUMENS}}$$

	Lamp Lumens		
	Watts	HPS	MH
Outdoor: k = 3	400	50000	36000
Indoor: k = 2	250	27500	20500
	150	16000	14000

24

---

---

---

---

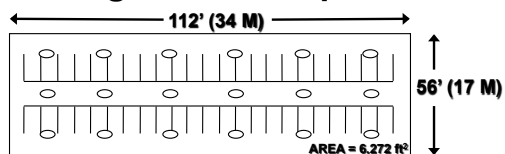
---

---

---



### Estimating Fixture Requirements

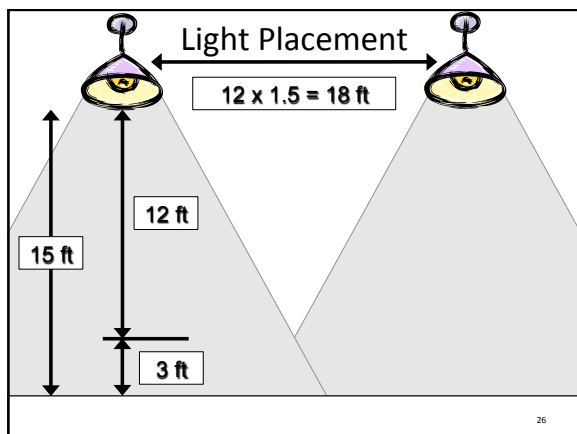


LAMP = 250 W Metal Halide       $k = 3$       FC Desired = 20

$$\begin{aligned} \text{Total Lumens} &= (\text{AREA}) (\text{FC}) (k) \\ &= (112' \times 56') (20) (3) \\ &= 376,320 \text{ Lumens} \end{aligned}$$

$$\begin{aligned} \text{Fixture Number} &= 376,320 \text{ Lumens} / 20,500 \\ &= 18 \text{ Fixtures} \end{aligned}$$

25



26

### Milk Price Sensitivity to Photoperiod Management

20.00	Milk Price	150	Herd Size
5	Milk Response	.12	\$ /lb DM
		.13	Electricity \$/cow/day
1.00	Milk Income	0.43	Total Cost/cow/day

#### Net Profits for Photoperiod Response

	Daily	Monthly	Yearly
Herd	\$86	\$2,565	\$25,992
Cow	\$0.57	\$17.10	\$173

### Long Days and bST

- Additive response to the combination
- Intake increased sooner in bST treated cows on LDPP vs. those on NDPP
- Energy balance did not decrease in cows on LDPP despite increased yield

28

---

---

---

---

---

---

---

### Long Days and 3X - Tips

- hr of darkness
- Coordinate milking schedule and lighting by barn
- Use  
dim red  
lights to  
facilitate cow  
movement

29

---

---

---

---

---

---

---

### Short Days When Dry?

- Need to provide cooling
- Solid sides on barn; mechanical ventilation
- Barn can be open 8 hr/day

30

---

---

---

---

---

---

---

### Conclusions

- Photoperiodic manipulation profitable across the life cycle of the cow.
- Select light type based on efficiency and long term total cost.
- Combine with other management interventions, i.e. bST, 3X, dry period

31

---

---

---

---

---

---

---



---

---

---

---

---

---

---