Outline

• Growing animals
  Endocrine responses
  Carcass, mammary growth
• Lactation response
• Dry period
  Production, endocrine effects
• Implementation
  Lighting types, design
Long Days Hasten Puberty in Heifers

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

Long Days Increase Growth – Regardless of Intake

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

Long Days Increase IGF-I in Heifers

Spicer et al., AJAVS, 2:42-45
Long Days Increase Mammary Parenchymal Growth

Growth Effects of Prepubertal Long Days Persist to First Lactation

<table>
<thead>
<tr>
<th>Treatment</th>
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<td>Control</td>
<td>Light</td>
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<td>12.2 ± 1.4</td>
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Rius & Dahl, JDS, 89:2080-2083

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Rius & Dahl, JDS, 89:2080-2083
Growth Summary

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

Long Days Increase Milk Yield During Lactation

Long Days During Lactation Increase Milk ... and Increase IGF-I
**Melatonin Implants Decrease Milk in Late Lactation**

Auldist et al., J Dairy Res, 74:52-57

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**Lactation Summary**

- Long days increase milk yield.
- IGF-I increases under long days, as does PRL.
- Short day decline absent; but melatonin decreased milk.

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**Short Days When Dry Decreases PRL ...**

Velasco et al., JDS, 91:3467–3473

... and Increases PRL-r Expression
Short Days When Dry Increase DMI

Velasco et al., JDS, 91:3467–3473

Short Days When Dry Increase Milk Yield in Next Lactation

Velasco et al., JDS, 91:3467–3473

PRL Replacement Reverses Short Day Effect - Milk

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

• 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

Estimating Fixture Requirements

Total Lumens = (AREA) (FC) (k)

Fixture Number = \( \frac{\text{TOTAL LUMENS}}{\text{LAMP LUMENS}} \)

<table>
<thead>
<tr>
<th>Outdoor: ( k = 3 )</th>
<th>Indoor: ( k = 2 )</th>
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</thead>
<tbody>
<tr>
<td><strong>Watts</strong></td>
<td><strong>HPS</strong></td>
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<tr>
<td>400</td>
<td>50000</td>
</tr>
<tr>
<td>250</td>
<td>27500</td>
</tr>
<tr>
<td>150</td>
<td>16000</td>
</tr>
</tbody>
</table>
Estimating Fixture Requirements

LAMP = 250 W Metal Halide  \( k = 3 \)  FC Desired = 20

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

Fixture Number = \(\frac{376,320 \text{ Lumens}}{20,500}\)
= 18 Fixtures

Light Placement

12 x 1.5 = 18 ft

Milk Price Sensitivity to Photoperiod Management

<table>
<thead>
<tr>
<th>Milk Price</th>
<th>20.00</th>
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<tbody>
<tr>
<td>Milk Price</td>
<td>150</td>
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<tr>
<td>Herd Size</td>
<td>5</td>
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<td>Milk Response</td>
<td>.12</td>
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<tr>
<td>$/lb DM</td>
<td>.13</td>
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<tr>
<td>Electricity $/cow/day</td>
<td>0.43</td>
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</table>

Net Profits for Photoperiod Response

<table>
<thead>
<tr>
<th>Herd</th>
<th>Daily $86</th>
<th>Monthly $2,565</th>
<th>Yearly $25,992</th>
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<tbody>
<tr>
<td>Cow</td>
<td>$0.57</td>
<td>$17.10</td>
<td>$173</td>
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</table>
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

Long Days and 3X - Tips

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

Short Days When Dry?

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

Questions?
qdahl@ufl.edu