Reproductive Management

P. D. French

Reproductive Program

- Objectives
  - Establish or re-establish lactation
  - More peaks
  - Less culling
  - Produce replacements

- Goals
  - Heifers pregnant 13 – 15 mo of age (avg)
  - Calve at 22 – 24 mo of age
  - Cows pregnant by day 115 of lactation (avg)
  - Calve every 13 mo

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Estrous Regulation

- Anterior pituitary secretes gonadotropins
  - FSH (Follicle Stimulating Hormone)
    - Stimulates follicular development
  - LH (Luteinizing Hormone)
    - Causes ovulation and stimulates formation and corpus luteum (CL)

- Ovaries secrete
  - Estrogen (from follicle)
    - Causes estrus (heat)
    - Causes LH release

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Estrous Regulation

- Ovaries secrete
  - Progesterone (from CL)
    - Readies uterus for implantation
    - Suppresses gonadotropin secretion

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Estrous Cycle

- Interval between two heats = 21 days
- A heat (estrus) lasts 6 to 30 hr
  - Cows average 8 hr
  - Heifers average 12 hr
- Follicular phase
  - End of heat cycle - follicle secretes estrogen
  - Ovulation - 28 ± 5 hr after onset of heat
  - Remaining cells form corpus luteum - produce progesterone to maintain pregnancy

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Estrous Cycle

- Corpus Luteal phase
  - Progesterone from CL prevents follicles from maturing and maintains pregnancy
  - D 16-17 of cycle - if uterus has not detected embryo, it will send a signal (prostaglandin) that causes CL to regress
  - Inhibition is removed and dominant follicle begins to develop
  - Another heat
Estrous Cycle

- Proestrus
- Progesterone
- Estrogen
- Proestrus

Day of Estrous Cycle

18 21 3 6 9 12 15 18 21 3

Estrous Characteristics

- Primary signs of estrus
  - Standing to be mounted
- Secondary signs of estrus
  - Attempting to mount other cows
  - Restlessness, chin resting, bellowing, trailing other cows
- Biological
  - Estrogen high, progesterone low
  - Swelling of vulva and mucous secretion

Reproductive Inefficiency

- Acceptable fertility challenged by
  - ↑ milk yield, heat detection, ↑ herd size
- Failure to detect estrus and the misdiagnosis of estrus
  - Annual loss of >$300 million (Senger, 1994)
  - Average heat detection rate = 48% (DHI Provo, 2001)
- Fertility during last 50 years (Nebel, 1999)
  - Virgin heifers remained constant at 65%
  - Decreased 33% for lactating cows (60 to 40%)

Milk Production and Fertility

- Milk yield and fertility relationship
- Conception rate (%)
- Heat detection
- Conception
- Pregnancy

Milk Yield and Reproduction

Calving Interval (CI)

- Length of time between calves (births)
- 12 to 13 mo calving interval most economical
- Function of
  - Days open (DO)
  - Gestation length (282 d)
Calving Interval

<table>
<thead>
<tr>
<th>Days Open</th>
<th>Gestation Length</th>
<th>Lactation Length</th>
<th>Dry Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>(115 Days)</td>
<td>(280 Days)</td>
<td>(335 Days)</td>
<td>(60 Days)</td>
</tr>
<tr>
<td>395 Days or 13 Months</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Days Open Affects Cash Flow

- Days open (calving interval) is affected by:
  - Heat detection
  - Days to 1st service
  - Conception rate
- Days open affects average days in milk (DIM)
  - DIM = number of days the average cow has been in milk = days postpartum

Costs of Poor Repro Efficiency

- Less milk sold ($$$$)
- Higher culling ($$$$
- Increased semen cost ($)
- Increased vet costs ($$
- Less calves born ($)

Effect of DO on Milk Yield

Cost per Day Open

<table>
<thead>
<tr>
<th>Days Open</th>
<th>Cost per Day Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>no cost</td>
</tr>
<tr>
<td>101 to 120</td>
<td>$0.50/cow/d</td>
</tr>
<tr>
<td>121 to 142</td>
<td>$1.00/cow/d</td>
</tr>
<tr>
<td>143 to 163</td>
<td>$1.50/cow/d</td>
</tr>
<tr>
<td>164 to 184</td>
<td>$2.00/cow/d</td>
</tr>
<tr>
<td>185 to 205</td>
<td>$2.25/cow/d</td>
</tr>
<tr>
<td>&gt;205</td>
<td>&gt;$2.25/cow/d</td>
</tr>
</tbody>
</table>
Reproductive Efficiency

1. Voluntary waiting period (VWP)
2. Percent of cows detected in heat
3. Conception rate
4. Reproductive disease

Voluntary Waiting Period (VWP)

- Day the cow is first available for breeding after calving
- For max fertility - cows should be on 3rd or higher cycle when breeding commences
- Optimal VWP = 60 d
  - <60 d - conception rates lower
  - >60 d - increasing days open

Priorities of the Lactating Cow

1. Maintenance
2. Lactation
3. Growth/Body Reserves
4. Reproduction

Early Lactation Cow

- Health Disorders
  - Uterine health (retained placenta, metritis)
  - Metabolic disease (milk fever, ketosis)
  - Postpartum disorders = conception rates ½ that of a normal cow
- Negative energy balance
  - Mobilizing body lipid

Effect of BC change on 1st Service Conception Rate

<table>
<thead>
<tr>
<th>Change in BCS</th>
<th>Conception Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.75</td>
<td>55.9</td>
</tr>
<tr>
<td>0.25</td>
<td>49.5</td>
</tr>
<tr>
<td>0</td>
<td>46.3</td>
</tr>
<tr>
<td>-0.25</td>
<td>43.2</td>
</tr>
<tr>
<td>-0.75</td>
<td>37.0</td>
</tr>
<tr>
<td>-1.50</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Ferguson, 1996

Heat Detection
Visual Observation Has Been the Backbone of Detection

- Recommendations established in 1940’s - minimum of three daily observation periods
- “Standing” to be mounted by a herdmate has been the Gold Standard

Distribution of Estrus Duration

Myth or Misconception

Cows stay in heat an average of 18 hours

Standing Events per Estrus

Myth or Misconception

Cows in estrus stand to be mounted 20 to 55 times

Myth or Misconception

Cows come into heat primarily at night
The Circadian Distribution of First Standing Event of Estrus

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:01 pm to 12:00 am</td>
<td>28.4%</td>
</tr>
<tr>
<td>12:01 am to 6:00 am</td>
<td>27.3%</td>
</tr>
<tr>
<td>12:01 pm to 6:00 pm</td>
<td>19.8%</td>
</tr>
<tr>
<td>6:01 am to 12:00 pm</td>
<td>24.5%</td>
</tr>
</tbody>
</table>

Myth or Misconception

Milk Yield Lowers Estrus Expression

Standing Events per Estrus

<table>
<thead>
<tr>
<th>Hours Standing Events</th>
<th>Duration of Estrus</th>
<th>Standing Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;69</td>
<td>Summit Milk (lbs)</td>
<td></td>
</tr>
<tr>
<td>69-75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76-88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>89-102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>103-114</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;114</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Estrus Characteristics)

<table>
<thead>
<tr>
<th>Standing Events (n)</th>
<th>Estrus Duration (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td></td>
</tr>
<tr>
<td>Holstein</td>
<td>7.4 ± 8.2</td>
</tr>
<tr>
<td>Jersey</td>
<td>9.8 ± 7.8</td>
</tr>
<tr>
<td>Heifers</td>
<td></td>
</tr>
<tr>
<td>Holstein</td>
<td>17.1 ± 12.8</td>
</tr>
<tr>
<td>Jersey</td>
<td>30.9 ± 21.5</td>
</tr>
</tbody>
</table>

Average Estrus Duration (h)

<table>
<thead>
<tr>
<th></th>
<th>Hammond (1927)</th>
<th>Trimmerger (1948)</th>
<th>Nebel (unpublished)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>19.3</td>
<td>17.8</td>
<td>7.6</td>
</tr>
<tr>
<td>Heifers</td>
<td>16.1</td>
<td>15.3</td>
<td>11.5</td>
</tr>
<tr>
<td>Range</td>
<td>6 to 30</td>
<td>2.5 to 28</td>
<td>0.5 to 42</td>
</tr>
</tbody>
</table>

OSU Mounting Activity per Estrus
**OSU Heat Detection Rate**

**Truths**
- Cows stay in heat an average of 7 hours
- Cows in estrus stand to be mounted 7 times
- Milk yield does not appear to influence expression of estrus

**Estrus Detection**
- Cows average 7 hr
  - 7 mounts or one per hour
  - Average mount time = 4 sec
  - Average mounted time per heat cycle = 28 sec
- Heifers average 11 hr
  - 17 mounts or 1.5 per hour
  - Average mount time = 4 sec
  - Average mounted time per heat cycle = 68 sec

**Expected Heat Detection Rates**

<table>
<thead>
<tr>
<th>Observations/Day</th>
<th>15</th>
<th>30</th>
<th>45</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>16</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>33</td>
<td>50</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>48</td>
<td>72</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>100</td>
</tr>
</tbody>
</table>

- 2x @ 36 min/obs
- 3x @ 25 min/obs

**Estrus Detection Problems**
- 5 - 15% of cows inseminated are not in estrus
- Reliance on secondary sings of heat
- Poor cow ID
- Incorrect use or interpretation of estrus detection aids

**Heat Detection Aids**
- Chalk, Paint
- Kamar, Beacon
- Pedometer
- Heat Watch
Heat Detection Aids

- **Chalk, Paint, Kamar, Beacon**
  - Mark or place on tailhead of eligible cows
  - Check cows
  - Breed if rubbed off or activated
  - Check often (6 - 12 h)
  - Check less often (4 - 6 h)

Pedometer

- Records activity - walking
- Activity increases with estrus
- Problem: check only as many times as you milk
- Antenna used to download info is assoc with parlor
- Inseminate
  - 6 to 17 hr (11.8) after onset of activity
- Don’t know onset of activity!

HeatWatch

- Mounted on tailhead of eligible cows
- Pressure sensitive transmitter
- When mounted, transmitter sends signal to computer
- Breeder checks computer several times per day
- Breed 4 to 12 h after standing event
- Only system that determines when standing events occurred

Heat Detection Rate (HDR)

- # of heats observed/total # of heats
- Goal = 80%
- Intervention = 40%
- Average = 40%

Timing of Insemination
Timing of Insemination

- Duration of Estrus
  - Cows average 7 hr
- Ovulation occurs 28(±5) hr after onset of heat
- Optimum ovum fertilization capacity
  - 6 to 10 hr
- Sperm transport to oviduct is 6 hr
  - Numbers increase over 8 to 18 hr
  - Viable life 24 to 30 hr

Timing of AI

- AM-PM rule
  - 30's & 40's
- PA Study (7,240 services)
  - AM-PM or once a day (3 hr period)
  - Non-return rates 57.8 vs 58.4%
- Pedometer
  - 6 to 17 hr (11.8) after onset of activity
- VA study (2660 inseminations)
  - 4 to 15 hours after onset of standing heat

Timing of AI

- Dransfield et al. (1998)

Timing of Insemination

- Dransfield et al. (1998)

When to Inseminate

- Observe frequently (2-4 h)
  - AM-PM or 6 to 12 h after visual signs
- Observe less than 6 times per day
  - 4 to 6 h after visual signs
- Know when first mount occurred (i.e. use HeatWatch)
  - 4 to 15 h after first mount
Conception Rate (CR)
- Measurement of
  1. semen quality and handling
  2. fertility of cows
  3. timing of insemination
  4. heat detection
  5. inseminator expertise (semen placement)
- Goals
  - 1st service = 45%
  - 2nd + services = 40%

Other Numbers
- Pregnancy Rate
  - Tells you the % of cows you are getting pregnant
  - PR % = HDR % x CR %
    - 16% = 40% x 40%
- Days Open
  - Days between parturition and pregnancy
  - Goal = 115
  - Intervention = 160

Benchmarks

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Goal</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Open</td>
<td>115</td>
<td>160</td>
</tr>
<tr>
<td>Calving Interval, mo</td>
<td>13</td>
<td>14.5</td>
</tr>
<tr>
<td>Days to 1st Service</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>CR 1st Service, %</td>
<td>45</td>
<td>30</td>
</tr>
<tr>
<td>CR all Services, %</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>HDR, %</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Repro Culls/lact, %</td>
<td>&lt;5</td>
<td>10</td>
</tr>
<tr>
<td>Abortions, %</td>
<td>&lt;15</td>
<td>20</td>
</tr>
</tbody>
</table>