Economics of fertility in high-yielding dairy cows on confined TMR systems

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Implications

 갖고 있는 기술을 사용할 수 있는 장점이 있습니다. 이는 효율적인 농장 운영과 생리적 성능 개선에 기여할 수 있습니다.

**Profitability**

**Reproductive performance**

**Effective:**

- Oestrous detection
- Synchronization

**Feasible:**

-Earlier pregnancy diagnosis

**Opportunity to:**

- Cow-level reproductive management
Introduction

**Economic net return:** Strongly associated to reproductive performance

**Reproductive performance:**
Most efficient part of lactation curve

- **Costs replacement and mortality**
- **On-farm replacements**
- **Relative reproductive costs**
21-d Pregnancy Rate: Best single index of reproductive performance
Ferguson and Galligan, 1999

Rate at which eligible cows become pregnant in successive 21-d periods

Integrates many other parameters that indicate reproductive performance

Managers of modern US commercial dairy herds use 21-d PR index
Economic impact of reproductive programmes: Difficult to assess

Series of recent simulation studies: Provide interesting clues and further direction

Giordano et al., 2011: Partial budgeting, DSS
Giordano et al., 2012: Daily Markov chains, DSS

Cabrera, 2012: Markov-Chain, DSS
Kalantari and Cabrera, 2012: Markov-Chain, DSS

Giordano et al., 2013: Decision theory
Galvao et al., 2013: Monte Carlo
The economic value of improving reproductive performance

Net return gain over 10% 21-d PR (US$/cow per year)

21-day pregnancy rate (21-d PR) (%)

- Cabrera, 2012
- Galvao et al., 2013
- Giordano et al., 2012
- Giordano et al., 2011
- Kalantari and Cabrera, 2012
Reproductive programs value ranking vs. herd’s milk productivity

Kalantari and Cabrera, 2012
PR vs. milk, feed, and IOFC ($/cow.yr)

Cabrera, 2012

Milk
Feed
IOFC

11,000 kg/cow.yr

13,600 kg/cow.yr

21-d Pregnancy Rate, %
PR vs. calf sales ($/cow.yr)

Return ($/cow.yr) =
- 0.0352 (21-d PR)^2
+ 2.8476 (21-d PR)
+ 18.93 (R^2 = 0.996)

Calf value = $100

Between $3 and $1 per 1% increase 21-d PR

<table>
<thead>
<tr>
<th>Study</th>
<th>♀ Calf value, $</th>
<th>Gain, $/1% 21-d PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galvao et al., 2013</td>
<td>$140</td>
<td>$1 to $3*</td>
</tr>
<tr>
<td>Giordano et al., 2012</td>
<td>$90</td>
<td>$2 to $1</td>
</tr>
</tbody>
</table>

Cabrera, 2012
## PR vs. replacement supply

チョークスカリー

<table>
<thead>
<tr>
<th>21d-PR, % (different reproductive programs)</th>
<th>Replacement balance (per 1,000 cow herd) when breeding cutoff was at 300 DIM</th>
<th>NEW breeding cutoff to balance the heifer supply and demand, DIM</th>
<th>Approximated net return change compared to 300 DIM breeding cutoff, $/cow.yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>-14</td>
<td>310</td>
<td>-5</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>300</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>15</td>
<td>281</td>
<td>+5</td>
</tr>
<tr>
<td>17</td>
<td>20</td>
<td>270</td>
<td>+6</td>
</tr>
<tr>
<td>18</td>
<td>38</td>
<td>240</td>
<td>+7</td>
</tr>
<tr>
<td>19</td>
<td>40</td>
<td>240</td>
<td>+8</td>
</tr>
<tr>
<td>20</td>
<td>48</td>
<td>235</td>
<td>+9</td>
</tr>
</tbody>
</table>

Souza et al., 2013

From Giordano et al., 2012
PR vs. replacement & mortality costs

Pregnant = Less risk than non-pregnant (e.g., 75% less risk)
Mortality = Proportion of culling risk (e.g., 17% of that risk)

Data from De Vries et al., 2010

Lower Costs $/cow.yr

↑1% 21-d PR

$4 to $1
Cabrera, 2012

$4 to $3
Giordano et al., 2012

$27 to $4
Galvao et al., 2013
PR vs. reproductive costs

- PR (no investment) → Reproductive costs
- PR may require investments
- Depends on investments vs. PR
- Seems to be inconsistent among studies

$/cow.yr 1% 21-d PR

- $4
- +$4

The Wisconsin-Cornell Dairy Repro$ Tool could be used for farm-specific assessments

http://DairyMGT.info/Tools
Oestrus detection, synchronisation, or a combination

Most high yielding USA herds use a combination 78% OD & 87% TAI Caraviello et al., 2006

Common reproductive practice:
   TAI protocol and perform inseminations at detected oestrous in between Giordano et al., 2012

Recent economic studies:
   OD or TAI main core, but combinations studied Giordano et al., 2011

Presynch-Ovsynch + Ovsynch with a focus on combination with OD Giordano et al., 2012; Galvao et al., 2013
## Economic effect of TAI with OD

<table>
<thead>
<tr>
<th>Study</th>
<th>Programme</th>
<th>First Serv.</th>
<th>Later Serv.</th>
<th>60% OD CR, %</th>
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<tbody>
<tr>
<td>Giordano et al., 2011</td>
<td>Double Ovsynch + D32 Ovsynch</td>
<td>45</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Double Ovsynch + Double Ovsynch</td>
<td>45</td>
<td>39</td>
<td>-12</td>
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<tr>
<td>Giordano et al., 2012</td>
<td>Presynch-Ovsynch + Ovsynch</td>
<td>42</td>
<td>30</td>
<td>-17 2 19</td>
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<td>33</td>
<td>25</td>
<td>23 57</td>
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<tr>
<th>Study</th>
<th>Programme</th>
<th>First Serv.</th>
<th>Later Serv.</th>
<th>Net return gain TAI vs. TAI + OD, $/cow.yr</th>
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Interbreeding interval vs. net return

Change in interbreeding interval (weeks)

Net return gain by changing interbreeding interval, US$/cow per year

8 to 7, 7 to 6, 6 to 5, 5 to 4

Presynch-Ovsynch + Ovsynch

Adapted from Giordano et al., 2013
Blood or milk-based pregnancy tests

Potentially effective when used earlier than conventional methods – **Shorten IBI**

Earlier pregnancy diagnosis with a chemical test could have some important drawbacks:

1. **Lower accuracy**
   a. False positive (issue of sensitivity)
   b. False negative (issue of specificity)
   c. Questionable diagnoses (inconclusive)

2. **Larger proportion of early pregnancy losses**
Accuracy of blood chemical test for early pregnancy diagnosis

Compared to conventional ultrasound or palpation

↓ Sensitivity  → 2-3% → Re-synch → Preg. loss

↓ Specificity  → 2-3% → Longer IBI → Time loss

↓ Conclusive  → 3-9% → Re-test/Longer IBI

↑ Preg. Losses  → 6-6.6%/week → ↓ Specificity

Adapted from Giordano et al., 2013
Chemical vs. Palpation
CT31 vs. RP39; 35 vs. 42 d IBI @ 50% OD

= -795
+535 (sensitivity %)
+305 (specificity %)
-305 (pregnancy losses %)
-39 (questionable diagnoses %)
-1.8 (cost of test $)

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<tr>
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<th>Sensitivity %</th>
<th>Specificity %</th>
<th>Pregnancy losses %</th>
<th>Questionable diagnoses %</th>
<th>Test Cost $</th>
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<tr>
<td>Baseline</td>
<td>98</td>
<td>98</td>
<td>6.0</td>
<td>3.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Positive</td>
<td>≥96</td>
<td>≥95</td>
<td>≤9.0</td>
<td>≤27</td>
<td>≤7.5</td>
</tr>
</tbody>
</table>
d25 Chemical vs. d32 Ultrasound
CT25 vs. TU32; 28 vs. 35 d IBI @ 50% OD

= -638
+450 (sensitivity %)
+253 (specificity %)
-253 (pregnancy losses %)
-34 (questionable diagnoses %)
-1.9 (cost of test $)

|            | Sensitivity % | Specificity % | Pregnancy losses % | Questionable diagnoses % | Test Cost $
|------------|---------------|---------------|---------------------|--------------------------|----------
| Baseline   | 97            | 97            | 6.6                 | 8.5                      | 2.4      |
| Positive   | ≥95           | ≥94           | ≤10                 | ≤34                      | ≤7.0     |
The value of a cow and reproduction

Important relationship for decision-making

Opportunities for cow-level reproductive management. E.g.,

High value cow → more inseminations
Low value cow → lower quality semen

Associated economic values could be used to enhance the value of reproductive programs. E.g.,

The value of a new pregnancy
The cost of a pregnancy loss
The cost of an additional day open
The value of a cow

Long-term expected net return of a cow compared with that of an imminent replacement

Critical factors

- Cow’s productivity level in relation to herd mates
- Replacement’s genetic improvement in relation to herd mates
- Cow’s current conditions
  - Lactation
  - Days after calving
  - Pregnancy status
The value of a cow

1. Value of a new pregnancy (e.g., US$ 222 (628-406)
2. Cost of a pregnancy loss (e.g., US$323 (488-165)
3. Cost of a day open (e.g., US$5.2 (704-549)/(120-90)
4. Effect of 10% increased productivity in future lactations

Average pregnant @ 120 DIM

Values calculated using the following:

- Average pregnant @ 120 DIM
- Average non-pregnant

10% higher producer non-pregnant

Days after second calving

Economic value of a cow, $