Accelerated lamb production: an opportunity to build markets and increase production efficiency

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Michigan State University

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This webinar is being offered in cooperation with the American Sheep Industry Association Rebuild the Sheep Inventory Committee.
Overview:

• What is accelerated production and how does it compare to annual production systems?
• Resources required for a successful accelerated system
• Barriers to accelerated production success
• Approaches to insuring aseasonal breeding success
What is accelerated lambing?

• Production system that decreases lambing interval to less than 12 months.
  ✓ Creates multiple birth periods
• Most accelerated systems have 2 major management groups:
  ✓ Ewes in late pregnancy or lactation
  ✓ Ewes exposed to rams or in early pregnancy
What potential advantages does an accelerated system have over a traditional, annual system?

• Lambs born and survival to market age/ewe
  ❖ Annual:
    ✓ Lambs born: 0.95 births/yr x 2.0 lambs/birth=1.9 lambs/ewe/yr
    ✓ Lambs to market age: 1.9 x 85% survival to market=1.6 lambs/ewe/yr
  ❖ Accelerated:
    ✓ Lambs born: 1.37 births/yr x 1.9 lambs/birth=2.6 lambs/ewe/yr
    ✓ Lambs to market age=2.6 x 85% survival to market=2.2 lambs/ewe/yr

• Marketable lambs: lambs to sell per ewe/yr
  ➢ Ewe replacement rate is slightly higher but offset by increased lamb production
  ➢ Marketable lambs/ewe, (lambs/ewe/year –ewe replacement rate)
    ❖ Annual: 1.6-0.22=1.38
    ❖ Accelerated: 2.2-0.25=1.95
    ❖ Accelerated: 41% greater annual ewe productivity
What potential advantages does an accelerated system have over a traditional, annual system?

Marketing flexibility:

• Can hit a huge diversity of markets allowing more opportunistic marketing possibilities
  ✓ Large, 140 lb lambs for traditional market
  ✓ Small “roaster”, 40-50 lbs for non-traditional trade
• Year-round supply allows creation/access to new markets
• Reduced risk due to price fluctuations within a year
What potential advantages does an accelerated system have over a traditional, annual system?

• Cash flow advantages of accelerated production

* John Molenhuis, Ontario Ministry of Agriculture (OMAFRA), Proceedings of the Ontario Sheep Seminars 2013, Summary of 3 year benchmarking study on lamb production. Ontario Sheep Marketing Agency (OSMA) sponsored study
What potential advantages does an accelerated system have over a traditional, annual system?

<table>
<thead>
<tr>
<th></th>
<th>Per Lamb</th>
<th>Accelerated</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td></td>
<td>$202</td>
<td>$195</td>
</tr>
<tr>
<td>Feed costs</td>
<td></td>
<td>$78</td>
<td>$77</td>
</tr>
<tr>
<td>Other variable costs (excluding labour)</td>
<td></td>
<td>$51</td>
<td>$54</td>
</tr>
<tr>
<td>Fixed costs</td>
<td></td>
<td>$23</td>
<td>$24</td>
</tr>
<tr>
<td><strong>Net enterprise income per lamb (before labour expenses)</strong></td>
<td></td>
<td>$50</td>
<td>$40</td>
</tr>
<tr>
<td>Marketable lambs per ewe</td>
<td></td>
<td>1.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Number of Ewes</td>
<td></td>
<td>708</td>
<td>918</td>
</tr>
<tr>
<td>Net enterprise income (before labour)</td>
<td></td>
<td>$66,906</td>
<td>$48,103</td>
</tr>
<tr>
<td>Ewes per person (labour)</td>
<td></td>
<td>354</td>
<td>481</td>
</tr>
<tr>
<td><strong>Net enterprise income per person</strong></td>
<td></td>
<td>$33,359</td>
<td>$25,152</td>
</tr>
</tbody>
</table>

*John Molenhuis, Ontario Ministry of Agriculture (OMAFRA), Proceedings of the Ontario Sheep Seminars 2013, Summary of 3 year benchmarking study on lamb production. Ontario Sheep Marketing Agency (OSMA) sponsored study*
What potential advantages does an accelerated system have over a traditional, annual system?

- More lambs to sell/ewe/yr, >40%
- Greater net income (per ewe, lamb, unit labor or enterprise basis)
- Creation of year-round supply of lamb
  - Create and build markets
  - Reduced market risk
  - Improvement in farm cash flow
Key strategies to improve the efficiency of sheep production:

- **Lower feed costs**
  - Extend the grazing season
  - Use inexpensive, by-product feedstuffs
  - Strategic nutritional management

- **Decrease labor input**
  - Birth systems-pasture and indoor
  - Efficient feeding systems-TMR and bale format

- **Increase production**
  - Prolific genetics
  - Use of terminal sires
  - Strategic nutritional management
  - Reduce the birth interval
Accelerated lambing-historical perspective

• Extension of efforts started in the 1960’s to try to increase the efficiency of production
• Efforts in the U.K., Canada and U.S.A. led to a number of systems designed to decrease lambing interval using various breed combinations
• The Polypay breed evolved out of these efforts
• Brian Magee and Doug Hogue from Cornell studied a variety of systems and fixed on the STAR system in the early 80’s.
Accelerated production systems:

- 8 month system: 3 lambing periods in 2 years
- STAR system: 5 lambing periods in 3 years (7.2 month intervals).
Cornell STAR® system
STAR system facts:

• Five, 73 day periods in one year
• Ewes can lamb at 7.2 mo intervals
• If ewes do not breed at first chance (7.2 mo) they can be rebred 72 days later (9.5 mo)
• 30 day lambing period
• 30 day breeding period
• 43-73 day lactation period
• Lambs are 43-73 days old at weaning
Cornell STAR® system
8 month system:
• Can alter birth periods a few weeks –creates flexibility to adjust for:
  ✓ Labor availability
  ✓ Need to hit specific market time table
  ✓ Variation in lactation length
• If ewes do not breed (8 interval) they must wait 120 days to be rebred (12 mo interval)
• Can allow ewes a few weeks of “recovery” between lactation and breeding
• Can lengthen breeding periods >30 days
## Summary of Accelerated Systems:

<table>
<thead>
<tr>
<th></th>
<th>STAR</th>
<th>8 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth interval</td>
<td>7.2 mo</td>
<td>7-9 mo</td>
</tr>
<tr>
<td>Lactation length</td>
<td>42-72 d</td>
<td>42-100d</td>
</tr>
<tr>
<td>Breeding period</td>
<td>&lt;30 d</td>
<td>&lt; 51 d</td>
</tr>
<tr>
<td>Lambing periods/year</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Breeding periods/year</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Max. # of births/ewe/yr</td>
<td>1.67</td>
<td>1.5</td>
</tr>
</tbody>
</table>

- Either system can be further manipulated by photoperiod and/or hormone therapy
Accelerated production: Theory vs. Reality

• Few formal comparisons of accelerated systems or deviations of systems.

CEPOQ studies (Cameron et al. 2010):

<table>
<thead>
<tr>
<th></th>
<th>Births/ewe/yr</th>
<th></th>
<th>Lambs/ewe/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1.5 max.)</td>
<td>Lambs/birth</td>
<td></td>
</tr>
<tr>
<td>Lighting control</td>
<td>1.37</td>
<td>2.81</td>
<td>3.85</td>
</tr>
<tr>
<td>Progesterone therapy</td>
<td>1.26</td>
<td>2.27</td>
<td>2.86</td>
</tr>
</tbody>
</table>

Note: this productivity is incredibly high compared to systems in the rest of the world!
2010-2013 production from 2000 ewes on an 8 month system: extended light

• 1.34 births/ewe/yr
  ✓ 83% conception in October
  ✓ 93% conception in May and Feb
• 1.73 lambs weaned/ewe/lambing
• 2.32 lambs weaned/ewe/year
• 2.07 lambs marketed/ewe/year
• 1.76 x maternal weight marketed in 2013
2009-2013 production from 150 ewes on an 8 month system: extended light and tease rams

• 1.38 births/ewe/yr
  ✓ 86% conception in October
  ✓ 93% conception in May and Feb
• 1.90 lambs weaned/ewe/lambing
• 2.62 lambs weaned/ewe/year
• 2.36 lambs marketed/ewe/year
• 1.79 x maternal weight marketed in 2013
Resources required for accelerated production

- **Birth facility** capable of housing 2/3 of flock
- **Must provide a higher plane of nutrition over the year than annual birth** as females are in a more productive state a greater proportion of the time
  - High energy forages (grazing or harvested)
  - Energy concentrates at critical windows (lactation)
- **Chronic disease** issues are more apparent in accelerated lambing (foot rot, OPP, Johnes) as any ceiling imposed on production is more apparent in highly productive animals.
- **Precise management: nutrition, reproduction, health**
  - An Ontario study* suggests that the productivity benchmarks for lambs marketed /ewe/year must be >1.3 for annual and >1.9 for accelerated for either system to be profitable.
  - Implication? If your annual system cannot produce >1.3 marketable lambs per ewe per year, work on improving that before considering a switch to accelerated production.

*John Molenhuis, Ontario Ministry of Agriculture (OMAFRA), Proceedings of the Ontario Sheep Seminars 2013, Summary of 3 year benchmarking study on lamb production. Ontario Sheep Marketing Agency (OSMA) sponsored study
Optimizing accelerated production:

• Nutrition
• Genetics
• Lighting protocols
• Hormone therapies
• Ram effect
• Male libido/fertility
Primary Barrier for Accelerated Systems

• Aseasonal fertility (ewes pregnant/ewe exposed) varied from 18-92% between surveyed farms in New York in 2004.

• Producers reported large variations in aseasonal fertility from year to year within their flocks.

• A change in aseasonal fertility from 92% to 18% translates into a profit loss of 36% per ewe/year in a 3 lambings per year system.
Why does aseasonal fertility vary so much within and between farms?

• Genetics

• Environment
  ➢ Nutrition
  ➢ Chronic disease
Sheep breeds that exhibit aseasonal fertility

Horned Dorset
Polled Dorset*
Rambouillet
Merino
Romanov
Finn

Many hair breeds of West African decent

- Aseasonal fertility is inversely related to the latitude unless selection pressure was exerted (i.e. Finn, Romanov, Dorset).
Cross breeding enhances aseasonal fertility:

**Heterosis and complimentarity**

Examples of crosses used in accelerated lambing:
- Romanov x Dorset
- Finn X Dorset
- Finn x Dorset x Ile de France x Romanov
- Finn x Dorset x Rambouillet

Composites:
- Rideau Arcott
- Polypay
Field Study to identify factors that influence aseasonal fertility

Two flocks chosen that share the same genetic background: Finn x Dorset with a trace of Romanov and Rambouillet.

Fertility average over 3 years

<table>
<thead>
<tr>
<th></th>
<th>April-June Mating</th>
<th>Sept.-Dec. Mating</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Fertility Flock</td>
<td>84%</td>
<td>92%</td>
</tr>
<tr>
<td>Low Fertility Flock</td>
<td>25%</td>
<td>87%</td>
</tr>
</tbody>
</table>

Supported by SARE (Sustainable Agriculture Research and Education)
## Ewe fertility and lambing percentage

<table>
<thead>
<tr>
<th></th>
<th>Low Fertility</th>
<th>High Fertility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fertility(^1):</strong></td>
<td>32%</td>
<td>92%</td>
</tr>
<tr>
<td><strong>Lambing Percentage(^2):</strong></td>
<td>133%</td>
<td>206%</td>
</tr>
</tbody>
</table>

\(^1\) Fertility expressed as ewe lambed/ewe exposed x 100%

\(^2\) Lambing Percentage expressed as lambs born/ewe lambed x 100%
Nutritional status of ewes at the start and end of the breeding season

Body weight

- **Low**
  - Start of breeding: 120 lbs
  - End of breeding: 140 lbs
- **High**
  - Start of breeding: 150 lbs
  - End of breeding: 160 lbs

**Statistics:**
- Flock: $P<0.001$
- Time: $P<0.001$
- Flock x time: $P<0.001$

Body condition score

- **Low**
  - Start of breeding: 2.5
  - End of breeding: 3.0
- **High**
  - Start of breeding: 3.5
  - End of breeding: 3.5

**Statistics:**
- Flock: $P<0.001$
- Time: $P<0.01$
- Flock x time: $P<0.001$
Comparison of energy requirements between annual and accelerated systems at 200% crop (expressed relative to maintenance, 1.0):

<table>
<thead>
<tr>
<th>Period</th>
<th>12 mo</th>
<th>8 mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>2wk pre-breeding</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>day 0-40 PC</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>day 40-115 PC</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td>day 115-term</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>day 0-40 lactation</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>day 40-60 lactation</td>
<td>1.9</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Energy nutrition during peak lactation (day 30) in 4 accelerated flocks during the winter rearing period

**Dietary energy concentration**

**Feed intake**

**Spring conception rate**

Forage quality as measured by fiber digestibility differed markedly between high and low out of season conception farms.
Nutritional management of accelerated lambing

• Critical aspect yet has received little study
• Important windows:
  ✓ Energy intake during lactation
  ✓ Energy intake during the breeding season
• Field observations indicate a link between energy intake during lactation and subsequent spring breeding success. Intake may be limited by:
  ✓ Neutral detergent fiber content and digestibility
  ✓ Starch content
CEPOQ-photoperiod control

- Nearly continuous production (4 groups)
- Alternating 4 month light intervals (16L/8D; 8D/16L)
- Overlapping 8 month system
- Optimizes ovulation rate and conception
- Limited grazing, mostly confinement
- Maximum production (3.78 lambs per/ewe/year!!)

Cameron et al. 2010; Journal of Animal Science 88: 3280-3290
Cyclic ewes, %

Day from start of SD photoperiod

Ram introduction

Extended day protocol:

• 60 days of 24 hrs light followed by 60 days of ambient lighting condition - turn in rams.
• 100 lux (10 FC) at ewe eye level (3.5 FC minimum)
• How I do it:
  ✓ Bring ewes in from winter pasture on Jan 5.
  ✓ Set lights to come on at dusk and off at dawn starting Jan 5.
  ✓ Ewes lamb Jan 25 - Feb 20
  ✓ Turn lights off on March 5, natural light thereafter
  ✓ Put in rams May 5.
Extended day: under evaluation...

Field application in 2008 with 300 ewe flock:

• No change of spring conception rate in aseasonal ewes (Finn x Dorset x Ile de France, n=140-182).
  ✓ 92% natural light (3 yr average [2005-7], n=132-186)
  ✓ 94% extended day (2008, n=182)

• Huge change in spring conception rate in seasonal ewes (purebred and ¾ suffolk ewes, ).
  ✓ 0% natural light (2 yr average [2006-7], n=13-17)
  ✓ 92% extended day (2008, n=16)
Extended day:

• Cost of $1.60/ewe/year for electricity use
• Bulbs cost $0.25/ewe/year
• Barn was lighted during winter lambing which created a stable environment for ewes and nice atmosphere for the shepherd

• *Will it overcome the negative effect of sub-par nutrition on spring conception?*
Hormonal therapeutics to insure successful out of season breeding and to tighten birth management:

- **Progesterone CIDRs**
  - FDA approved for use in sheep
  - 40-85% conception in spring

- **Melengestrol acetate (MGA) plus gonadotropin**
  - Not approved for sheep
  - Ceiling of ≈70% conception in spring as reported in commercial production in Canada
Ram “male” effect:

- Induces estrus in females “on the edge” of anestrus; synchronizes females that are naturally cycling
- 1 vasectomized male: 50 females
- Isolate females from males 30 days prior to exposure
- Introduce vasectomized males and remove 14 days later, females will exhibit estrus in two modes either 17-18 or 22-23 days following initial male exposure.

- Does it work on females that are deep in anestrus?

- IT IS A VERY GOOD SYNCHRONIZATION TOOL!
Male fertility:

• Male fertility and libido have a huge impact on the success of out of season breeding programs.

• How can you ensure that males are not limiting conception?
Ensuring male fertility:

• Feed males 1.4X maintenance for 3 weeks pre-breeding

• Perform breeding soundness exam
  ✓ Documents fertility but are all fertile males active breeders (have high libido)?

• Light priming: works well on all genotypes
  ✓ 120 day protocol: 30 d (16h L/ 8h); 30 d (8h D/ 16 L), 30 d (16h L/ 8h); 30 d (8h D/ 16 L) then introduce rams/bucks.
  ✓ Ensures high libido even in seasonal breeding rams/bucks
Accelerated: reduced birth interval with multiple birth periods

- **Pros**
  - Year-round supply: create new and build existing markets
  - Improve cash flow
  - Reduced market risk
  - Greater net income (per ewe, lamb, labor unit, enterprise)
  - Spreads labor out more evenly over the year

- **Cons**
  - Higher level of management: nutrition, reproduction, health
  - Requires a winter lambing period and facilities
  - Steady labor requirement
  - Requires higher quality forage (grazing or machine harvested)
Factors to consider in choosing accelerated production:

1. Land value: accelerated production systems are well suited for higher value, more productive land.
2. Genetics: aseasonal genetics are key, light control protocols reduce risk.
3. Can you buy or produce high quality forages?
4. Investment: accelerated production requires a greater initial investment (indoor lambing facility, feeding infrastructure) however the higher productivity creates lower fixed cost/lamb produced when depreciated over time.
5. Labor: accelerated production evens labor over the year but is a steady requirement.
6. Management benchmarks: If your annual program cannot attain >1.3 lambs marketed/ewe, it is unlikely that accelerated production will be a profitable option.
Accelerated lamb production: an opportunity to build markets and increase production efficiency

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Host/Moderator: Jay Parsons

September 23, 2014

This webinar is being offered in cooperation with the American Sheep Industry Association Rebuild the Sheep Inventory Committee.
Consequences of poor out-of-season breeding success:

<table>
<thead>
<tr>
<th>Program</th>
<th>Conception</th>
<th>Breeding Season</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Total 2 years</th>
<th>Relative to Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Jan</td>
<td>May</td>
<td>Sept</td>
<td>Jan</td>
<td>May</td>
</tr>
<tr>
<td>Accelerated</td>
<td>Excellent</td>
<td>0.93</td>
<td>0.92</td>
<td>0.90</td>
<td>140</td>
<td>148</td>
</tr>
<tr>
<td>Accelerated</td>
<td>Average</td>
<td>0.93</td>
<td>0.90</td>
<td>0.67</td>
<td>140</td>
<td>144</td>
</tr>
<tr>
<td>Accelerated</td>
<td>Poor</td>
<td>0.93</td>
<td>0.90</td>
<td>0.35</td>
<td>140</td>
<td>144</td>
</tr>
<tr>
<td>Accelerated</td>
<td>Poor adjusted</td>
<td>0.93</td>
<td>0.90</td>
<td>0.35</td>
<td>140</td>
<td>144</td>
</tr>
<tr>
<td>Annual</td>
<td>Excellent</td>
<td>0.93</td>
<td></td>
<td></td>
<td>279</td>
<td>279</td>
</tr>
</tbody>
</table>