Gilt Nutrition and Reproductive Management are Critical

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History . . .

+ Improved efficiency of pork production
  - 30% leaner
  - 25 p/s/y
+ Changes
  - Health, stockmanship, business management, facilities
  - Genetics
  - Nutrition
+ Can we become even more efficient?

If so, then . . .

+ Know how to take care of the modern sow
  - Maternal lines
    □ Prolific (NASS)
    □ Lean (Long, 1998)
    □ Less appetite
    □ ↑ removals (PigCHAMP, 2000)
    » Cull - 43%
    » Dead - 5.9%
    » Average parity - 2.6

Development begins at birth

+ Identification - ear notch, tattoo, tag
+ Gilts from litters with:
  - Large NBA
  - No abnormalities
  - Majority of gilts → more fertile as sows
+ Gilts reared in smaller litters tend to be more fertile cross-foster-off barrows

Development begins at birth

+ Dams with:
  - Early puberty
  - Little or no farrowing difficulties
  - Good disposition
  - Healthy udder
+ Keep notes
+ Retain 300%

Nursery

+ No “nursery” gilt development × reproduction research
+ So recommendation is to maximize growth
  - Little or no mixing
  - Typical nursery diets
  - Do not crowd
  - Group size??
+ Retain 200 to 250% when moving out of the nursery
**Grow-finishing**

**Impact on puberty**
- Stocking density
  - #/pen ??
  - #/gilt ??
- ↓ age at puberty
  - Crowding ↓ growth
  - Excessive pit gases
  - Darkness
  - Disease - ileitis
  - Parasites

- Relocation
  - Indoor to outdoors at 70 to 120 d hastens puberty
  - Not if done in extreme heat or cold
  - Indoor to other indoor pens at 70 to 120 d less effective
- Do not need to have male contact
- Nutrition
  - Not related to body composition
  - Very severe, in essence starvation

**Impact on sow performance (e.g. w-t-e, locomotion, litter size and litter growth)**
- Environmental or managerial factors??
- Nutrition . . .

**Variation in gilt genotypes**

<table>
<thead>
<tr>
<th>Line</th>
<th>Wt, lb</th>
<th>Backfat, mm</th>
<th>ADG (lb)</th>
<th>Age (d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>238</td>
<td>21.6</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>234</td>
<td>23.6</td>
<td>1.59</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>232</td>
<td>22.4</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>248</td>
<td>24.9</td>
<td>1.63</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>242</td>
<td>19.8</td>
<td>1.63</td>
<td></td>
</tr>
</tbody>
</table>

U of MN at P1 Farrowing (H.Yang, 1998)
Camborough 22
- Lowest Line
  - 364
  - 15.8
  - 329

- Highest Line
  - 424
  - 25.4
  - 370

Michigan State University at Puberty (Lyvers, 2000)

<table>
<thead>
<tr>
<th>Y x L</th>
<th>Retained</th>
<th>Culled</th>
</tr>
</thead>
<tbody>
<tr>
<td>306</td>
<td>17.6</td>
<td>195</td>
</tr>
</tbody>
</table>

**Effect of G-F backfat depth on sows to 4th parity**

<table>
<thead>
<tr>
<th>Backfat thickness at 220 lb (mm)</th>
<th>Retention rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 14</td>
<td>28</td>
</tr>
<tr>
<td>14-16</td>
<td>36</td>
</tr>
<tr>
<td>16-18</td>
<td>39</td>
</tr>
<tr>
<td>18-20</td>
<td>40</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>46</td>
</tr>
</tbody>
</table>

Adapted from Gueblez et al., 1985

**Body condition at first breeding and longevity**

<table>
<thead>
<tr>
<th>Item</th>
<th>Retained</th>
<th>Culled</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of sows</td>
<td>53</td>
<td>34</td>
</tr>
<tr>
<td>Age, d</td>
<td>202.5</td>
<td>210.4</td>
</tr>
<tr>
<td>Backfat depth, mm</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Live weight, lb.</td>
<td>231.3</td>
<td>240.0</td>
</tr>
</tbody>
</table>

Rozeboom and coworkers (1996)


Supported by Kirkwood et al., 1988; Young et al., 1990; Newton and Mahan, 1993; Long, 1998
Grow-finishing

Nutrition methods studied to-date
- Restrict feed intake
- Altered energy:protein density
  - Moderate protein-high energy
    » 1.9 to 2.1 g lysine per Mcal ME
    » Add dietary fat
  - Encourage fat deposition
  - High protein-moderate energy
    » 2.2 to 3.0 g lysine per Mcal ME
    » Limit fat deposition
- Stair-step compensatory growth

Restricting rearing intake and locomotive failure in gilts

- Decrease
  - Kirchgessner et al., 1984; Nielsen and Danielsen, 1984; Snoeyen, 1979 and van Erp, 1980 (later ↑ sow culling)
- No change
  - Simmins et al., 1994 (later ↑ sow culling, ↓ fertility)
  - Jørgensen and Sørensen, 1998 (later ↓ sow culling through 12P, 25% verses 46% culled for locomotive failure for restricted and ad libitum, excessive culling of sows for locomotive failure
  - LeCozler et al., 1999 (later ↑ sow culling)

Performance of gilts fed one of three dietary regimes from 180 to 250 lb (Ad Lib), or from 180 lb to 180 d (4 lb/d)

<table>
<thead>
<tr>
<th>lysine level</th>
<th>Weight at 180 d, lb.</th>
<th>Backfat at 180 d, mm</th>
<th>Number born alive parity one</th>
<th>Average NBA parity 1 to 4</th>
<th>Stayability thru 4 parities, %</th>
<th>% of gilts at 180 d completing 4 parities</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.95% lys</td>
<td>247</td>
<td>1.48 Mcal/lb</td>
<td>8.99</td>
<td>10.03^</td>
<td>19.4</td>
<td>35a</td>
</tr>
<tr>
<td>0.6% lys</td>
<td>248</td>
<td>1.58 Mcal/lb</td>
<td>9.16</td>
<td>10.36^</td>
<td>56b</td>
<td>55b</td>
</tr>
<tr>
<td>1.31% lys</td>
<td>221</td>
<td>5.8 Mcal/kg</td>
<td>9.36</td>
<td>10.28^</td>
<td>30</td>
<td>19.4</td>
</tr>
</tbody>
</table>


Grow-finishing

Caution: if lysine-to-energy ratio too low
- Cia et al., 1998
  - 1.3 g lys per Mcal ME(0.46% lys)
- Fed until breeding
  - Less estrus
  - Decreased ovulation rate
- Consider housing and season

Stair-step compensatory growth (SSCG) during rearing

<table>
<thead>
<tr>
<th>Period</th>
<th>Weeks</th>
<th>Control</th>
<th>Moderate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>A max</td>
<td>B moderate</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>A max</td>
<td>A max comp</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>C max</td>
<td>D moderate</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>E max</td>
<td>E max comp</td>
</tr>
</tbody>
</table>

Lyvers-Peffer and Rozeboom, 2001
Diets fed during the four pre-pubertal feeding periods

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Diet</th>
<th>Diet</th>
<th>Diet</th>
<th>Diet</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>Corn</td>
<td>62.20</td>
<td>36.20</td>
<td>71.95</td>
<td>39.57</td>
<td>75.87</td>
</tr>
<tr>
<td>Sunflower hulls</td>
<td>35.00</td>
<td>35.00</td>
<td>35.00</td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>Soybean meal, 44%</td>
<td>30.26</td>
<td>22.42</td>
<td>20.56</td>
<td>19.26</td>
<td>17.96</td>
</tr>
<tr>
<td>Mon-dical-phos, 21% P</td>
<td>2.07</td>
<td>2.73</td>
<td>1.98</td>
<td>2.52</td>
<td>1.74</td>
</tr>
<tr>
<td>Ground limestone</td>
<td>.84</td>
<td>.55</td>
<td>.81</td>
<td>.55</td>
<td>.83</td>
</tr>
<tr>
<td>Choice white grease</td>
<td>1.50</td>
<td>1.50</td>
<td>3.00</td>
<td>1.50</td>
<td>2.00</td>
</tr>
<tr>
<td>MSU vitamin premix</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
<td>.60</td>
</tr>
<tr>
<td>MSU TM premix</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>Salt</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
<td>.50</td>
</tr>
<tr>
<td>L-lysine HCl, 78.8%</td>
<td>-</td>
<td>-</td>
<td>.10</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Effect of SSCG regimen on average gilt weight

SSCG and P1 lactation feed intake

SSCG and P1 litter weights, lb

SSCG and culling

Grow-finishing

+ Zearalenone
  * Delays puberty and interrupts cycle,
  * Normalize 3 to 4 weeks after removal
+ Retain 170 to 200%
  * Mammary, genital, and structural soundness
Acclimation, Isolation, Quarantine

+ When to move?
  - 4 to 5 months
  - 5 to 6 months of age

+ Identify puberty and estrus cycles
  - Age viewed as indicator of subsequent fertility
  - Cull if no puberty by 7.5 months of age.

+ Factors influencing occurrence of puberty
  - Genetics
    - Crossbred earlier
    - $h^2 = 25$ to 35%
  - Seasonal
    - Fall born earlier
    - Poor lighting
  - Confinement and crowding
    - 10-12 ft²/gilt
  - Disease, parasites and mycotoxins

Acclimation, Isolation, Quarantine

+ Stimulation
  - Moving to new location (possibly indoor to outdoor)
  - Mixing with new pen mates
  - Mix with sow(s) in estrus
  - Boar exposure
    - Older boars are more effective than younger boars, but may injure young gilts
    - Direct boar contact better than fence-line
    - Boar stimulation 2 times per day, 10 to 15 minutes
    - House boars away from gilts, down wind
    - Rotate boars

Acclimation, Isolation, Quarantine

+ Age of gilt is important
  - Gilts < 140 d of age take longer to reach puberty if stimulated
  - Gilts from 185 to 200 d of age respond quickly and uniformly - Synchronization.
  - Best to combine moving, mixing, and boar exposure together

Acclimation, Isolation, Quarantine

+ Characteristics of estrus in the gilt
  - Hesitant - sometimes takes 20 to 30 minutes, flanking
  - “Fright and flight”
    - Boar
    - Stockperson
  - Refractory quickly
  - Short - 24 hours maximum

Acclimation, Isolation, Quarantine

+ PG 600™
  - Pregnant mare’s serum gonadotropin [PMSG] + Human chorionic gonadotropin [HCG]
  - Prepubertal gilts; not cycling
  - Single injection 5 mL IM
  - Estrus in 50 to 80% of gilts 3 to 10 days later
  - Few gilts (up to 15%) may not ovulate normally
  - Pregnancy rates 60 to 90%
  - Recommend not breeding on first estrus post-injection
Acclimation, Isolation, Quarantine

- **Regumate™**
  - Altrnogest - progesterone-like compound
  - Extends diestrus until product is withdrawn
  - Feed minimum of 14 d
  - Estrus occurs 3-5 days later
  - Use in cycling gilts only
  - Off-label prescription only in U.S.; Canada and Europe legal
  - Observe all precautions

Acclimation, Isolation, Quarantine

- Time to change body condition
  - Full feed lean gilts
    - Increased energy
    - Decrease amino acid concentration
    - Make fatter
  - Limit feed "average-lean" gilts
    - Avoid “too” fat
  - Vitamin E 30 IU/lb

Acclimation, Isolation, Quarantine

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>↑ fatness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning weight, lb</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>Beginning backfat, mm</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Dietary DE Mcal/lb</td>
<td>1.41</td>
<td>1.41</td>
</tr>
<tr>
<td>Lysine %</td>
<td>0.75</td>
<td>0.45</td>
</tr>
<tr>
<td>Backfat change allocation to service, mm</td>
<td>2.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Weight change allocation to service, lb</td>
<td>97.4</td>
<td>101.0</td>
</tr>
<tr>
<td>Backfat change service to farrow, mm</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Weight change service to farrow, lb</td>
<td>133.6</td>
<td>123.7</td>
</tr>
<tr>
<td>% completing 3 parities</td>
<td>70</td>
<td>83</td>
</tr>
</tbody>
</table>

Gilt pool - breeding

- Flush limit-fed gilts prebreeding
  - Ad-lib intake for 10 to 14 days to normalize ovulation rate (OR)
- Not superovulation; only normalizes OR
  - Superovulation achieved using PMSG alone and repeated; possibly insulin injections

Gilt pool - breeding

- Ovulation rate = potential litter size
  - Related to Breed; White > Duroc > other colored breeds
  - Can select for it, moderately heritable
  - Changes with sexual age
  - Increasing from puberty to 4th estrus
  - Greatest increase from first to second estrus, less from second to third
  - Interaction with physiologic age, increase less if gilts are older at puberty

Gilt pool - breeding

- Not recommended to breed at puberty
- Time depends on age, sexual age (estrus number), weight and backfat
- If older at puberty (185 to 200 d), breed on second or greater estrus
- If younger at puberty (160 to 180 d), breed at third or greater estrus

O’Dowd et al., 1997
Targeted body condition
- With excellent P1 feeding in gestation and lactation, gilts can be bred at 200 to 210 d of age, 260 to 280 lb, and 15 to 20 mm backfat
- Otherwise wait until 220 to 260 d of age, 300 lb and 20 to 25 mm of backfat

<table>
<thead>
<tr>
<th>P2 Fat recovery, mm</th>
<th>Feeding protocol (d 30 to 90 of gestation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>60 d at 7.5 lb/d CSBM</td>
</tr>
<tr>
<td>4</td>
<td>60 d at 6.2 lb/d CSBM</td>
</tr>
</tbody>
</table>

Pool size
- # of culls
- # of recycles
- Seasonal adjustment
- Cost
  - Feed: 5 lb/d x $0.05 x 30 d = $7.50
  - Facility and variable: 30 d x $0.20/d = $6.00
  - Labor: 30 d x $0.10/d = $3.00

Pool size
- Grow-finish 200 to 250%
  - 25 to 35% of gilts will be culled in G-F because of poor growth and structure
- Acclimate about 170% of what is needed
  - 20 to 25% of gilts no puberty, irregular cycles, illness, injury, culled
- Breed about 130% of what is needed
  - 15 to 30% of gilts bred will not farrow