Value of Cross-Breeding and Genetic Improvement for the Producer

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The Canadian Pork Industry
- $2.2 billion in pork exports in 2001
- $560 million more in live exports
- 26 million hogs produced in 2001, a 70% increase since 1991
- Efficient production of high quality pork gives Canada a competitive edge
- Genetic improvement is the cornerstone

Getting the Most From Genetics
1. Use a good genetic source
2. Minimize genetic lag
3. Take advantage of cross-breeding

1. A Good Genetic Source
- Should have a history to demonstrate long-term genetic improvement
- Current genetic improvement program should be creditable and provide evidence of rapid progress
- A decent program will make commercial operations more efficient by at least $1.50 per hog every year ($15 per hog in 10 years)

2. Minimize Genetic Lag
- Every year behind costs $1.50 per hog
- Five years is $7.50 per hog
- Ten years is $15 per hog ($300/sow)

3. Advantage of Cross-Breeding
- Cross-bred sows and hogs have hybrid vigor
- F1 sows are 20 to 30% more productive than purebreds
- Hybrid hogs survive better and grow faster
- Parents must be different breeds to get full advantage e.g. York-Land sow, Duroc sire
Example of a Good Program
Canadian Swine Improvement Program

- Effective selection since the 1970s
- BLUP since mid-1980s, first in the world
- 3 geneticists on staff nationally, supported by Canadian PhDs from coast to coast
- 9,000 nucleus sows (York, Landrace, Duroc)
- 90,000 pigs tested per year
- 125 breeders and companies across Canada

Genetic Improvement for Growth
Duroc X Yorkshire-Landrace Averages

Genetic Improvement for Lean
Duroc X Yorkshire-Landrace Averages

Genetic Improvement for Litter Size
Yorkshire-Landrace Averages

Value of Genetic Improvements in Litter Size and Hog Performance

Sows are about $300 per year more productive today than 10 years ago due to genetic improvements for growth, efficiency, lean yield, and litter size.
The Effect of Hybrid Vigor*

<table>
<thead>
<tr>
<th>Trait</th>
<th>Heterosis level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dam heterosis</strong></td>
<td></td>
</tr>
<tr>
<td>Conception rate</td>
<td>+3%</td>
</tr>
<tr>
<td>Litter size at birth</td>
<td>+0.66 pig</td>
</tr>
<tr>
<td>Litter size at weaning</td>
<td>+0.84 pig</td>
</tr>
<tr>
<td>Litter weight at 42 days</td>
<td>+15.0 kg</td>
</tr>
<tr>
<td>Litter size at birth</td>
<td>+0.24 pig</td>
</tr>
<tr>
<td>Litter size at weaning</td>
<td>+0.49 pig</td>
</tr>
<tr>
<td>Litter weight at 42 days</td>
<td>+13.35 kg</td>
</tr>
<tr>
<td>Post-weaning growth</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

* The Genetics of the Pig, 1998

Effect of Crossbreeding
P.E.I. Commercial Herds

What’s in Your Sows?

- F1 (2 separate breeds eg. York x Land): maximum heterosis;
- Backcross or F2 (eg. gilts from York X F1): ½ heterosis;
- 2 breed rotational (alternate York and Land): 2/3 heterosis;
- “F1” from 2 synthetic lines: depends if same breeds used in both;

Genetic Improvement for Commercial Producers

<table>
<thead>
<tr>
<th>Traits</th>
<th>Current Genetic Gain per Year</th>
<th>$/sow/year*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter size (pigs)</td>
<td>0.2</td>
<td>$10.87</td>
</tr>
<tr>
<td>Lean yield (%)</td>
<td>0.14</td>
<td>$3.61</td>
</tr>
<tr>
<td>Growth rate (days)</td>
<td>1.5</td>
<td>$8.91</td>
</tr>
<tr>
<td>Feed Conversion</td>
<td>0.022</td>
<td>$9.09</td>
</tr>
<tr>
<td>Total per year</td>
<td></td>
<td>$32.48</td>
</tr>
<tr>
<td>Total over 5 years</td>
<td></td>
<td>$162</td>
</tr>
</tbody>
</table>

* Duroc sires, Yorkshire X Landrace sows, 20 pigs/sow/year

Benefits Due to Selection

- benefits are cumulative (added year after year);
- most benefits accrue through better production efficiency (reduction in costs);
- benefits from higher carcass value are comparatively smaller (increase in revenue).

Costs and Benefits From Selection and Crossbreeding Example

- herd of 500 sows;
- uses CSIP Duroc sires and York x Land sows;
- value of weaned pig (minus cost): $30;
- Benefits from maximum hybrid vigor: 1 extra pig per litter, 10 days faster to market
- Ignore other benefits to keep it simple
- cost of replacing gilts (over market price): $140
### Annual Benefits From Cross-breeding and 5 Years of Selection

- **crossbred females:** $33,000  
  500 x 2.2 x $30/pig
- **crossbred pigs:** $27,000  
  10,000 pigs x 10 days x $0.27/day
- **selection (CSIP data):** $81,000  
  500 x $162/sow
- **total** $141,000  
  $282/sow

### Cost of Compromise

#### 500 sow herd example

- Reduce genetic replacement costs by 50% eg. buy half as many F1s and keep some “F2”s using terminal Yorkshires
- Lose 1/3 of hybrid vigor =.3 pigs/litter, 3 days to market ($20,000)
- Increasing genetic lag ($5,000 in first year increasing to $16,000 in 5th year)
- In year 5, loss is $36,000 or $72/sow

### Is This For Real?

- Look at Quebec example
- CDPQ monitors large numbers of commercial herds (180,000 sows in 2001)
- Productivity improvements have been large due to management improvements
- Recent genetic improvements in litter size are adding even more benefit

### Commercial Trends in Quebec Litter Size

*Source: CDPQ 2003*
Commercial Trends in Quebec
Pigs per sow per year*

Producing Your Own Gilts
Why?
- Biosecurity – a good reason
- Save money – not a good reason
  - It costs something to maintain and improve the nucleus
  - It costs more if you don’t keep up to date
    ($1.50 per hog after 1 year, $3 after 2 years, …)

Producing Your Own Gilts
Option 1: In-herd nucleus
- Maintain and improve your own nucleus
- Breed purebred replacements
- Must become a breeder as well as a producer
- Not practical for most producers
  - Need a large number of purebreds, expertise and extra work – otherwise purebreds will not improve fast enough

Producing Your Own Gilts
Option 2: In-Herd Multipliers
- For every 100 commercial sows, approximately 10 pure multiplier sows
- Example, purchase Yorkshire purebreds and breed them to Landrace AI boars
- Must bring in new Yorkshire female replacements from time to time

Producing Your Own Gilts
Option 3: Rotational Breeding
- For every 1000 commercial sows, approximately 100 multiplier sows
- Select best commercial sows as multipliers and cross to Yorkshire AI sires
- Next generation, cross best sows to Landrace AI sires, then back to York, …
- Lose 1/3 of hybrid vigor in sows, but can reduce lag while keeping herd closed

What Boars (Semen) Should You Use?
- There is maximum heterosis on market pigs when the boars are of a different breed or breeds than those for your commercial sows (e.g. Duroc semen on York x Land sows);
  - Heterosis affects litter size (+.5 weaned) and growth rate of market pigs (increase of about 7%);
Other Benefits From Genetic Improvement

- Some benefits are long-term or harder to quantify:
  - Meat quality;
  - Conformation/longevity;

- Molecular vs quantitative genetics
  - Halothane gene;
  - RN gene;
  - Others.

What Can Genetic Improvement Do for the Commercial Producer?

- Good herd management (health, feeding, etc.) is required to take full advantage of improved genetics;
- Genetic improvement is a slow but regular process: it does not “jump at you” like a disease outbreak or a big improvement in feeding, but it will put money in your pocket year after year;
- The benefits are substantially greater than the costs.

Conclusions

1. A good genetic source will increase profitability by at least $1.50 per hog or $30 per sow every year

Conclusions

2. Genetic improvement is cumulative, so it’s very important to keep up. Genetics that are 5 years behind cost you at least $7.50/hog or $150/sow every year.

Conclusions

3. Maximize the benefits of cross-breeding. If you are getting only 50%, it costs 15 to 20% in lost productivity, piglet survival and performance. This could be easily worth $50 per sow.

Genetics For the Producer

- Genetic improvement really works, but…you need to know where to get it and how to use it:
  - A good source
  - Minimum genetic lag
  - Maximum hybrid vigor
- Not taking advantage is very costly
- You need it to stay competitive