Genetic Improvement of Feed Efficiency in Swine Herds

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Goal is Production of a High Quality Product at a PROFIT

- Profit means: \( \text{Return} > \text{Cost} \)
- \( \text{Return} \) is based on number of pigs marketed, weight of pigs, value of each pig, marketing expertise, cull sow sales

Recent Economic Trends

- Since 2000 (USA):
  - 5-6 years of very good profits,
  - 2-3 years of large losses

Recent Economic Trends

- Since last year:
  - Feed costs and energy have gone up by 100%
  - Other costs have increased, not as much
  - These increases probably won't go away

Current Profit = Major Loss

- Current return vs cost (USA):
  - 2008: \( \text{Return} < \$110/\text{pig}, \text{cost} > \$145/\text{pig} \)
  - Future
    - Input costs will not go down much
    - Market return will be higher
**What Does Producer Do?**

- Maximize pig flow
  - Improve reproduction through both management and genetics
- Minimize feed costs
  - Terminal sire lines focus more on FCR
  - Include FCR in maternal line selection
- Reduce Non-Productive Sow Days
  - Management and genetics

**Genetic Improvement of Feed Efficiency**

- Methods to make genetic improvement
- Selection
  - Measure performance and keep the best
- Migration
  - Identify animals from outside that are superior and bring them into your herd
  - Live animals or AI

**Import from the Best Genetic Merit Population**

- Large number of purebred GGP animals
- National program to identify where the genetically superior animals are within the population
- Demonstrated genetic improvement in the economically important traits

**National Program to Identify the Genetically Superior Animals**

- One example is STAGES = Swine Testing and Genetic Evaluation System
- Program of “across-herd” genetic evaluation
- Largest, most accurate national genetic evaluation program in the world

**Improving Feed Efficiency Through Selection**

- Select terminal breed with proven superiority for high growth rate and excellent feed conversion
- Duroc

**Potential Feed Savings Terminal Sire Selection on FCR**

- Heritability = 0.30
  - Moderate, will respond to selection
- Selection for fast growing, lean pigs
  - Results in improved feed efficiency
- Genetic markers for feed efficiency
Genetic Trend - Durocs
Feed Efficiency

Genetic Trend – Yorkshires
Feed Efficiency

Feed Efficiency
SGI - DUROC

<table>
<thead>
<tr>
<th>SGI CODE NUMBER</th>
<th>BOAR NAME</th>
<th>FE EBV Lb Per 100 Lb Gain</th>
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<tr>
<td>1332</td>
<td>YELLOW JACKET</td>
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<td>1290</td>
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Feed Efficiency
SGI - YORKSHIRE

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<tr>
<td>2448</td>
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<td>2452</td>
<td>KING DAVID</td>
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<td>2439</td>
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Feed Efficiency
SGI - LANDRACE

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<td>3349</td>
<td>CHOIKO</td>
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<tr>
<td>3324</td>
<td>IZUMI</td>
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Economic Potential
For Feed Savings

- Base feed conversion = 2.80
- Weight range 15# → 265# = 250 #
- Duroc EBV = -8.00 (#feed/100#gain)
- Transmits ½ of BV to each pig sired
**Economic Potential For Feed Savings**

- Transmits ½ of BV to each pig sired
- Feed savings per pig = 8 * ½ * 2.5 cwt
  - 10 # feed * $0.20/# = $2.00 / pig
- Translate that to savings/sow/year
- 20 pigs marketed/sow/year
- 20 * $2.00/pig → $40/sow/year

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**Economic Potential For Feed Savings**

- 20 pigs marketed/sow/year
- 20 * $2.00/pig → $40/sow/year
- If a 1000 sow herd,
  - Savings = $40,000 per year
- If a 10,000 sow herd,
  - Savings = $400,000 per year

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**Maternal Line - Genetic Improvement in Feed Efficiency**

- Include Feed Efficiency in the Maternal Line Index used for selection

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**SGI 2446 BIG THUNDER**

**EPDs INDEXES**

- Days -5.08
- NBA 0.43
- MLI 125.9
- Feed Efficiency -7.01
- LWT 6.81
- SPI 116.1

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**SGI 3345 PIKKUS**

- Sire Currently No. 1 Sire in U.S. – SPI and MLI
- Grand sire Was No. 1 Sire For Many Years – SPI and MLI

**EPDs INDEXES**

- Days -0.6
- NBA 0.8
- MLI 122.6
- Feed Efficiency -2.85
- LWT 4.5
- SPI 119.4

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**Maternal Line - Genetic Improvement in Feed Efficiency**

- Consider selection for Non-Productive Sow Days in maternal breeds
  - Yorkshire
  - Landrace

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Lower Feed Costs By Improving Reproduction Through Selection

- **Costs** to maintain the sow herd
- **Costs** to get the sows pregnant
- **Return** is from number of viable pigs weaned

Improve Reproduction Through Selection

- Which traits (of **cost** or **return**) have adequate genetic qualities to respond to selection?

Traditional Selection

- Focused on traits that are associated with outputs from the sow and her litter (**return**)
  - Litter size
    - Number born alive or Total number born
  - Litter weaning weight
  - Growth rate

Traditional Selection

- Need to expand our selection opportunities to traits that relate to the **cost of production**, if possible

Basic Unit of Cost: Breeding Female Days

- Once a female enters the herd inventory, she starts to accumulate ‘Breeding Female Days’
- Those days where she is pregnant with a successful litter are ‘Gestation Days’ that are also defined as ‘Productive Days’

Basic Unit of Cost: Breeding Female Days

- Those days where she is lactating are ‘Lactation Days’ and are also ‘Productive Days’
- All others are ‘Non-Productive Days’
**Breeding Female Days Accumulation**

- Entry
- Service
- Farrow
- Wean
- Service
- Removal

**Factors Influencing PWSY**

- Pigs weaned/sow/year
- Pigs weaned litter (NBA – PWM%)
- Cross-foster Pigs?
- Litters/sow/year
- Non productive sow days
- Gestation Length
- Lactation Length
- Farrowing Rate

**Components of LSY**

- Entry to first service interval (Decision)
- Farrowing rate (Confounded)
- Gestation length (little variation)
- Lactation length (Decision)
- Weaning to first service interval ($h^2 = .2$)
- Culling to removal interval (Decision)

**Questions:**

- How are LSY distributed?
- Will the variance component composition support genetic progress via selection?
Decrease Feed Costs - Selection for Non-Productive Sow Days

- Improve LSY by one genetic standard deviation
  - 0.2 increase in LSY = saves 23 Non-Productive sow days
  - 23 Non-Productive Sow Days ~ 100# feed
    - 100# feed = $20 per sow per year
    - $20/sow/year = $1/pig marketed/year
    - 1000 sow herd = $20,000

Terminal Cross Mating System

- Purebred animals are the basis (starting point) for all genetic programs
- There are different breeds of purebred swine that have been developed for different purposes
  - White breeds (for maternal purposes)
  - Colored breeds (for paternal purposes)

Advantages of a Terminal Cross Mating System

- Heterosis
  - you can increase the pounds of pork marketed per sow per year by +40% using an efficient terminal cross mating system
- Specialized sire and dam lines

Terminal Cross Mating System Sire and Dam Lines

- Use animals of maternal breeds for the sow lines
  - Landrace, Large White
- Use animals of sire breeds for the boar lines
  - Durocs
What is Heterosis?

- Heterosis is the increased performance of crossbred animals (above the average of their parents) because the parents are of different breeds.

Heterosis Levels

- Litters/sow/year = +18%
- Litter size = +8%
- Preweaning mortality = -5%
- Growth rate = +5%
- Pounds product/sow/year = +40%

Potential Management Areas To Improve Feed Efficiency

- Ration Formulation
- Ration Preparation
- Feeder Type & Management
- Sow Management
- General Management Practices
- Housing & Environment
- Health Program
- Market Weight

Use Of Crystalline Amino Acids

- Can Substitute Lysine for up to 2% of Crude Protein In Ration From Soybean Meal
- Above This Level Will need Other AA Acids
  - Methionine (Young Pig), Typtophan, Threonine
With High Feed Costs

- Balancing Ration More Important Than with Low Feed Costs
- Unbalances Result in Higher Feed Per Gain
  - Make Sure Mixers Are Mixing Properly
  - Check Scales that Measure Ingredients for Accuracy
- Know Nutrient Content of Substitute Ingredients

Feed Preparation

- Particle Size
  - Decreasing Particle Size when Grinding Corn
    - From 750 to 600 Micrometer will Improve Feed Efficiency
  - Should Not Cause Ulcer or Dust Problems at this Particle Size
  - Check Mills to Insure They are Producing Proper Particle Size

Pelleted Rations

- Improves Nutrient Availability
  - Results in Better Feed Efficiency
- Less Feed Waste
- In U.S. Practical to Pellet if Cost in $5 to $7 Range per Ton

Feeder Type And Management

- Adjust Feeders to Prevent Waste
- Never Allow Feed Outage
- Clean Feeders (corners) Daily
- Use of Wet-Dry Feeders
  - Reduces Feed Wasteage, increases consumption
  - Increase Palatability
  - Better feed conversion

Split Sex Penning and Split Sex Feeding

- Barrows are more aggressive than gilts
  - Male aggressiveness will retard the growth of gilts if penned together
  - Protein Requirements Higher for Gilts
  - Barrows Grow Faster

Split Sex Penning and Split Sex Feeding

- Separate penning will result in faster growth rate, better feed conversion and lower mortality rates at virtually no cost
- Split sex feeding requires investment
  - Dual feed lines in barn, or
  - Single sex barns
Add More Phased Rations

- Pigs' nutritional needs change from weaning to marketing
- The more rations are fed, the more closely each ration will meet the needs of the pigs
- Compare feeding programs of 3 grow finish rations versus 6 grow finish rations

Add More Phased Rations

- With less nutrient wastage, the feed conversion will be better
- It does take more management to increase the number of rations fed

Sow Management

- Target sows' nutrient requirements to maintain constant body condition
  - Very inefficient to gain body condition during gestation
  - And lose body condition during lactation
There Are Differences In Requirements By Parity

- Gilts & Young Sows Require Higher Protein and Energy Levels
- As Sows Become Older & Energy Requirements Lowers
- Need Higher Density of Micronutrients • Vitamins, Minerals

Sow Longevity Very Important

- Takes investment to get gilt into production
- Sows produce more pigs than gilts
- Use feet/leg soundness in gilt selection
- Housing – Flooring – Penning to Prevent • Injury or Death
- Proper Breeding Management

Proper Sow Culling Also Important

- Remove Low Producers
- Remove Open Sows Quickly ● Real-time Ultrasonic for Pregnancy Checking
- Get Gilts into Production ● Estrus Synchronization • AI Max - Matrix

Herd Health

- Probably Major Factor in Determining Your Feed Requirement Per Unit Gain ● Prevent Death Loss of Sows and Pigs ● Vaccinate to Control Disease
- Maintain High Sanitation & Bio-security
- Don’t Cut Corners on Health Inputs Just Because Feed Cost High and You are Losing Money on Each Pig Marketed You Only Lose More

Herd Health

- Practice Timely Euthanasia ● Poor performing pigs do not make a profit ● Humanely euthanize ● Sort nursery pigs aggressively before moving to finishing
Market Weight

- Feed conversion gets worse as pigs get heavier
- In general, market at lighter weights
- When feed costs get extremely high
- Have to balance cost of extra gain with market price of heavier weight

Cost Of Gain

<table>
<thead>
<tr>
<th>Cost Feed/ Lb</th>
<th>Feed/ Gain</th>
<th>Cost/ lb</th>
<th>Cost/ kg</th>
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<tr>
<td>0.10 Previous</td>
<td>3</td>
<td>$0.30</td>
<td>$0.66</td>
</tr>
<tr>
<td>0.20 Now</td>
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Computerized Sow Management Programs

- Good production records are essential to the efficient management of the pig farm.
- Computerized production records are essential to maximize your profits.
- Key to identifying non-productive sows
  - And reducing non-productive sow days

Computerized Sow Data Management

- Breeding herd management.
  - Sow and boar inventories with details for each animal.
  - Accurate evaluation of reproductive performance.
    - sows, boars, ai technicians, genetic types, sires, parities, facilities
    - time frame summaries and analysis
    - data extraction for analysis

Management Software

- Post-weaning performance.
  - Growth rates, feed costs, mortalities, feed conversion (by groups of animals).
  - Feed usage, formulation, costs.
  - Facilities performance comparisons.
  - Multiple herd comparisons.
Diagnosis of Problems is First Step to Solutions

- Diagnostic capabilities.
  - Reproductive traits
    - Farrowing rates, litter sizes, pig mortality
  - Post-weaning traits
    - Death losses, growth rates, feed conversion.
  - Data extraction
    - For all sow and boar records to assist in diagnostics.

Reproductive Areas to Analyze

- General reproductive efficiency
- Boar fertility
- Sow reproduction
- Reproductive management

General Reproductive Efficiency

- Breeding performance
- Farrowing performance
- Weaning performance
- Population information

Breeding Performance

- Total number of services
- Percent repeat services
- Percent multiple matings
- Weaning to 1st service interval
- Percent bred by 7 days
- Entry to 1st service interval

Farrowing Performance

- Number farrowed
- Avg. parity farrowed
- Number born alive
- % stillborns
- % mummies
- Farrowing rate
- Farrowing interval
- Litters/sow/year

Weaning Performance

- No. litters weaned
- No. pigs weaned
- Pigs weaned/sow
- Pre-weaning mortality
- Avg. pig weaning weight
- Age at weaning
- Litter weight
- Pigs weaned/sow/yr
Population Information

- Ending female inventory
- Gilt pool inventory
- Gilts entered
- Females culled
- Female deaths
- Ending boar inventory
- Replacement rate
- Culling rate
- Death rate
- Non-productive sow days

Analyzing Boar Fertility

- Boar use report
- Boar performance report
- Database extraction

Analyzing Sow Reproduction

- Parity comparison report
- Genetic line report
- Farrowing Rate / Pregnancy loss report
- Removal analysis report
- Genetic comparison report
- Database extractions

Analyzing Reproductive Mgt.

- Action lists
- Farrowing rate / pregnancy loss report
- Multiple matings report
- Repeat service report
- Database extractions

Improvement of Feed Efficiency

- Through Sound Programs
  - Selection & Crossbreeding
  - Feeding & Nutrition
  - Management Practices and Software
  - Housing & Environment
  - Herd Health
  - Marketing Program

Action Lists

- Sows needing preg checking
- Sows found open
- Sows needing action pre-farrowing
- Sows due to farrow
- Sows farrowed but not weaned
- Sows weaned but not served
Thank You For Your Attention