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: Return > Cost
- Return is based on number of pigs marketed, weight of pigs, value of each pig, marketing expertise, cull sow sales

Goal is Production of a High Quality Product at a *PROFIT*

- Profit means: Return > Cost
- Cost is influenced by feed, labor, genetics, management fees, health, fixed costs (rent, capital), variable costs (ins., utilities, etc), other

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: Return < $110/pig, cost > $145/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

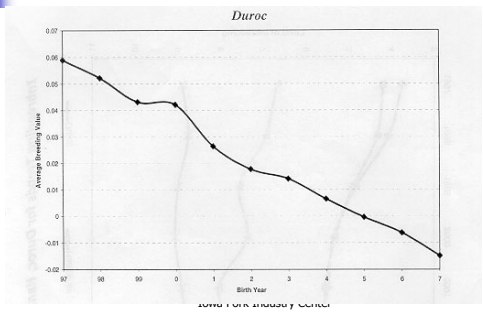
Improving Feed Efficiency Through Selection

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

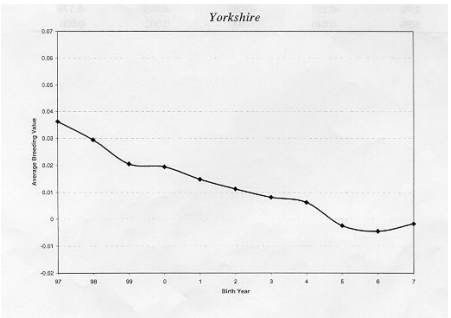
Potential Feed Savings Terminal Sire Selection on FCR

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

GeneticTrend - Durocs
Feed Efficiency



Genetic Trend – Yorkshires
Feed Efficiency



Feed Efficiency
SGI - DUROC

SGI CODE NUMBER	BOAR NAME	FE EBV **Lb Per 100 Lb Gain**
1332	YELLOW JACKET	-8.34
1290	HULK 7-1	-7.77
1319	ROJO RHINO	-6.55
1322	FOUNDATION	-5.13
1329	PILLAR	-4.52
1312	EMPEROR	-2.47
1331	LOCKDOWN	-2.45

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Feed Efficiency
SGI - YORKSHIRE

SGI CODE NUMBER	BOAR NAME	FE EBV **Lb Per 100 Lb Gain**
2446	BIG THUNDER	-7.01
2452	KING DAVID	-5.32
2439	PURSI	-4.49
2419	URON	-4.46
2412	TOTAL PACKAGE	-3.99
2436	BIG UNIT	-3.88
2414	JUPITER	-3.60
2417	4-WHEELER	-2.77
2423	FROSTER	-2.74
2422	PURON	-1.99
2425	KDU	-0.70

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Feed Efficiency
SGI - LANDRACE

SGI CODE NUMBER	BOAR NAME	FE EBV **Lb Per 100 Lb Gain**
3328	SAMSTORP	-7.53
3349	CHOKIO	-5.20
3351	FALCON	-4.59
3342	TANBARK	-3.84
3350	JA MAR CYRUS	-3.52
3345	PIKKUS	-2.85
3331	MARCO	-2.15
3348	EPITOME	-1.79
3340	ALEX	-0.98
3347	MILHAM	-0.98
3324	IZUMI	-0.60

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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

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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

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

Maternal Line - Genetic Improvement in Feed Efficiency

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

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

SGI 3345 PIKKUS

Sire Currently No. 1 Sire in U.S. – SPI and MLI

Grandsire 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

Maternal Line - Genetic Improvement in Feed Efficiency

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

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

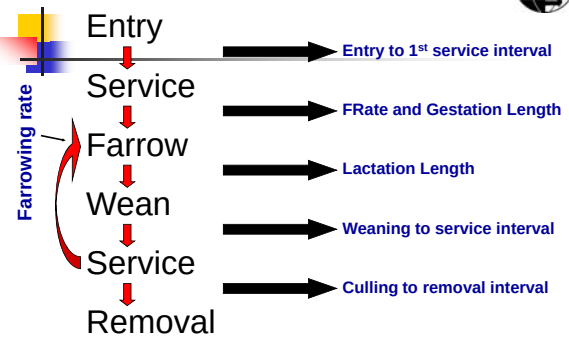
Basic Unit of Cost: Breeding Female Days

- 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'

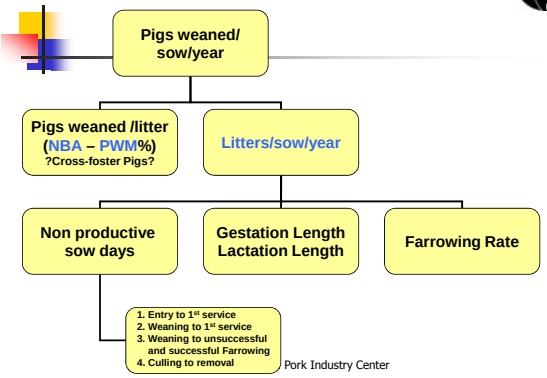
Breeding Female Days Accumulation



Litters/Sow/Year

- L/S/Y is estimated over a period of time
  - = [sum of gestation days/ sum of breeding female days] * [365/115]
- Measureable on sow basis, and across sows
- Normally distributed ?
- h^2 = ?

Factors Influencing PWSY



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)

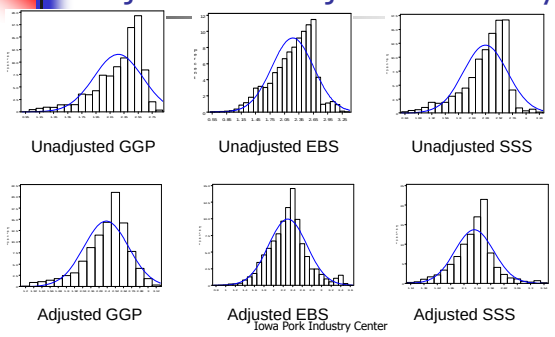
Challenge

- Selection for WSI is possible, but that for other components of LSY is difficult
- Direct selection for LSY has not been studied

Questions:

- How are LSY distributed?
- Will the variance component composition support genetic progress via selection?

Data distribution of LSY Unadjusted and Adjusted for Parity



Estimated Variance Components and Heritabilities

LSY

Herd	σ^2_a	σ^2_e	σ^2_{total}	h^2
GGP	0.01	0.12	0.13	0.09
EBS	0.04	0.16	0.20	0.18
SSS	0.01	0.12	0.13	0.09

* EBS = EC-BOX-SYC herd

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

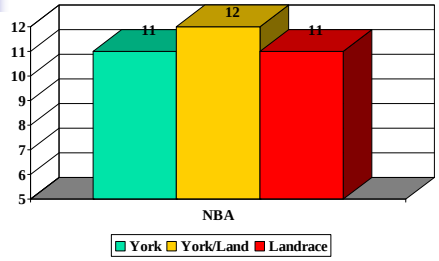
Terminal Cross Mating System Sire and Dam Lines

- 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



Heterosis Levels

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

Terminal Cross - F1 Female

Grandparent Female Cross

Y x L

X

X

Parent Cross
Duroc x F1 Y/L

Market Hogs

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 Wastage
- 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 Wastage, 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

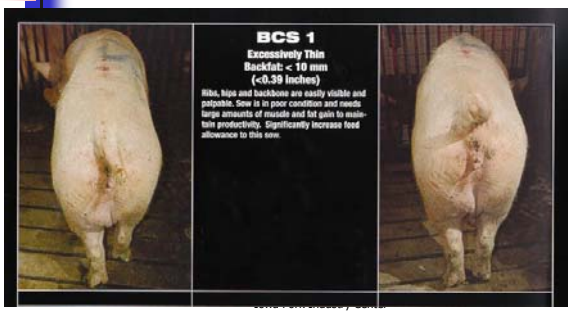
- Pigs nutritional needs change from weaning to marketing
- The more rations are fed the more closely each ration will meet the needs of the pigs
  - Compare feeding programs of 3 grow finish rations versus 6 grow finish rations

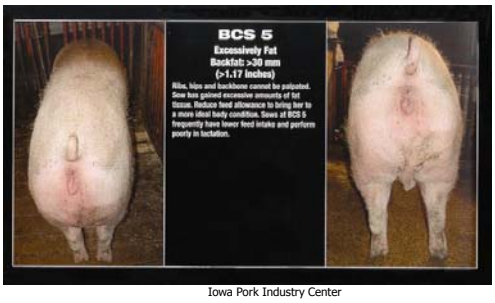
Add More Phased Rations

- 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

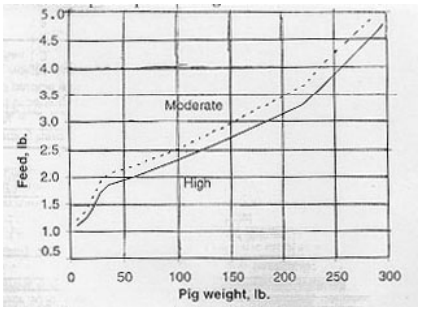
Herd Health

- 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**

FEED REQUIRED PER UNIT GAIN



Cost Of Gain

Cost Feed/Lb	Feed/Gain	Cost/lb	Cost/kg
0.10 Previous	3	$0.30	$0.66
0.20 Now	3	$0.60	$1.32
0.30 Future?	3	$0.90	$1.98
0.10	4	$0.40	$0.88
0.20	4	$0.80	$1.76
0.30	4	$1.20	$2.64
0.10	5	$0.50	$1.10
0.20	5	$1.00	$2.20
0.30	5	$1.50	$3.30

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.

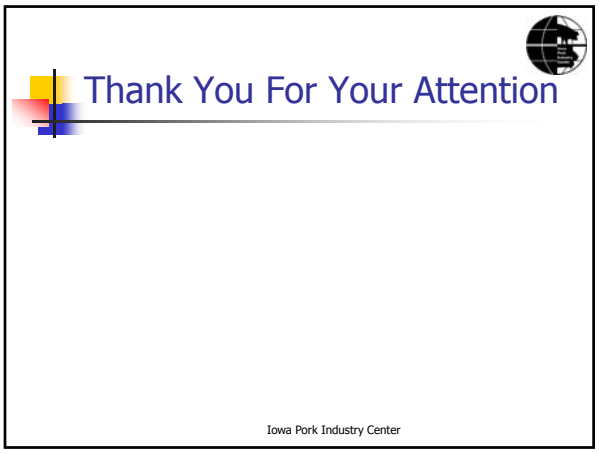
- Action lists
- Farrowing rate / pregnancy loss report
- Multiple matings report
- Repeat service report
- Database extractions

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

Improvement of Feed Efficiency

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