Breeding Program for USA Swine Genetics

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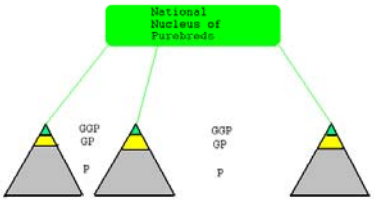
Swine Production Goals

- Primary goal = Maximize Profit
  - Start with the best genetic merit GGP animals
  - Improve the merit of the GGP animals
  - Use the most efficient Genetic System
  - Provide an adequate environment for the animals to express their genetic merit

USA Purebred Genetic System



Best Genetic Merit Population

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

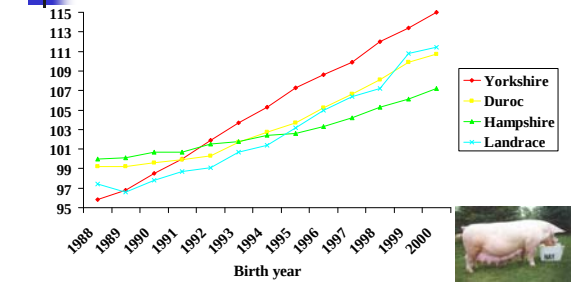
National Program to Identify the Genetically Superior Animals

- 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

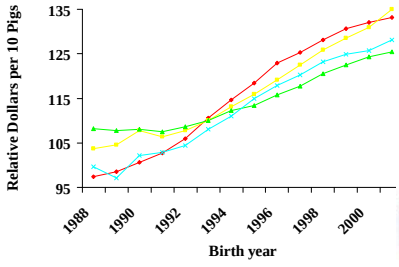
Duroc - Top Sires for TSI
Ranked on Terminal Index (TSI) July 2004

Name Owner	Pigs Herds	BF acc	Days acc	Lbs.	TSI	Reg. No.
ZMAC2 KOBE 55-1 ZIERKE FARMS/ZMAC	20 1	-0.03	-5.34	1.02	131.6	248928001
SDF1 OUTERLIMITS STEWARTS DUROC FARM	88 2	0.03	-6.60	-0.55	131.1	233822002
ID2 TINSLEY 94-3 ISLER GENETICS	50 1	-0.03	-5.74	0.26	130.7	245573003
WFD2 CORNHUSKER WALDO FARMS	253 2	0.00	-6.07	-0.33	129.8	245363004
YFG1 NEXT LEVEL 41-2 GOOD FARMS	97 1	-0.02	-5.13	0.46	128.8	241451002
STN2 KOI 62-2 SWINE GENETICS INT	21 2	0.00	-5.25	0.04	127.8	247165002
STN1 SENSOR 48-2 STEIN & STEWART	274 2	-0.02	-4.79	0.45	127.4	232844002
WFD1 CORNHUSKER WALDO FARMS	150 1	-0.03	-3.89	0.68	124.5	235862001
WFD2 KOBE 249-2 WALDO FARMS	39 2	0.01	-4.25	0.23	124.4	249886002

Maternal Line Index



Terminal Sire Index



Steps For a Successful Importation

- Tour selected purebred swine farms in USA
- Select purebred Yorkshire, Landrace and Duroc animals for purchase
- Extensive health testing of pigs
- Delivery of pigs
- Now, what do you do with them?

General Breeding Plan Strategy

- Produce Duroc, Landrace and Yorkshire animals for GGP farm
- Possibly produce GGP and GP purebred animals to sell
- Produce F1 (parent stock) females
- Produce terminal boars (AI stud)

Breeding Program Goals

- Want to make genetic improvement in the pigs you purchased
- Want to minimize inbreeding
- Value of these products is the genetic merit of the animals
  - Expressed as Breeding Value or BV

Genetic Improvement Program

- Selection (Which animals to purchase)
  Which breed, which animals in the breed, use BV's
- Mating System (How to mate them)
  Decide on number of desired purebred animals
  Set up a mating plan

Genetic Improvement Program

- Utililize traditional technology
  - Heterosis
- Utilize new genetic technologies
  - Computerized data management system
  - Real-time ultrasound technology
  - BLUP based selection technology

Terminal Cross - F1 Female


x

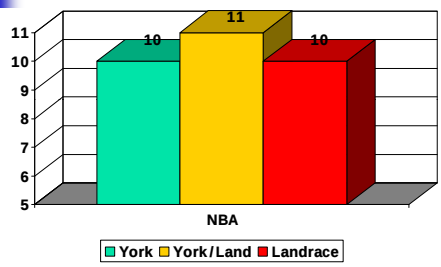

Grandparent
Female Cross Y x L


x


Parent Cross
Duroc x F1 Y/L

Market Hogs

Heterosis



Heterosis Levels of Traits

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

- *Pounds product/sow/year = +40%*

Genetic System Structure

GGP — York sows x York boars ⇒ Yorks

GP — York sows x Land boars ⇒ F1 parents

Parent — F1 sows x Duroc boars ⇒ market hogs

Genetic System Heterosis

System Level	Maternal	Offspring
3% GGP(York x York, Land x Land)	0%	0%
12% GP (York x Land)	0%	100%
85% PS (Duroc x F1)	100%	100%
Entire Genetic System	85%	97%

General Mating Plan

- GGP = 3% (York and Landrace sows)
  - *Best Y or L sows x Y or L boars → York or Landrace GGP gilts*
  - *Other Y or L sows x Y or L boars → York or Landrace GP gilts*
- GP = 12% (Yorkshire and Landrace sows)
  - *Y sows x Landrace boars → LY parent gilts*
  - *L sows x Yorkshire boars → LY parent gilts*
- Parent = 85% F1 sows
  - *F1 sows x Duroc boars → market hogs*

Starting Your GGP Herd

- Which breeds to use?
- How many of each breed?
- How many lines within each breed?
- How to mate the GGP to avoid inbreeding?

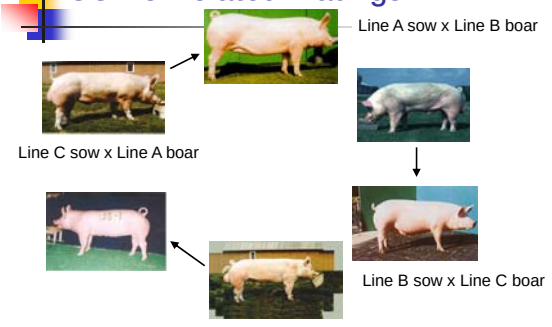
How Many of Each Breed?

- GGP herd size = minimum 50 sows per breed
  - The larger the GGP the greater the potential for genetic progress
- Need both maternal and terminal breeds
- Terminal Durocs
- Maternal Breeds
  - *Yorkshire and Landrace sows*

Number of Lines

- Within each breed, get animals from 3-4 unrelated lines
- Make matings of unrelated lines to produce replacement GGP and GP animals
- Must separate the Duroc, Landrace and Yorkshires into GGP lines

GGP Unrelated Matings



General Purebred Mating Plan

- Divide the purchased purebreds into four separate lines (A, B, C, D)
- For the purebred matings:

Females From Line	Mated To Sires From Line	Offspring Given Line ID
A	B	Females B, Males A
B	C	Females C, Males B
C	D	Females D, Males C
D	A	Females A, Males D

Enter Animals Into Inventory in Computer Program

- Data management program(s)
  - Need to monitor reproductive performance
  - Need to be able to manage growth testing
  - Need to estimate breeding value (BV)
  - Need to create indexes of BV's for selection
- Each animal that has been brought to the farm needs to be entered into inventory (sows and boars)

Animal Information into Computer

- Entry date
- ID (sow tag)
- Breed or Genetics
  - Landrace or YL
- Line
- Origin
  - Waldo USA
- Pedigree Info
  - Sire and Dam
- Date of birth
- Alternate ID
  - Reg. number
  - Tattoo id
  - Ear Notch

Traits to Focus On for Profit

- Reproductive traits
  - *farrowing rate, litter size, preweaning mortality, wean-estrus interval, non-productive sow days*
- Growth traits
  - *growth rate (ADG, days to market), feed conversion, mortality rate*
- Carcass traits
  - *backfat, loin muscle area, percent lean, marbling, color, pH, water holding capacity*

Goal of Selection

- Identify the animals with the best genetic merit
  - *Focus on economically important traits*
- Allow them to reproduce
- Cull the other animals with lower genetic merit
- ***Result = Permanent improvement in performance due to better genetics***

Procedures to Identify Genetically Superior Animals

1. Phenotypic evaluation
   Visual assessment
2. Phenotypic evaluation
   Measure trait performance
3. BLUP genetic evaluation
   Using trait measurements

Phenotypic Evaluation (Visual Appraisal)

- ***Look at the phenotype to estimate the genotype***
- Structural Soundness
  - *Influences longevity*
- Reproductive Soundness
  - *Influences semen traits, farrowing rate*

Phenotypic Evaluation (Measure Traits)

- ***Objectively measure the phenotype to estimate the genotype***
- Litter size, semen quality = slight improvement
- Days to market = moderate improvement
- Percent lean = excellent improvement

BLUP Genetic Evaluation (Using Measured Performance)

- Reduce environmental effects not related to genetics using computer based technology
  - *Use of Contemporary group deviation*
  - *Account for other fixed effects in computerized data analysis*
- Include performance information of animals that are relatives to better estimate the genetic merit of each animal
- ***Result = great increase in accuracy of selection***

Selection of Boars for AI

- Should have EBV on boars for the economically important traits (top %)
  - *growth rate, lean percent, litter size, etc.*
- AI boars must be structurally correct

Selection of Replacement Females

- Must be of correct breed or breed combination
  - *GGP animals must be purebred*
  - *Maternal GGP should be LR or York*
  - *Terminal GGP should be Duroc*

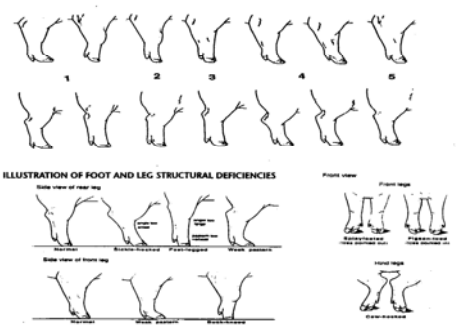
Selection of Replacement Females

- GGP females should be performance tested with EBV's or EPD's
- All replacement females should be structurally sound

Selection For Feet and Leg Soundness

- Breeding animals must be structurally correct and mobile to carry out normal functions
- Research suggests that soundness is heritable
- All potential breeding animals should have their structural soundness evaluated and those that are unacceptable should not be selected

Soundness Scoring



Scoring System For Soundness

- Score 1-5 for the front legs and 1-5 for rear legs
- Add to get a total score of 1-10
- Unacceptable = 1-3 points (severe problems that restrict ability to breed)
- Good = 4-7 points (slight structural problems)
- Excellent = 8-10 points

Improvement of Carcass Quality

- Carcass Quality has two components
  - Composition (percent of lean)
  - Eating quality (marbling, pH, color)
- Need to measure in the live pig if possible
  - So the tested animals can be used for breeding

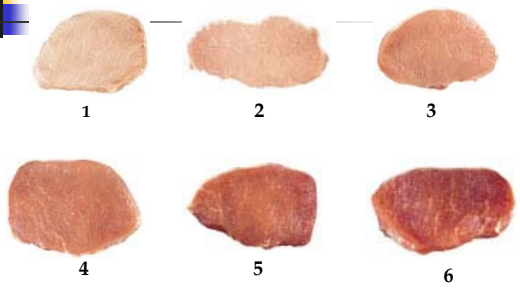
Meat Quality

- Ultimately, meat quality is defined as a wholesome product that tastes good, has good value and generates repeat sales

"Quality" Indicators

- Color
- Marbling
- Firmness
- Water holding capacity
- pH
- Tenderness
- Taste

Color Scores



Marbling Scores

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Improvement of Carcass Quality

- We can measure composition accurately on the live animal, not eating quality
- Improve eating quality by using terminal sire breed known for superior eating quality

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Measuring Carcass Composition
Real-time Ultrasound Evaluation

- Breeding animal evaluation and selection
- Eliminates need to slaughter animal
- Monitor lean growth and predict growth curves

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Pig Holding Crate

- Pig must be restrained so that they can be measured accurately
- Scales today had too much room for the pig to move around
- Must be easy for the pig to enter and exit

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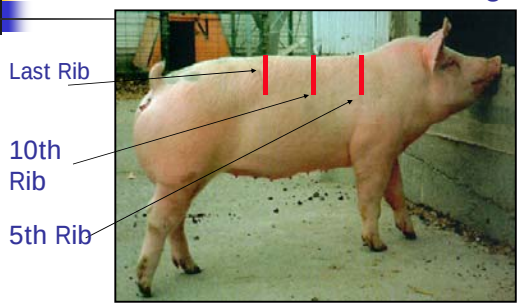
Anatomical Locations on the Pig



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Ultrasound Technology

- Uses high frequency sound waves to map tissue boundaries
- Sound waves received through quartz crystals
- Sound waves reflected back at different speeds from different tissues
- Central processor collects time and distance information to form ultrasound image
- Reports a measurement or image for the technician

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A-mode Ultrasound

- Introduced in 1950's
- Single quartz crystal receives sound waves
- Gives point estimate of characteristics of the tissue of interest
- Digital read-out of depth or graphical representation of sound waves
- Accurate for backfat depth - inconsistent for loin depth
- Cannot measure loin muscle area

Easy to Use Ultrasound

Must be easy to use

Must have probe designed to measure backfat

Digital readout is easy to read

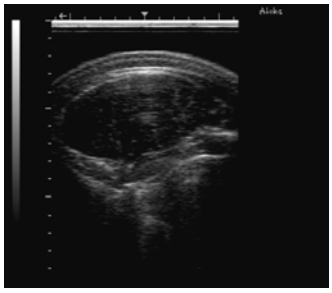
Renco Lean Meter

B-mode Ultrasound or Real-time

- Multiple quartz crystals
- Aligned in sequence over a linear space (up to 18 cm)
- Creates a linear ultrasonic image displayed on a video monitor
- Real-time -- updated at high rate of speed
- Highly accurate for backfat and loin muscle area

Real-time Ultrasound Machine, Probe and Accessories

Example Ultrasound Image



On-Farm Evaluation of Backfat

- Measured at 10th rib
- 100 ± 10 kilograms
- Measure 5 cm off midline
- Average both sides for A-mode
- Single measurement for B-mode
- Backfat depth at midpoint of loin - include skin and all fat layers

Summary

- Purchase best animals from best genetic population
- Breeding program should be complete and simple
- Testing program needs correct equipment (holding scale, ultrasound machine)
- Must start computerized data management