Using BLUP Technology on Swine Farms

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**BLUP**
Breeding Value Estimation

- BLUP = **Best Linear Unbiased Prediction**
- Prediction of an animal's genetic merit (BV)
- Unbiased means estimating BV after removing all non-genetic influences
  - Time of year sow is bred, parity, breed
  - Best means most accurate predictor of BV
- Developed in the 1970’s for use on mainframe computers, now can be run on any PC at the farm

**Traits of Economic Importance**

**Reproductive Traits**
- Litter size, litter weight, wean to service interval
  - Easily measured at GGP, GP and PS farms when using reproductive management software such as PigChamp®, PigWin®, Herdsman®, GBS)
- Mortality, Longevity
  - Use of phenotypic selection at all farms

**Growth Traits**
- Days to market, backfat, loin muscle area, percent lean
  - Important in both terminal and maternal breeds
- Can measure accurately at farm using Realtime Ultrasound
- Selling of pigs before 100kg does not allow for measurement and selection

**Meat Quality Traits**
- Marbling, pH, color, water holding capacity
  - Important in both terminal and maternal breeds
  - Hard to measure on the live animal
  - Estimate marbling with Realtime Ultrasound
  - Selling pigs before 100kg does not allow for measurement and selection
Traditional Genetic System

GGP
York sows x York boars → Yorks
GP
York sows x Land boars → LY parents
Parent
LY sows x Duroc boars → market hogs

Genetic Pyramid Structure

GGP = 250 Yorkshire or Landrace sows
- Y sows X Y boars → York GGP gilts
- Selection on reproductive traits first, then growth traits, meat quality if possible

GP = 50 Duroc sows
- D sows X D boars → Duroc terminal boars
- Selection on terminal traits (growth, percent lean, meat quality, muscle shape)
- Can use BLUP for all traits

Parent = 1200 Yorkshire or Landrace sows
- Y sows X Landrace boars → LY parent gilts
- What selection is done at the GP level?
- Can identify the poor performing sows to cull
- Reproductive information from GP can be used to augment the data from the GGP
  - Lowly heritable traits so more value
  - BLUP will be most effective

Parent = 8500 LY sows
- LY sows X Duroc boars → market hogs
- What selection is done at the PS level?
- Can identify the poor performing sows to cull
- Reproductive information from PS can be used to augment the data from the GGP
  - Lowly heritable traits so more value
  - BLUP will be most effective

What If You Had A 1500 Sow Combined GGP/GP Herd?

GGP = 250 Yorkshire or Landrace sows
- Y sows X Y boars → York GGP gilts
GGP = 50 Duroc sows
- D sows X D boars → Duroc terminal boars
GP = 1200 Yorkshire or Landrace sows
- Y sows X Landrace boars → LY parent gilts
An extra question arises here
- 1450 York sows? Which are the GGP sows?

? Breed Pure or Breed Cross?

- Each week there will be many purebred Yorkshire (or Landrace) sows to breed
- The best ones need to breed purebred
  - To produce replacement purebred Y or L
- The worst need to be culled
  - For genetic progress
- The rest will be bred to make LY gilts
- Must accurately ID the genetic best
Estimation of Breeding Values (BV’s)
- Goal is to allow the animals that are genetically superior to reproduce, thus making permanent genetic progress
- First, you must measure the traits
- Must then separate the genetic effects on an animal’s performance from the environmental effects
- Most accurate BV estimation = BLUP

Advantages of BLUP System
- Defines performance as the pig’s contemporary group deviation (CG)
  - Reproductive contemporary group is a group of sows that were bred together, housed together and farrowed together (same environment)
  - CG deviation allows performance to be expressed without those environmental effects
- Increases accuracy of BV estimation

Advantages of BLUP System
- Combines the performance information on a pig with its relatives’ data
  - Example: sow BV based on 4 of her litter records plus litter records from her daughters, half sisters, cousins, etc.
  - This greatly increases the accuracy of the BV estimation
  - Proven to produce the fastest genetic gains

BLUP Sow Indexing (On Farm)
- Primary reproductive traits are farrowing rate, number born alive, litter weaning weight and wean to estrous interval
- Farrowing rate is confounded with boar fertility and not clean to measure
- Other traits are lowly heritable
- Therefore, BLUP genetic evaluation system is needed to make genetic progress

BLUP Sow Indexing (On Farm)
- Purebred GGP/GP system:
  - At weaning, decide which GGP and GP sows to breed pure and which to breed cross and which to cull

BLUP Sow Indexing
- What does it do?
  - Estimates the breeding value of animals for litter size, litter weight and wean to estrous interval
  - Creates an SPI from the BV estimates for use in selection
  - Estimates this BV with the most accuracy
Demonstrate On-Farm BLUP System

BLUP Sow Indexing

- How are these BV estimates used?
  - As an aid to select the genetically superior pigs
- Where is this selection done?
  - At weaning, decide which GGP and GP sows to breed pure and which to breed cross and which to cull
  - Evaluation of current herd sires and potential herd sires

Genetic Progress Example

- How does this improve profitability?
  - Uses selection to make permanent genetic improvement in the herd for litter size, litter weight and wean to estrous interval component of non-productive sow days
  - Adds to genetic progress made from across herd BLUP selection programs
  - The pig farmer feels they are ‘doing something’ fun and profitable

Genetic Progress Example
Technologies to Enhance Genetic Improvement

- Quantitative Genetics
  - BLUP based BV estimation systems
- Phenotypic selection on structural and reproductive soundness
- Molecular Genetics
  - Marker assisted selection
- Which can be used at the farm??

Requirements to Do BLUP Indexing

- PigChamp® or PigWin® or Herdsman® or GBS or an equivalent data management system that can extract data
- Computer with math co-processor (486DX or higher CPU)
- Pedigree information entered on the sows
- BLUP system that can be made extremely user friendly to use at the farm

Summary

- Health concerns have forced some farms to move to a closed herd management system
- Economic concerns force them to try to capture all the genetic improvement possible
- It is possible for the better managed farms to use BLUP technology plus phenotypic selection

Summary

- BLUP technology is the most accurate tool for estimation of breeding value in pigs
- BLUP technology used at the farm level adds to genetic progress realized from across herd BLUP programs
- Important selection and mating decisions require accurate estimates of BV
- Profit will be maximized when cost effective technologies are used at the farm