Gilt Nutrition and Reproductive Management are Critical

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History . . .

- Improved efficiency of pork production
  - 30% leaner
  - 25 p/s/y
- Changes
  - Health, stockmanship, business management, facilities
  - Genetics
  - Nutrition
- Can we become even more efficient?

If so, then . . .

- Know how take care of the modern sow
  - Maternal lines
    - Prolific (NASS)
    - Lean (Long, 1998)
    - Less appetite
    - ↑ removals (PigCHAMP, 2000)
      - » Cull - 43%
      - » Dead - 5.9%
      - » Average parity - 2.6

Development begins at birth

- Identification - ear notch, tattoo, tag
- Gilts from litters with:
  - Large NBA
  - No abnormalities
  - Majority of gilts → more fertile as sows
- Gilts reared in smaller litters tend to be more fertile cross-foster-off barrows

Development begins at birth

- Dams with:
  - Early puberty
  - Little or no farrowing difficulties
  - Good disposition
  - Healthy udder
- Keep notes
- Retain 300%

Nursery

- No "nursery" gilt development × reproduction research
- So recommendation is to maximize growth
  - Little or no mixing
  - Typical nursery diets
  - Do not crowd
  - Group size??
- Retain 200 to 250% when moving out of the nursery

Grow-finishing

+ Impact on puberty
  - Stocking density
    - #/pen ??
    - ft^2/gilt ??
  - ↓ age at puberty
    - Crowding ↓ growth
    - Excessive pit gases
    - Darkness
    - Disease - ileitis
    - Parasites

Grow-finishing

- Relocation
  - Indoor to outdoors at 70 to 120 d hastens puberty
    - » Not if done in extreme heat or cold
  - Indoor to other indoor pens at 70 to 120 d less effective
- Do not need to have male contact
- Nutrition
  - Not related to body composition
  - Very severe, in essence starvation

Grow-finishing

+ Impact on sow performance (e.g. w-t-e, locomotion, litter size and litter growth)
  - Environmental or managerial factors??
  - Nutrition . . .

Variation in gilt genotypes

	Wt, lb	Backfat, mm	ADG (lb) Age (d)
NPPC Gilt Project at 180 d (Long, 1999)			
Line A	238	21.6	1.52
Line B	234	23.6	1.59
Line C	232	22.4	1.65
Line D	248	24.9	1.63
Line E	242	19.8	1.63
U of MN at P1 Farrowing (H.Yang, 1998)			
Camborough 22	364	15.8	329
NPPC Maternal Line at P1 Farrowing (Goodwin and Boyd, 1998)			
Lowest Line	412	18.3	354
Highest Line	474	25.4	370
Michigan State University at Puberty (Lyvers, 2000)			
Y x L	306	17.6	195

Effect of G-F backfat depth on sows to 4th parity

	Backfat thickness at 220 lb (mm)				
	< 14	14-16	16-18	18-20	> 20
Retention rate, %	28	36	39	40	46

Adapted from Gueblez et al., 1985

Supported by King et al., (1984), Gaughan et al., (1995), Brisbane and Chesnais (1996)

Body condition at first breeding and longevity

Item	Retained	Culled
No. of sows	53	34
Age, d	202.5	210.4
Backfat depth, mm	25	25
Live weight, lb.	231.3	240.0

Rozeboom and coworkers (1996)

Supported by Kirkwood et al., 1988; Young et al., 1990; Newton and Mahan, 1993; Long, 1998

Grow-finishing

- Nutrition methods studied to-date
  - Restrict feed intake
  - Altered energy:protein density
    - Moderate protein-high energy
      - » 1.9 to 2.1 g lysine per Mcal ME
      - » Add dietary fat
      - » Encourage fat deposition
    - High protein-moderate energy
      - » 2.2 to 3.0 g lysine per Mcal ME
      - » Limit fat deposition
  - Stair-step compensatory growth

Reproductive performance of gilts fed differing amounts of feed from 12 to 38 weeks of age

	Energy level as per cent of ad libitum			
	100	83	70	60
ADG from 80 to 210 lb live wt (lb)	1.65	1.50	1.31	1.13
Age at 210 lb live wt	177	186	200	221
Backfat at 215 lb live wt (mm)	13.7	11.7	10.7	9.7
Live wt at first estrus (lb)	306	289	260	240
Age at first estrus	234	237	237	244
Parity one litter size (born alive)	9.2	9.0	8.3	8.9
No. litters per initial gilt	1.50	1.18	2.14	2.78
No. litters per first-parity sow	3.3	2.3	3.5	4.0

From den Hartog (1984), den Hartog and Noordewier (1984), den Hartog (1985), and te Brake (1986)

Restricting rearing intake and locomotive failure in gilts

- Decrease
  - Kirchgessner et al., 1984;Nielsen and Danielsen, 1984; Snoeyen, 1979 and van Erp, 1980 (later ↑ sow culling)
- No change
  - Simmins et al., 1994 (later ↑ sow culling, ↓ fertility)
  - Jørgensen and Sørensen, 1998 (later ↓ sow culling through 12P, 25% verses 46% culled for locomotive failure for restricted and ad libitum, excessive culling of sows for locomotive failure
  - LeCozler et al., 1999 (later ↑ sow culling)

Performance of gilts fed one of three dietary regimes from 180 to 250 lb (Ad Lib), or from 180 lb to 180 d (4 lb/d)

	0.95% lys 1.48 Mcal/lb	0.6% lys 1.58 Mcal/lb	1.31% lys 5.8 Mcal/d
Weight at 180 d, lb.	247	248	221
Backfat at 180 d, mm	23.6	25.4	18.3
Number born alive parity one	8.99	9.16	9.36
Average NBA parity 1 to 4	10.03[a]	10.36[b]	10.28[b]
Stayability thru 4 parities, %	35[a]	56[b]	55[b]
% of gilts at 180 d completing 4 parities	19.4	30.2	33.6

R. Johnson, National Hog Farmer , March 15, 1998
T.E. Long, Swine Health Management Video Series, October, 1998

Grow-finishing

- Caution: if lysine-to-energy ratio too low
  - Cia et al., 1998
    - 1.3 g lys per Mcal ME(0.46% lys)
    - Fed until breeding
      - » Less estrus
      - » Decreased ovulation rate
  - Consider housing and season

Stair-step compensatory growth (SSCG) during rearing

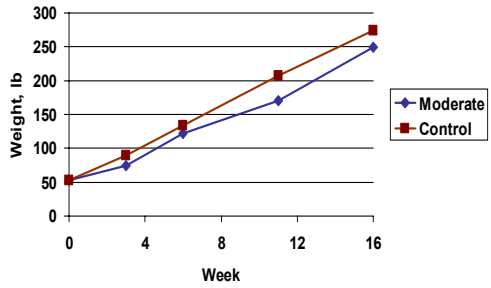
	Period			
	1	2	3	4
Weeks	0 to 3	3 to 6	6 to 11	11 to 16
Control	A max	A max	C max	E max
Moderate	B moderate	A max/comp	D moderate	E max/comp

Lyvers-Peffer and Rozeboom, 2001

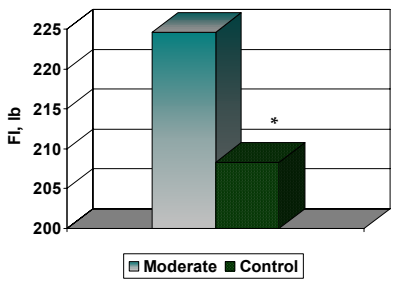
Diets fed during the four pre-pubertal feeding periods

	Diet				
Ingredient, %	A	B	C	D	E
Corn	62.26	36.20	71.95	39.57	75.87
Sunflower hulls	-	35.00	-	35.00	-
Soybean meal, 44%	30.26	22.42	20.56	19.26	17.96
Mon-dical-phos, 21% P	2.07	2.73	1.98	2.52	1.74
Ground limestone	.84	.55	.81	.55	.83
Choice white grease	3.00	1.50	3.00	1.50	2.00
MSU vitamin premix	.60	.60	.60	.60	.60
MSU TM premix	.50	.50	.50	.50	.50
Salt	.50	.50	.50	.50	.50
L-lysine HCl, 78.8%	-	-	.10	-	-

Effect of SSCG regimen on average gilt weight



SSCG and P1 lactation feed intake

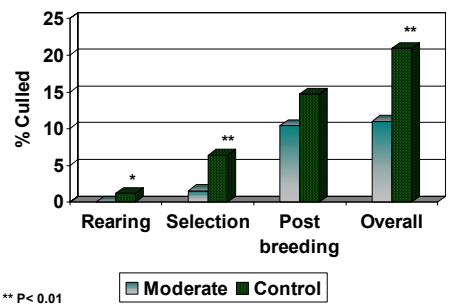


* P< 0.05

SSCG and P1litter weights, lb

	Pre-pubertal nutrition regimen		
Day	Moderate	Control	P
0	34.9 (59)	35.3 (48)	.79
7	63.1 (75)	61.0 (48)	.23
14	104.2 (75)	98.8 (50)	.02
Weaning	140.3 (59)	135.3 (59)	.07

SSCG and culling



* P< 0.05, ** P< 0.01

Grow-finishing

+ Zearalenone
  - Delays puberty and interrupts cycle,
  - Normalize 3 to 4 weeks after removal
+ Retain 170 to 200%
  - Mammary, genital, and structural soundness

Acclimation, Isolation, Quarantine

- When to move?
  - 4 to 5 months
  - 5 to 6 months of age
- Identify puberty and estrus cycles
  - Age viewed as indicator of subsequent fertility
  - Cull if no puberty by 7.5 months of age.

Acclimation, Isolation, Quarantine

- Factors influencing occurrence of puberty
  - Genetics
    - Crossbred earlier
  - h^2 = 25 to 35%
  - Seasonal
    - Fall born earlier
    - Poor lighting
- Confinement and crowding
  - 10-12 ft^2/gilt
- Disease, parasites and mycotoxins

Acclimation, Isolation, Quarantine

- Stimulation
  - Moving to new location (possibly indoor to outdoor)
  - Mixing with new pen mates
  - Mix with sow(s) in estrus
  - Boar exposure
    - Older boars are more effective than younger boars, but may injure young gilts
    - Direct boar contact better than fence-line
    - Boar stimulation 2 times per day, 10 to 15 minutes
    - House boars away from gilts, down wind
    - Rotate boars

Acclimation, Isolation, Quarantine

- Age of gilt is important
  - Gilts < 140 d of age take longer to reach puberty if stimulated
  - Gilts from 185 to 200 d of age respond quickly and uniformly - Synchronization.
  - Best to combine moving, mixing, and boar exposure together

Acclimation, Isolation, Quarantine

- Characteristics of estrus in the gilt
  - Hesitant - sometimes takes 20 to 30 minutes, flanking
  - "Fright and flight"
    - Boar
    - Stockperson
  - Refractory quickly
  - Short - 24 hours maximum

Acclimation, Isolation, Quarantine

- PG 600™
  - Pregnant mare's serum gonadotropin [PMSG] + Human chorionic gonadotropin [HCG]
  - Prepubertal gilts; not cycling
  - Single injection 5 mL IM
  - Estrus in 50 to 80% of gilts 3 to 10 days later
  - Few gilts (up to 15%) may not ovulate normally
  - Pregnancy rates 60 to 90%.
  - Recommend not breeding on first estrus post-injection

Acclimation, Isolation, Quarantine

- Regumate™
  - Altrenogest - progesterone-like compound
  - Extends diestrus until product is withdrawn
    - Feed minimum of 14 d
  - Estrus occurs 3-5 days later
  - Use in cycling gilts only
  - Off-label prescription only in U.S.; Canada and Europe legal
  - Observe all precautions

Acclimation, Isolation, Quarantine

- Time to change body condition
  - Full feed lean gilts
    - Increased energy
    - Decrease amino acid concentration
    - Make fatter
  - Limit feed "average-lean" gilts
    - Avoid “too” fat
  - Vitamin E 30 IU/lb

Acclimation, Isolation, Quarantine

Item	Control	↑ fatness
Beginning weight, lb	230	230
Beginning backfat, mm	12	12
Dietary DE Mcal/lb	1.41	1.41
Lysine %	0.75	0.45
Backfat change allocation to service, mm	2.8	4.0
Weight change allocation to service, lb	97.4	101.0
Backfat change service to farrow, mm	3.0	3.0
Weight change service to farrow, lb	133.6	123.7
% completing 3 parities	70	83

O’Dowd et al., 1997

Gilt pool - breeding

- Ovulation rate = potential litter size
  - Related to Breed; White > Duroc >other colored breeds
  - Can select for it, moderately heritable
  - Changes with sexual age
  - Increasing from puberty to 4th estrus
  - Greatest increase from first to second estrus, less from second to third
    - Interaction with physiologic age, increase less if gilts are older at puberty

Gilt pool - breeding

- Flush limit-fed gilts prebreeding
  - Ad-lib intake for 10 to 14 days to normalize ovulation rate (OR)
- Not superovulation; only normalizes OR
  - Superovulation achieved using PMSG alone and repeated; possibly insulin injections

Gilt pool - breeding

- Not recommended to breed at puberty
- Time depends on age, sexual age (estrus number), weight and backfat
- If older at puberty (185 to 200 d), breed on second or greater estrus
- If younger at puberty (160 to 180 d), breed at third or greater estrus

Gilt pool - breeding

+ Targeted body condition
  - With excellent P1 feeding in gestation and lactation, gilts can be bred at 200 to 210 d of age, 260 to 280 lb, and 15 to 20 mm backfat
  - Otherwise wait until 220 to 260 d of age, 300 lb and 20 to 25 mm of backfat

P_2 Fat recovery, mm	Feeding protocol (d 30 to 90 of gestation)
8	60 d at 7.5 lb/d CSBM
4	60 d at 6.2 lb/d CSBM

Gilt pool - breeding

+ Pool size
  - # of culls
  - # of recycles
  - Seasonal adjustment
  - Cost
    - Feed: 5 lb/d x $0.05 x 30 d = $7.50
    - Facility and variable: 30 d x $0.20/d = $6.00
    - Labor: 30 d x $0.10/d = $3.00

Gilt pool - breeding

+ Pool size
  - Grow-finish 200 to 250%
    - 25 to 35% of gilts will be culled in G-F because of poor growth and structure
  - Acclimate about 170% of what is needed
    - 20 to 25% of gilts no puberty, irregular cycles, illness, injury, culled
  - Breed about 130% of what is needed
    - 15 to 30% of gilts bred will not farrow