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Development of Gilts and Boars for Efficient Reproduction

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Development of Gilts and Boars for Efficient Reproduction

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Successful introduction of replacement gilts and boars into the breeding herd is an important aspect of breeding herd efficiency. To attain herd efficiency, females must ovulate adequate numbers of viable ova, express estrus, show willingness to mate, and conceive in a regular manner. Males must produce adequate numbers of fertile spermatozoa, possess ability and show willingness to mate, and produce high-conception rates. If these qualities are properly developed, pregnancy rate and litter size will be maximized.

Gilt Development

A gilt development and management program begins at birth. Factors to consider when choosing replacement females are presented in PIH-27, *Guidelines for Choosing Replacement Females*. This publication discusses factors during rearing and upon selection for breeding that influence the attainment of puberty and subsequent reproductive performance in gilts.

Gilt Rearing–Birth to 160 Days

Litter size while nursing the sow. The influence of size of litter during the nursing phase on future reproductive performance is discussed in PIH-8, *Managing Sows and Gilts for Efficient Reproduction.*

Floor space. Although the minimum floor space needed to prevent a delay in attainment of puberty has not been established, the floor space listed in Table 1 should allow prepubertal gilts to mature properly.

Gilts per pen. Research is limited in this area, but it appears that gilts should reach puberty between 5.5 to 9 months of age when housed in groups of 10 to 30 per pen. Group sizes greater than 50 to 60 pigs per pen have been shown to delay puberty when gilts were maintained under relatively crowded conditions throughout development. Housing prepubertal gilts in individual stalls or tethers, or in groups of two to three per pen, will delay puberty.

Table 1. Floor space per pig.

Pig weight (lb)	Space[a] (ft²/ pig)	Pig weight (lb)	Space[a] (ft²/ pig)
15	1.3	150	6.2
30	2.1	180	7.0
60	3.4	210	7.7
90	4.4	240	8.4
120	5.3	270	9.1

[a] Floor space was calculated by using the equation $A = kW^{.66}$ where A represents square meters, k is a constant of .036, and W is the liveweight in kilograms. The metric values were converted to English values.

Rearing mates. Rearing gilts with contemporary barrows, contemporary intact males, or fenceline contact with a mature boar from 70 to 160 days of age does not influence age at puberty. It is advantageous to physically expose gilts to mature boars at least three weeks before mating to reduce the frequency of gilts exhibiting an inadequate standing response due to their being afraid of the boar.

Season of birth. Environmental and climatic conditions during the time of year when the gilt is approaching sexual maturity have more of an influence on age at puberty than season of birth. The percentage of gilts reaching sexual maturity during June through September can be 23% to 60% lower than during other months of the year. So, increase the number of gilts selected for mating during June through September. It is critical that gilts be exposed to mature boars during the summer months to increase the percentage of gilts reaching puberty.

Nutrition. The technology of feeding barrows and gilts separately is being adopted widely in the United States. Separate-sex feeding provides the opportunity to feed gilts from very early in life for maximum sow productivity and longevity. Table 2 lists suggested nutrient recommendations for developing maternal-line gilts. Gilts are full-fed during the rearing phase. Calcium and phosphorus concentrations are 0.1% greater than those provided in the diets of grow-finish hogs of the same weight. This insures maximum bone mineral deposition and sow longevity.

In the US and other countries, gilts are full-fed during the rearing phase. In several European countries however, gilt feed intake is moderately restricted during the rearing period. Restricting feed intakes to 70 to 80% of ad libitum slows growth to 1.1 to 1.3 lb./day and increases the number of gilts available for breeding purposes because fewer gilts experience the mobility problems associated with over-fatness and fast growth rates. The disadvantages of restricting the feed intake of developing gilts during rearing are delayed puberty, additional labor and management to accomplish feed intake restrictions, and greater facility cost associated with a longer gilt development period.

Table 2. Nutrient recommendations for developing maternal-line gilts (as fed basis).[a,b,c]

Body weight, lb	45 to 80	80 to 130	130 to 190	190 to 230
Feed intake (lb/day)[d]	3.3	4.5	5.5	6.5
Nutrient	**Percent of diet**			
Lysine, total	1.00	.90	.80	.65
Lysine, digestible	.82	.73	.64	.51
Tryptophan	.19	.17	.16	.13
Threonine	.65	.59	.54	.44
Methionine	.27	.24	.22	.18
Methionine + cystine	.55	.50	.48	.39
Calcium	.85	.80	.75	.70
Phosphorus, total	.75	.70	.65	.60
Phosphorus, available	.49	.45	.40	.36
Nutrient	**Calculated daily intake, grams**			
Lysine, total	15.0	18.3	20.0	19.1
Lysine, digestible	12.3	14.8	16.0	15.0
Tryptophan	2.8	3.5	4.0	3.8
Threonine	9.7	11.9	13.5	12.9
Methionine	4.0	4.9	5.4	5.1
Methionine + cystine	8.2	10.1	12.0	11.4
Calcium	12.7	16.3	18.7	20.5
Phosphorus, total	11.2	14.2	16.2	17.6
Phosphorus, available	7.3	9.1	10.0	10.6

[a] Nebraska-South Dakota Swine Nutrition Guide, 1995.
[b] All diets are full-fed under thermoneutral conditions.
[c] Digestible and available nutrient levels are calculated based on a corn-soybean diet.
[d] Average dietary energy density is 1.48 Mcal metabolizable energy/lb.

Housing. Housing gilts indoors has increased breeding problems, mainly the lack of estrus, but the indoor factors which inhibit puberty have not been identified. Producers have attempted to circumvent the problem and hasten pubertal development by moving gilts to outdoor lots at 70 to 120 days of age. Relocating indoor-reared gilts to other indoor pens at 70 to 120 days of age hastens pubertal development but is less effective than moving gilts to outdoor lots.

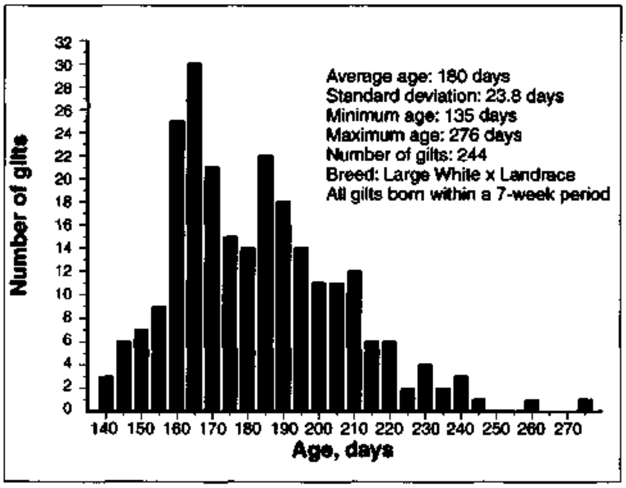

Figure 1. Distribution of age at puberty.

Gilt Rearing - 160 Days of Age to Breeding

Genetics. Age at puberty is genetically influenced. However, specific conclusions about breed differences are difficult to make because many stimulatory and inhibitory factors influence age at puberty. The average age at puberty can range from 164 to 230 days of age. Also, a substantial range in age at puberty from the first to the last gilt can be found within a contemporary group of gilts (Figure 1). The average age at puberty of crossbred gilts is three to 36 days earlier than the average of the parent breeds represented in the cross. Thus, crossbred gilts bred at the usual breeding age will ovulate more eggs and produce larger litters than purebreds bred at the same age because they have experienced more heat periods. Inbreeding, on the other hand, tends to increase age at first estrus.

Because the heritability of age at puberty is relatively high (35% to 50%), replacement gilts should not be kept from dams that were late (old) in showing their first estrus, or in conceiving their first litter. Producers should not keep gilts for breeding that have not expressed first estrus by 225 days of age.

Photoperiod. With indoor production there is concern about the effect of light on the attainment of puberty. The influence of photoperiod on age of puberty and proportion of gilts reaching puberty remains controversial. Many scientific studies used boar exposure to detect estrus when evaluating the effect of photoperiod on puberty attainment; thus, the true effect of photoperiod cannot be determined. Table 3 indicates the proportion of gilts reaching puberty is greatest when gilts are exposed to mature boars, regardless of whether duration of daylight is increasing or decreasing. Neither the type of lighting (fluorescent or incandescent) nor intensity of light (lux) significantly influences puberty attainment in gilts. So, it is most economical to maintain developing gilts under cool white fluorescent light (270 to 500 lux) for 10 to 12 hours per day. Complete darkness delays puberty as compared to nine to 11 hours per day of natural light.

Ambient temperature. High environmental temperatures (>85° F) do interfere with the expression of behavioral estrus, reduce feed intake, and lower ovulation rate in cycling gilts. Protect replacement gilts from high environmental temperature (>85°F) by providing adequate shelter and supplemental cooling to prevent severe stress.

Indoor versus outdoor housing. During fall and winter periods when seasonal conditions favor early puberty, indoor housing results in delayed puberty, an increase of irregular estrous cycles, and an increase of behavioral anestrus (ovulation unaccompanied by standing heat) as compared to outdoor housing.

Holding gilts beyond nine months of age in the indoor facility where they were reared seems to increase incidence of irregular or abnormal estrous cycles, and lack of estrus. Gilts that are eight months of age or younger and near the age when cycling first occurred have delayed puberty onset but have fewer problems with irregular estrous cycles.

Some breeds (e.g., Landrace, Large White and their crosses) reach puberty about as readily indoors as outdoors, whereas in other breeds (e.g., Duroc and Yorkshire), puberty is markedly delayed indoors.

Gilts reared indoors respond readily to relocation and boar exposure stimuli when they are nearing the spontaneous onset of puberty (165 to 190 days of age). Gilts reared indoors should be relocated within the facility or moved outdoors and provided contact with a boar approximately three weeks prior to their exposure for breeding.

Stocking density. Research has not been conducted to determine whether the number of gilts per pen or square feet per gilt affects the ability of a gilt to express regular estrous cycles.

Boar effect. The exposure of prepubertal gilts to a mature boar will significantly reduce the age of the gilt at puberty attainment. The interval from first boar exposure

Table 3. Proportion of gilts reaching puberty when the duration of daylight is increasing or decreasing.

	Duration of daylight is increasing		Duration of daylight is decreasing	
Study	Boar exposure[a]	No boar exposure	Boar exposure[a]	No boar exposure
1	74.0	13.9	89.4	52.6
2	72.4	2.9	62.1	54.1
	(195)[b]	(227)	(196)	(212)
3	79.0	31.0	80.0	12.0
	(192)	(200)	(205)	(199)

[a] Age of gilts at initiation of boar exposure was 165 to 173 days.
[b] Numbers in parentheses are average age at puberty in days

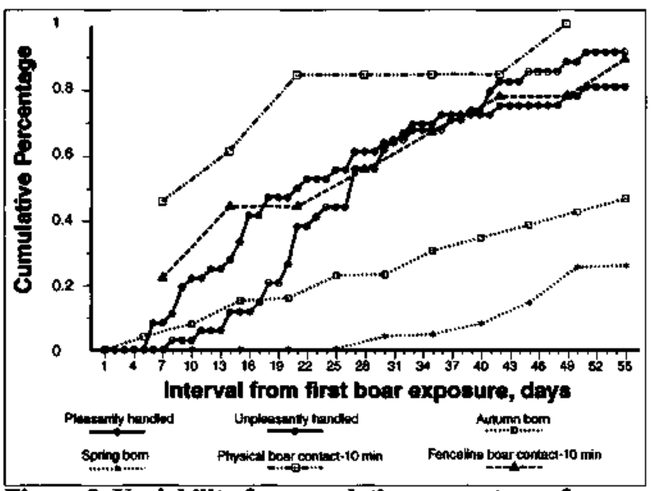

Figure 2. Variability for cumulative percentage of gilts expressing pubertal estrus after initiation of boar exposure.

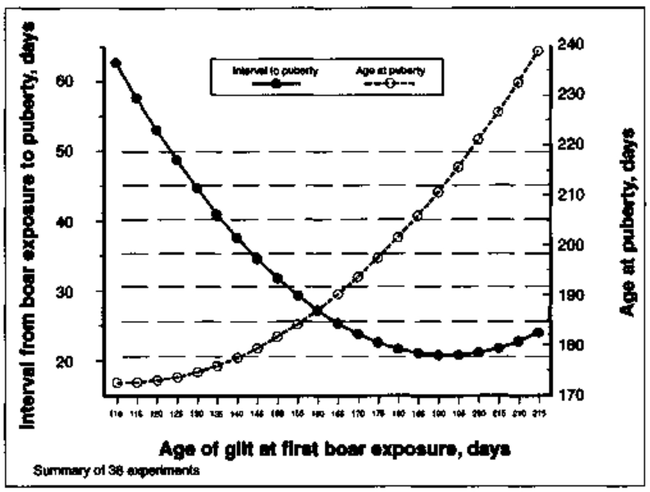

Figure 3. Generalized trend for age of gilt at first boar exposure on attainment of puberty.

to puberty can be quite variable (Figure 2); therefore, many times it is assumed that boar exposure does not work. Although the effectiveness of boar exposure can be influenced by nutrition, genetics, and environment, the reason boar exposure may not work on a particular unit is due to a failure to observe the "rules" of boar contact. The factors to consider when using boar contact are:

Age of gilt at first boar exposure. The age of the gilt at first boar contact influences the interval from boar contact to puberty. Gilts less than 140 days of age take considerably longer to reach puberty after initial boar contact than do older gilts (Figure 3). Average age at puberty is similar among gilts exposed between 145 and 175 days of age. The interval from boar exposure to puberty is lowest when gilts are exposed to boars at 185 to 200 days of age. Schedule boar contact to maximize the earliest possible puberty or synchronized first estrus desired. In cases where synchrony is desired, provide boar exposure about three weeks before the breeding season starts and when the gilts are 165 days of age or older.

Age and sexual behavior of boar. Pheromones and physical contact are the major components of boar exposure that stimulate puberty in gilts. A major source of pheromones is the submaxillary portion of the salivary gland which does not commence development until about six months of age. Therefore, the boar should be at least 10 to 11 months of age to adequately stimulate puberty. Boars of this minimum age may not stimulate puberty in gilts as effectively as will older boars. Considerable differences do exist between mature boars in their ability to stimulate puberty attainment in gilts. Puberty attainment in gilts occurs 14 to 30 days earlier when they are stimulated with a high-libido boar as compared to a low-libido boar. The cause of this difference is speculated to be differences in the level of pheromones emitted and tactile stimulation provided to the gilt.

Type of boar contact. The method of exposing gilts to the boar is important. Direct physical contact with a boar is usually more effective than fenceline contact. Also, a greater proportion of gilts are likely to attain puberty if the gilts are taken to the boar area for estrus detection. The interaction between a boar and gilt was found to be significantly decreased when the number of gilts per group was increased from two to eight or the size of the exposure pen was increased from 14.7 sq ft to 117.3 sq ft per gilt. However, the number of gilts per group and the size of the exposure pen did not affect the proportion of gilts reaching puberty within 21 days after starting estrus detection. Additional research needs to be conducted to evaluate how the level of boar sexual behavior influences the maximum number of gilts that can be exposed at one time per pen and size of exposure pen.

Frequency and duration of boar contact. Although exposing prepubertal gilts to mature boars for 10 to 15 minutes daily can stimulate puberty relative to no boar contact, puberty stimulation is maximized by providing gilts with boar contact two or three times per day. Increasing the frequency of boar contact is more beneficial during the summer than winter months. Exposing gilts to boar contact on alternating days delays puberty. Research shows that 5 to 15 minutes of boar contact per exposure is sufficient to stimulate puberty in gilts provided there is ample opportunity for physical contact between gilts and boars.

Estrous sow effect. Although boar exposure is generally more effective to stimulate puberty in gilts than estrous sow exposure, research shows that contact (continuous or 20 minutes per day) with estrous female pigs can stimulate and synchronize the onset of puberty in gilts. When exposing gilts at 160 days of age to an estrous sow the age at puberty ranged from 176 to 197 days, the proportion cycling by 215 days ranged from 26% to 80%, and the interval from first exposure to puberty ranged from 12.6 to 45 days. Research has not been conducted to determine whether or not the combination of boar and estrous sow exposure have an additive effect on puberty attainment.

Transport phenomenon. "Transport stress" triggers a synchronous first estrus in prepubertal gilts nearing puberty. Many pork producers have observed this response when gilts are moved to outdoor pens after being reared indoors. The response varies according to how close the gilts are to reaching puberty spontaneously when transport is initiated. Most gilts that respond to the "transport phenomenon" (15% to 30%) normally show estrus four to six days after transport. The main stimulus in the "transport phenomenon" seems to be the change in location rather than the change in social grouping caused by mixing unfamiliar gilts or the actual transport. Relocation should be scheduled after 165 days of age and combined with the initiation of boar exposure to obtain the maximal response. Transporting and boar exposure should occur about three weeks prior to breeding.

Air quality. The rearing of gilts indoors and exposing them to a gaseous environment may cause delayed puberty. Research shows that 33% of gilts reared in an environment having 5 ppm to 10 ppm ammonia reached puberty by 203 days of age compared to 12% for gilts reared in a 20 ppm to 35 ppm ammonia environment. However, the proportion of gilts attaining puberty by 240 days of age was similar and their average age at puberty was not different.

Nutrition Most replacement gilts are selected at market age. At that time, they are frequently relocated and enter a new feeding program. This time is sometimes called "acclimation."

Replacement gilt feeding programs are two-to-three month strategies designed to prepare replacement gilts for maximum lifetime reproductive performance. They vary depending on gilt genetic composition, rearing nutrition programs, environmental temperature, animal activity, individual or group housing, use of bedding, and desired age and body condition at mating. Programs focus on nutrition, but also include disease exposure and estrus management. In general, one of two nutrition programs is employed during acclimation: full or limit feeding.

Full feeding. Increasing carcass leanness is a major trend in the pork industry and it has led to the selection of very lean maternal genetic lines. Leanness is most evident when females are reared using grow-finish feeding programs designed to maximize lean tissue accretion. "High-lean" gilts generally have smaller appetites, are larger in mature body size, and have less backfat than conventional "average-lean" gilt lines.

A full-feeding strategy is used during acclimation to increase body fat deposition and slow lean tissue growth of high-lean gilts. This approach is taken because body fat reserves are important for subsequent lactation and rebreeding performance. Lean genotypes, if fed for maximum lean gain during rearing, may not have large enough body fat stores to meet the metabolic demands of parity one and two reproduction.

Fat and lean tissue growth of high-lean gilts in the replacement pool, can be manipulated in different ways. There is evidence that ad libitum access to a diet containing 0.45% lysine and 1340 kcal ME/lb. of feed, from selection until first farrowing, improves reproductive efficiency and longevity of high-lean females. Formulation of such a diet will require the use of fibrous feedstuffs. Alternatively, 5.5 to 6.5 lb./day of a 0.70% lysine, corn-soybean meal based diet, may be fed during acclimation. This regimen will also enhance body fat accretion in lean-genotype females.

Limit feeding. Some conventional, or "average-lean" gilt lines can get too fat if full-fed while in the replacement gilt pool. Problems with fat gilts and sows are well-known and include: anestrous, increased farrowing difficulties, decreased lactational feed intake, decreased milk production, and lighter litter weaning weights.

A limit-feed nutrition program is designed to maintain maximum lean and structural growth, with only moderate increases in body fatness. Dietary amino acids, vitamins and minerals are provided to maximize lean-gain potential. Energy intake is limited by restricting feed intake to 4.5 to 5.5 lb./day. A corn-soybean based diet formulated to contain 0.80% lysine is appropriate for conventional gilts being held for two to three months until mating.

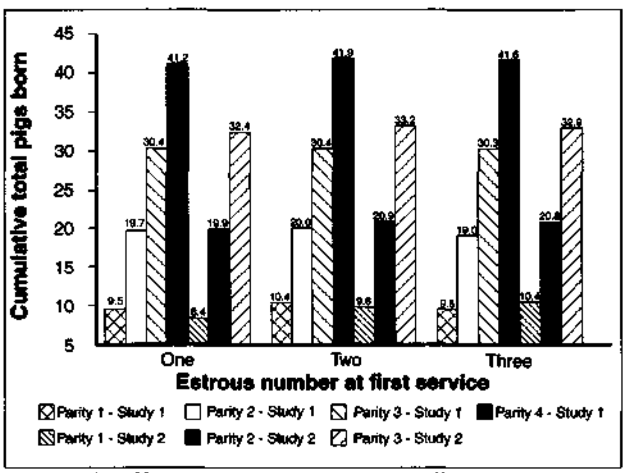

Figure 4. Effect of estrous number at first mating on cumulative number of pigs produced.

Flushing. Ten to 14 days before breeding, gilts should be given ad libitum access to feed (>10,000 kcal ME per day). This practice is called flushing and maximizes ovulation rate. Flushing increases the number of eggs released by about 2.6 as compared to limit feeding during the two-week pre-mating period. The high energy intakes associated with flushing should be discontinued immediately after the first service to prevent embryonic mortality. Gilts should be fed 4 to 6 lb. per day during the breeding period and early gestation.

Sow nutrition. The ability of young sows to produce milk, rebreed promptly after weaning and give birth to a large litter in parity two depends on both the amount of body reserves present at first farrowing and the extent of losses during lactation. Nutrition during parity-one gestation and lactation should be uniquely and appropriately intended for females which are both reproducing and still growing.

Age, weight, backfat, and estrous number at mating. Pork producers are concerned about feed cost during the non-productive period from selection to first pregnancy and the influence that age, weight, backfat, and estrous number at first mating have on long-term reproductive performance. There are considerable ranges in age (140 to 258 days), body weight (198 to 286 lb), and backfat (.4 to 1.2 inches) at puberty among and within genotypes. Interpreting data as to the true effect of age, weight, backfat, and estrous number at first mating on sow longevity and reproductive performance is difficult because several variables change simultaneously so the factor responsible for a result cannot be determined. In seven studies, sow longevity and reproductive performance were not influenced by body composition, live weight, backfat depth, or age of gilt at first breeding. In contrast, three studies showed that increased gilt age and(or) increased backfat at first mating enhanced sow longevity and reproductive performance. A study of commercial farms in The Netherlands indicated that the optimal economic age at first conception was 200 to 220

Table 4. Effect of feeding level and estrous number at mating on pigs produced.[a]

Estrous number at mating	Feeding level to:		Number of pigs at Parity:			Pigs born (total)	Sows culled (%)
	Puberty	Mating	1	2	3		
1	ad lib[b]	ad lib	9.5	9.1	12.2	31.0	28.6
2	ad lib	5.94 lb/day[c]	10.2	9.0	11.8	30.5	25.0
2	ad lib	Maintenance[d]	8.9	7.7	10.5	27.5	25.0
3	ad lib	5.94 lb/day[c]	9.2	11.5	10.0	31.1	22.2
3	ad lib	Maintenance[d]	9.6	9.5	11.0	30.5	33.3

[a] Landrace x Yorkshire gilts; first boar exposure at 120 to 130 days of age; average age at puberty was 172 ±31.3 days.
[b] 14% Crude protein corn-soybean meal finishing diet.
[c] 14.3% Crude protein, 1.6 Mcal metabolizable energy/lb.
[d] Maintenance amounts of crude protein and metabolizable energy each day.

days of age when the cost of housing and feed for the gilt from entry to first conception are taken into account.

A reduction in litter size born occurs when gilts are bred at puberty as compared to mating at second estrus. However, the difference between mating gilts at puberty or second estrus on lifetime production of pigs born narrows as the number of litters produced increases (Figure 4 and Table 4).

The decision of when to mate gilts becomes a compromise between costs (genetics, housing, nutrition, and culling) and estimated lifetime production of pigs.

Exogenous hormones. When using a hormone or hormone-like substance to induce puberty, the hormone treatment should be cost-effective, produce a significant improvement in gilt reproductive performance, and produce consistent and predictable results. A single injection of 400 IU of pregnant mare serum gonadotrophin (PMSG) and 200 IU of human chorionic gonadotrophin (hCG) to prepubertal gilts (5.5 to 7.5 months of age) has stimulated estrus in 52% to 87% of the gilts by six days after treatment. The percentage of treated gilts ovulating has ranged from 85% to 100% and pregnancy rate has ranged from 60% to 88%.

Estrus detection. The determination of first estrus in gilts is often difficult because they do not exhibit clear signs of estrus. About 36% of replacement gilts exhibit a questionable first estrus and about 16% have a silent estrus. The efficiency of detecting estrus can be influenced by the method and time of day of estrus detection. A research study found the proportion of estrous gilts showing the standing response was greater at 6:00 am (60%) than at noon (24%) or 6:00 pm (16%). To obtain the greatest efficiency when detecting estrus, gilts should not be exposed to boar stimuli for at least one hour prior to estrus detection. Gilts that have been stimulated to express the standing reflex will start becoming refractory to boar stimuli after about 10 minutes of standing.

Duration of proestrus (reddening and swelling of the vulva) is longer at first and second estrus (avg, 47 hours; range, 12 to 72 hours) than at third to sixth estrus (avg, 26 hours; range, 0 to 72 hours). Duration of estrus tends to be longer at first through third estrus (avg, 51 hours; range, 36 to 72 hours) than at fourth through sixth estrus (avg, 45.6; range, 12 to 84 hours). Duration of estrus in gilts is about 10 hours less than in multiparous sows.

Estrous behavior in gilts appears to be influenced by genetics. Heritability estimates for length of proestrus, length of estrus, ability to show standing reflex, and intensity of vulvar symptoms are .23, .16, .29, and .24, respectively. Negative genetic correlations have been reported for growth rate and length of estrus (-.49), growth rate and ability to show standing reflex (-.61), and body leanness and intensity of vulvar symptoms (-.17).

Boar Development

The optimum environment and management procedures for rearing young boars to maximize growth rate and hasten onset of sperm production and sexual behavior has not been extensively investigated. Early puberty is important if young replacement boars are to become efficient breeders (produce high conception rates and normal litter size) when put into service at a typical breeding age (7.5 to 9 months of age). Boars that reach puberty at an earlier age will have greater breeding capacity and can be mated successfully at an earlier age than slower maturing boars.

From a practical viewpoint, the actual age of puberty can be defined as the time at which a maturing boar is first observed mounting with an erection and able to produce sufficient sperm to impregnate a female. Although sufficient spermatozoa to impregnate a female can be found in the epididymis of young boars by 4.5 to 5 months of age, sexual motivation combined with ejaculation generally does not start until the boars are between 5 to 9 months of age. Sperm output is low immediately after puberty, increases to a maximum at 15 to 18 months of age, plateaus from 18 to 35 months of age, and then decreases.

Social environment. When boars are reared individually (to measure their growth rate, feed conversion efficiency, and daily feed intake), there can be detrimental effects on age at puberty, sexual behavior, and soundness of feet and legs. The development of the boar's reproductive organs or age at first copulation is not affected when group-housed boars are reared with contemporary gilts or in fenceline contact with adult cycling females. Research results of rearing group-housed boars indoors versus outdoors on age at puberty and expression of sexual behavior have been contradictory. In one study, rearing group-housed boars indoors did not significantly affect testis volume or sexual behavior as compared to group-housed boars reared outdoors on pasture lots. Another study showed boars in groups of five reared on earth lots reached puberty earlier and had a higher mating score than group-housed boars kept indoors on concrete floors.

Photoperiod. The onset of mating behavior is accelerated when natural daylight is extended to 15 hours of light by using either one 250-watt incandescent bulb or two 40-watt fluorescent bulbs per 80 sq ft of floor space. Extending light exposure during pubertal development has not affected testicular sperm production, semen quality, or serum concentrations of gonadotrophic hormones and testosterone; however, longer periods of light have been shown to decrease testis volume.

Ambient temperature. The effects of high ambient temperature on testicular development and function during the time of sexual maturation in boars has received limited study. Exposing the scrotum of boars at three months of age to 93.2°F to 98.1°F temperatures for 100 hours decreased sperm motility, decreased total sperm number, increased proximal cytoplasmic droplets, and increased abnormal sperm head shapes when the boars were six to eight months of age. Additional research is needed to clarify whether elevated ambient temperature and(or) cyclic ambient temperature during prepubertal development permanently affects sperm production and semen quality.

Nutrition. The nutritional effect on physical soundness and future reproductive performance of the boar is as important as its effect on boar growth rate, backfat, and feed efficiency. A 17% to 30% reduction in feed intake can delay age at puberty by 30 to 47 days. In practice, most young boars are offered amounts of feed that are close to their appetite potential during rearing. At this level there is unlikely to be any detrimental effect on sexual development or subsequent reproductive capacity. Table 5 lists suggested nutrient recommendations for terminal-line boars.

Mycotoxins. When prepubertal boars consumed a diet containing 9 ppm of zearalenone from 4.5 to 44.6 weeks of age, there was a numerical decrease of testicular and epididymal weight and a significant reduction of sperm motility. When prepubertal boars consumed a diet containing 40 ppm of zearalenone from 14 to 18 weeks of age, testicular weight, total sperm production, and sperm motility at 36 weeks of age was not affected; however, libido scores were reduced. The effect of zearalenone consumption by boars during the developmental phase on future farrowing rate and litter size has not been reported. The consumption of a diet containing .45 ppm of aflatoxin B_1 by prepubertal boars from 12.8 to 35.4 weeks of age did not significantly affect sperm motility, percent live sperm, or percent abnormal sperm.

Genetics. Crossbred boars clearly can reach puberty 40 days earlier than corresponding purebred boars. As a result of earlier maturity, crossbred boars have heavier testes, increased sperm concentration, more ejaculate volume, and improved semen quality at younger ages than their purebred counterparts.

Breed differences in pubertal development exist, but it is difficult to find comparative research data based on adequate numbers of each breed. It is generally recognized that certain white breeds (e.g., Yorkshire and Large White) have more sex drive and are more successful breeders at an early age than some of the dark breeds (e.g., Hampshire and Duroc). Regardless of the breed involved, select young boars from herds that emphasize reproductive efficiency and produce sexually active boars. With proper management, boars 7.5 to 9 months of age should settle 80% to 90% of the females they service.

Testes size. Long-term genetic studies have shown that selection for testes size at 150 days of age will increase testes size and sperm production in later generations. The influence of testes size on libido is uncertain.

Training boars. Replacement boar training is important because the mating act is a learned behavior. Boars that learn bad mating habits when they start mating will likely have bad mating habits throughout their lives. One training program will not be good for all boars because boars are individualistic and temperamental. People handling boars need to keep a positive mental attitude about handling boars and build a strong personal bond between themselves and the boar. Boars should be handled gently but firmly and never abused or teased.

The first few matings by replacement boars are important. Take the young boar to the breeding area a

Table 5. Nutrient recommendations for boars.[a]

		Development phase			
Item	**Unit**	**Early**[b]	**Middle**[b]	**Late**[b]	**Mature**[c]
Body weight	**lb.**	**50-120**	**120-200**	**200-300**	**300-600**
Nutrient					
Lysine	%	1.2	1.1	1.0	.85
Tryptophan	%	.24	.22	.20	.17
Threonine	%	.86	.79	.72	.61
Methionine + cystine	%	.72	.66	.60	.51
Calcium	%	.95	.85	.75	.90
Phosphorus, Total	%	.75	.65	.80	.80
Phosphorus, Available	%	.49	.40	.52	.52
Salt (NaCl)	%	.3	.3	.5	.5
Chloride	%	.08	.08	.08	.12
Copper	ppm	15	15	15	25
Iodine	ppm	.15	.15	.15	.15
Iron	ppm	80	60	60	80
Manganese	ppm	10	10	10	20
Selenium	ppm	.3	.3	.3	.3
Zinc	ppm	150	100	100	150
Vitamin A	IU/lb.	2000	2000	2000	2500
Vitamin D	IU/lb.	250	200	200	250
Vitamin E	IU/lb.	90	50	50	90
Vitamin K	mg/lb.	2	2	2	3
Choline	mg/lb.	250	250	250	600
Niacin	mg/lb.	15	12	12	15
Riboflavin	mg/lb.	6	4.5	3	6
Pantothenic Acid	mg/lb.	7.5	7.5	5	10
Vitamin B_{12}	ug/lb.	15	15	15	20

[a]Tri-State Nutrition Guide (Michigan, Ohio, Indiana), 1997 (In-press)
[b]Early, middle and late phase diets full-fed in thermoneutral conditions.
[c]Mature boars are limit fed (5 to 6.5 lb./day; depending on body weight and frequency of service).

few times before he is expected to mate. This procedure lets the boar become familiar with the mating area before he encounters his first female to mate. Also, it is very important that the mating pen floor be non-slick. Provide excellent traction and keep the floor as clean and dry as possible. Initially, mate replacement boars to first-litter sows because sows usually exhibit a stronger and longer immobilization response than gilts. Never let the replacement boar ejaculate in the rectum or be physically abused by an aggressive female or handler.

Introducing New Breeding Animals

Isolation, blood testing of purchased replacement animals, and a strict sanitation and traffic control program minimize opportunities for new disease organisms to enter the breeding herd. The following PIH fact sheets contain various types of information to prevent the spread of disease:

PIH-8	*Managing Sows and Gilts for Efficient Reproduction*
PIH 59	*Infectious Swine Reproductive Diseases*
PIH-68	*Guidelines for the Development of a Swine Herd Health Calendar*
PIH-79	*Environmental Sanitation and Management in Disease Prevention*
PIH-80	*Selection and Use of Disinfectants in Disease Prevention*

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