Management of Developing Gilts and Boars for Efficient Reproduction – Pork Industry Handbook
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pork industry handbook

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Management of Developing 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 fertile ova, show willingness to mate (estrus) and conceive readily. Males must produce adequate numbers of fertile spermatozoa, possess ability and show willingness to mate and produce high conception rates. If these traits are properly developed in both sexes, pregnancy rate and litter size will be maximized. The purpose of this fact sheet is to help producers better understand the important factors in the management of the developing gilt and boar for maximizing their reproductive efficiency.

Gilt Development

Gilts should reach puberty (exhibit first estrus and ovulate) at an early age, continue regular estrous cycles until bred and conceive readily at first breeding. Early puberty is necessary if replacement gilts are to be successfully bred during a limited breeding season and express their full potential for litter size. Gilts should express one or more estrous periods before the usual breeding age (7-9 mos.) since more eggs and larger litters are thus produced. Litter size in gilts receiving adequate energy will be increased approximately 2 pigs per litter by breeding at second estrus rather than at first estrus. Gilts that express first estrus at a young age (<6 mos.) can be bred earlier as long as one or more estrous periods have been expressed before breeding. This practice will materially reduce feed and other overhead costs associated with gilt maintenance without detracting from reproductive performance.

Genetic Factors

Most gilts reach puberty between 6 and 8 mos. (average 200 days). Crossbred gilts generally express first estrus earlier (1-4 wks.) than the average of the parent breeds represented in the cross. Thus, when bred at the usual breeding age, crossbred gilts will have experienced more heat periods, will ovulate more eggs and will produce larger litters than purebreds. Inbreeding, on the other hand, tends to increase age at first estrus.

Producers should not routinely keep for breeding gilts that have not expressed first estrus by 7½ months. Breeders should not keep replacements from dams that were late (old) in showing their first estrus or in conceiving their first litter because the heritability of age at puberty is relatively high (35-50%).

Level of Nutrition

Most gilts are developed to 175-200 lbs. (4½-6 mos.) by self-feeding growing-finishing diets which allow maximum expression of their genetic potential for growth rate and fat deposition. Although this practice is necessary to obtain satisfactory individual growth and backfat records for use in selection, self-feeding should not be continued after the performance test is completed.

Energy intake can be restricted after 175-200 lbs. without delaying puberty. This restriction can be accomplished by daily hand feeding each gilt 4-5 lbs. of a 14% protein, well-balanced diet. Protein, vitamins and minerals should be supplied in the diet in amounts that provide the daily allowance recommended by the National Research Council when the diet is restricted-fed. Energy restriction not only saves on feed costs but prevents the accumulation of unneeded weight and body condition which may decrease longevity of production and be a contributing factor in the development of unsoundness in young as well as older breeding females.

Other factors which must be considered in the proper management of a limited feeding program are the influences of animal activity and cold temperature on the level of feed required. Gilts maintained in confinement require approximately 10% less feed (.5 lb./head daily) than gilts maintained outside in large pens. Requirements are approximately 25% greater (1 lb./head daily) during the extreme cold of winter as compared to other seasons.

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Prebreeding Conditioning

The restricted feeding program should be terminated and replaced by a high or moderate level of energy just prior to breeding so that gilts are in an improved nutritional state and are gaining weight. High energy feeding (essentially full-feeding) during the last 7-10 days of the estrous cycle prior to the breeding estrus will maximize the number of eggs released. If high energy feeding is continued into early gestation, however, the gilts may suffer increased embryonic mortality and fail to show improvement in litter size. Gilts should be fed a moderate level of energy (5-6 lbs./head daily) during the prebreeding period when it is not possible to remove them from the high energy diet immediately after breeding. Bred gilts can continue on this level of energy without the risk of increased embryonic mortality encountered with high energy feeding.

Seasonal Effect and Influence of Photoperiod (Day Length)

Slaughterhouse data and controlled experiments have demonstrated that winter- and spring-born gilts are delayed in expressing first estrus as compared to gilts born in other seasons of the year. Whether the delayed puberty is because of the high summer temperatures or the reduced day length during a critical stage of puberal development is not known. High environmental temperatures (>85°F) do interfere with the expression of behavioral estrus, reduce feed intake and lower ovulation rate in cycling gilts. Replacement gilts should be protected from high environmental temperature (>85°F) by providing adequate shelter and enough supplemental cooling to prevent severe stress. Curtain-sided buildings with insulation overhead and equipped with thermostatically controlled foggers and fans appear to be as good as totally enclosed air conditioned breeding buildings

The importance of photoperiod as a component of the seasonal effect is not adequately documented by research data. Complete darkness appears to delay puberty as compared to natural light variations or 12 hrs. of artificial light per day. Six hours of artificial light per day does not appear to be adequate for early puberty. Thus, it appears that gilts in total confinement should receive approximately 12 hrs. of artificial light per day. More information is needed, however, before sound recommendations can be made regarding the optimal photoperiod and lighting intensity needed for early puberty in swine.

Confinement Effects

The management of gilts in total confinement has caused increased breeding problems, mainly lack of estrus. Producers have attempted to circumvent the problem by removing gilts from confinement (usually relocating them to outside lots) prior to breeding. The failure of gilts to express estrus at the usual breeding age (7-9 mos.) may be caused by delayed puberty or by an increased incidence of behavioral anestrus (ovulations unaccompanied by standing heat).

The magnitude of the breeding problems encountered in confinement is related to age, breed and season. The maintenance of older gilts (>9 mos.) in the same confinement facility where they were reared seems to result in an increased incidence of irregular or abnormal estrous cycles, including lack of estrus. Gilts that are younger (<8 mos.) and nearer the age when cycling was first initiated have less problem with irregular estrus, but are delayed in reaching puberty. Some breeds (e.g., Landrace, Large White and their crosses) reach puberty about as readily in confinement as in nonconfinement, whereas in other breeds (e.g., Duroc and Yorkshire), puberty is markedly delayed in confinement. Confinement seems to produce the greatest delay in puberty and causes the greatest increase in the incidence of irregular estrous cycles, compared to nonconfinement, when the seasonal conditions are optimal for early puberty (fall and winter periods). Puberty in confinement managed gilts may be less affected by season because seasonal factors (day length, temperature etc.) are not allowed to vary as they do under natural outside conditions.

Relocating gilts from confinement to outside lots (70-120 days of age) results in earlier puberty. Relocation in confinement also hastens puberal development but is less effective than relocation to the outside lots at these ages.

Gilts reared in confinement respond readily to relocation and boar exposure stimuli when they are nearing the onset of puberty (165-190 days of age). Confinement-reared gilts should be relocated (inside or outside) and provided contact with a boar approximately 3 wks. prior to their exposure for breeding.

The factor or factors in confinement which are inhibitory to puberty have not been identified. Inadequate light may be a factor in some confinement situations; but this does not explain the inhibitory effects of confinement when supplemental light is provided.

Rearing Intensity. Rearing intensity represents another change in the environment of confinement-reared gilts. Gilts have less space or elbow room, and there is more competition for available space because of the presence of more pigs per unit of space. Research is limited in this area, but it appears that the recommended density for finishing pigs (8 sq. ft./pig) is adequate for normal puberal development up to the time gilts are selected for replacement (5-6 mos.). Group size should be limited to 24 pigs/pen or less. Larger group sizes (50-60 pigs/pen) have been shown to delay puberty when gilts were maintained under relatively crowded conditions throughout development.

Social Isolation. Social isolation of gilts during development should be avoided. Research has shown that individually penned or tethered gilts are delayed in reaching puberty compared to group-reared gilts.

Boar Effect

Isolation of developing gilts from the presence of a boar markedly delays puberty compared to providing gilts with once daily or continuous contact (fence line or physical) with a boar. The timing or age of the gilts at boar exposure has an important bearing, however, on the response obtained. Gilts provided boar exposure too early in development (before 125 days of age) are often delayed reaching puberty, whereas, gilts provided contact with a boar starting at 135-165 days of age attain puberty at the youngest possible age. Withholding boar exposure until after 165 days of age will produce an older average age at first estrus compared to a 135-165 day boar exposure; but the estrous response will be more rapid (3-7 days in 30-90% of the gilts) and more synchronized.

Contact with the boar should be scheduled to maximize the puberal response (earliest possible puberty or synchronized first estrus) desired. Boar exposure should be provided about 3 wks. prior to the start of the breeding season in cases where synchrony is desired and boar exposure is initiated after 165 days of age.

The Transport Phenomenon

"Transport stress" triggers a synchronous first estrus in prepuberal gilts nearing puberty (200-250 lbs.). Many swine producers have observed this response when gilts are moved to outside pens after being grown-out in confinement. The response varies according to how close the gilts are to reaching puberty when transport is initiated. Most gilts that respond to the "transport phenomenon" (15-30%) normally show estrus 4-6 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 about 3 wks. prior to breeding and should be combined with the initiation of boar exposure to obtain the maximal response.

Boar Development

Most boars reach puberty (ability and willingness to ejaculate fertile spermatozoa) between 5 and 8 mos. of age. Sperm may be found in the testes much earlier (110-125 days of age) than this, but there is some delay before the sperm are able to fertilize ova and the boar develops the coordinated pattern of sexual behavior necessary for successful copulation.

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 the usual breeding age (7½-9 mos.). Boars that reach puberty at an earlier age will have greater breeding capacity and can be mated successfully at an earlier age than slow maturing boars. The number of spermatozoa and the volume per ejaculate increases up to 18 mos. of age.

Genetic Factors

Crossbred boars generally show accelerated puberal development as compared to the average of the parent breeds represented in the cross. One research report observed that the reciprocal crosses of the Duroc and Hampshire breeds exceeded the two parent breeds by 16% in testes weight and 25% in the number of sperm in the testes at 7½ mos. of age. Young crossbred boars (7½-9 mos. of age) also showed more libido (sex drive), were more successful breeders and produced higher pregnancy rates than the purebreds. Crossbred boars have many advantages and their possible contribution should not be overlooked when attempting to maximize the benefits of hybrid vigor in a commercial crossbreeding program.

Breed differences in puberal development also exist, although it is difficult to find comparative research data based on adequate sized samples 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). No matter which breed of boar is purchased, young boars should be selected from herds that place emphasis on reproductive efficiency and produce and sell boars that are sexually active and able to settle a high percentage (80-90%) of the females they are exposed to at 7½ to 9 mos. of age.

Level of Nutrition

Most boars are developed to 200-240 lbs. (4-6 mos.) by self-feeding growing-finishing diets that allow maximum weight gain. This practice is necessary to obtain individual growth rate and backfat information for use in selection programs but should be discontinued as soon as reliable measures of these traits can be obtained. Level of nutrition can be markedly reduced without influencing age at puberty and subsequent fertility. Consequently, energy intake should be restricted to approximately 70% of full-feed intake after 175-200 lbs. This restriction can be accomplished by individual hand feeding 4-5 lbs. daily of a 14% protein well balanced diet or by self-feeding this diet every other day. Just as with gilts, energy restriction during development saves on feed and prevents the accumulation of unneeded body weight and condition which may be a contributing factor to the development of unsoundness, awkwardness and reduced libido.

Nutrients other than energy should be supplied to meet the daily nutrient allowances recommended by the National Research Council. Boars managed in confinement will require about 10% less feed (.5 lb. daily) to maintain proper body condition than boars maintained outside. Energy requirements are approximately 25% greater (1 lb. daily) during extreme cold and when boars are being used actively for breeding.

Seasonal Effects

Studies of yearly herd records by several research groups have revealed rather pronounced seasonal influences on conception and farrowing rates. Matings made during August consistently produced the poorest reproductive performance with the months of June, July and September following closely behind. Evaluation of the role of the male and female in the problem of reduced summer fertility indicates that both sexes are adversely affected by the high temperature conditions characteristic of the summer months. Little information is available regarding the effect of seasonal factors on puberal development, but one researcher has reported that boars born in the summer had longer testes and higher numbers of sperm in the epididymis at 168 days of age. This finding suggests that puberal development in boars, as in the situation with gilts, is accelerated during the cooler seasons of the year.

Temperature effects. Seasonal variation in boar fertility is eliminated when boars are housed in a temperature controlled building (maximum summer temperatures 65-75°F.) rather than in outdoor pens with shelter (maximum summer temperature 86-104°F.) during the summer months. The adverse effects of high environmental temperature (88-95°F.) on semen characteristics (number of sperm/ejaculate and sperm motility) persist for approximately 6 wks. after the end of heat stress. The period of heat stress need not be more than 72 hrs. in duration to exert a detrimental effect on semen quantity and quality and on fertility during the 2-6 wk. period following heat stress. Thus boars should be allowed 6 wks. after the end of heat stress to return to normal semen production and to regain high fertility. Even though the temperature has declined and breeding conditions seem favorable, the boar must not be put back into service until recovery is complete.

Young boars should be relieved of high environmental temperatures prior to and during breeding to insure high fertility. When ambient temperatures exceed 80°F. or respiratory rates increase to greater than 50 breaths per min., some type of cooling should be provided. Evaporative cooling or a combination of shade and sprinklers effectively counteracted summer infertility in boars under Oklahoma conditions ($<$50% relative humidity), whereas shade alone did not appear to be adequate. Thermostatically controlled foggers, in curtain-sided buildings with insulation overhead, gave equally good conception rates as enclosed air conditioned breeding buildings under North Carolina conditions.

Low environmental temperature seems to have little influence on semen production and fertility in young (7-8 mos. of age) boars. Damage may occur, however, if boars are not provided with adequate shelter and bedding to protect them from extreme cold.

Boars should be monitored closely for illness and elevated temperatures prior to and during the time they are being used for breeding. Young boars should be purchased at least 45-60 days prior to anticipated use to allow time for quarantine, acclimation, gradual introduction into the herd and sufficient time for recovery in case illness and elevated temperatures occur upon arrival at the farm or are produced following exposure to other pigs on the farm.

Light effects. Limited research suggests that the addition of supplemental light (light from a 250 watt incandescent bulb) to the natural daylight received in the fall through windows will hasten puberty in boars. Boars receiving supplemental light were heavier, were collected significantly earlier and had more sex drive than unsupplemented boars. This finding was not confirmed, however, when the supplemental lighting was provided during a period of increasing natural day length.

In older boars, a long photoperiod (16 hrs. of light daily) seem to reduce sperm output, lower motility and decrease fertility as compared to a shorter photoperiod (10 hrs. of light daily). The adverse effects of long day length are expressed in both moderate (59°F.) and high (95°F.) temperature environments, but the effects are most pronounced when the temperature is also high. More research is needed before sound recommendations can be made.

Confinement Effects

Confinement management of swine has increased rapidly during the past decade. The shift from pasture to confinement management has been accompanied by increased breeding problems with young boars. Most of the breeding problems are associated with subnormal development of sexual behavior rather than with deficiencies in semen production. These include refusal to mount, mounting only males, mounting but failure of intromission, decreased ability to identify estrous females and general sexual indifference.

The fact that reproductive problems have increased with adoption of confinement management systems is not surprising when considering how these systems evolved and the changes which the pigs have been subjected to are taken into account. Facilities (buildings and equipment) generally have not been designed to meet the developmental needs of the pigs, but rather to maximize production with a minimum of labor and inconvenience. Consequently, pigs are usually weaned at an early age (2-4 wks.), reared in large, homosexual groups under relatively crowded conditions and kept separated from older, sexually mature animals of both sexes until after they are selected as replacements. Boars being performance tested for certain individual traits, e.g., feed efficiency, require individual penning and have virtually no opportunity to interact with other pigs during development. In addition, boars with outstanding performance credentials are often kept isolated from other pigs after selection to protect them from possible injury.

Based on information in laboratory species and a limited amount of data in pigs, it appears that this type of handling is incompatible with the development of normal sexual behavior and is an invitation to development of sexual ineptness.

Social Restriction. A large part of adult sexual behavior is learned before and during the attainment of puberty. It has been demonstrated in laboratory species that males deprived of social contact during early development are less likely to copulate successfully than similar males reared with littermates. Males reared alone typically did not mate, whereas males reared with other males mated occasionally and males reared with both males and females nearly always mated successfully.

Social contact is also important to the development of normal sexual behavior in young boars. Young boars reared without visual and physical contact with other pigs achieve fewer copulations and display less courting behavior than group-reared pigs. Socially deprived boars are also slower to react to estrous females and tend to have less mating dexterity. The poor copulatory performance of socially deprived boars seems to be permanent.

Young boars need to be reared in groups so that they have the opportunity for physical contact and interaction with other pigs during development. It makes no difference whether the group is all male or of mixed sex. If the needs of the boar are ignored during development, he may develop into a sexual misfit and cause the breeder or purchaser unnecessary breeding problems. A development plan needs to be established which provides boars the lessons or training needed to allow them to become successful breeders later on in life.

Summary

1. Gilts usually reach puberty between 6 and 8 mos. of age. Selection for early sexual maturity will result in genetic improvement for this trait.

2. Energy restriction after gilts reach 175-200 lbs. will produce replacements that are in more productive condition to "flush" and yet not delay puberty.

3. Flushing gilts for 7-10 days following an extended period of restricted energy intake will increase litter size at birth.

4. Fall-born gilts reach puberty at an earlier age than spring-farrowed females.

5. There is some evidence that photoperiod (length of daylight) does affect age at puberty, but not all research shows that more light than is normal in fall and winter is essential to shorten age at puberty.

6. Close confinement of gilts does delay puberty and increases the incidence of behavioral anestrus (lack of heat).

7. Crowding is suspected to inhibit puberty but it appears that if 8 sq. ft. per pig are maintained and group size does not exceed 24 pigs per pen, puberal development will proceed in a normal pattern.

8. Isolating gilts in individual pens (or stalls) in confinement or outside is known to delay puberty, to increase silent estrus and/or to bring about irregular estrous cycles.

9. For maximum early sexual development, gilts and boars should be exposed to one another by not later than 165 days of age.

10. Moving gilts to new housing and exposing them to boars (by either direct or through-the-fence contact) at intervals of 21 days prior to the desired breeding date will produce maximum synchronization of replacement gilts.

11. Most boars reach puberty between 5 and 8 mos. of age. Crossbreds reach puberty at an earlier age and mount quicker than purebreds.

12. Age of boars has a greater influence on sexual maturation than body weight. Energy intake should be restricted to 70% of *ad libitum* after 175-200 lbs. to prevent too much condition on young boars.

13. Environmental factors that lead to elevated body temperature of boars, such as hot weather, diseases or infections of various types, do reduce fertility and consequently, the litter size of females mated during these periods.

14. Temperature stress begins to exert its influence at 80°F. Shade, evaporator coolers, forced air ventilating systems and/or water sprinklers contribute to increased conception and larger litters when both boars and gilts are cooled with these means during periods when the environmental temperature exceeds 80°F.

15. Cold weather stress generally does not affect reproduction unless shelters and bedding are inadequate to protect the well-being of the animals.

16. Close confinement rearing of boars in small groups, such as is done in Swine Evaluation Stations, is not conducive to ideal mating behavior and/or reproductive success.

17. Exposing boars to gilts and/or raising them in groups with gilts or other boars is an extremely important process in teaching boars to become successful breeders. The ideal age for this practice is not evident from research but, from a practical point of view, it appears to be no later than 5½ mos. of age.

18. Some large commercial pork producers have found the practice of acquiring boars at a younger age (2-3 mos.) and rearing them in their own facilities has produced replacements that more successfully maintain a high level of reproduction efficiency on their farms.

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