# Management of Replacement Gilts

Dr. Tim Safranski
University of Missouri-Columbia

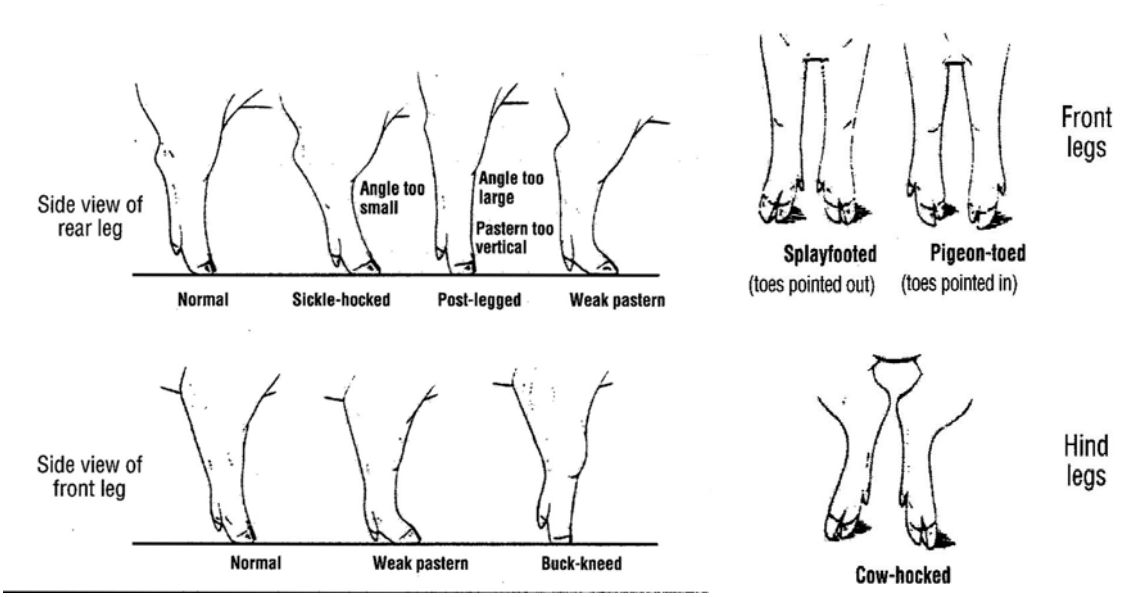
## Introduction

Management of replacement gilts may be the area of pork production with the widest gap between what we know how to do and what we actually do. That suggests that with application of existing knowledge we can make great strides in efficiently developing females to enter the herd, breed quickly, raise large litters of marketable pigs, breed back quickly, and remain in the herd. This paper is intended to provide an overview of some of the things we know how to do, as well as raise some issues that perhaps need more research. It is assumed that the reader has other sources for some details (e.g. formulating feeds). The information is intended to be broadly applicable, although the author recognizes that every farm is unique.

Management of replacement gilts is a critical area of production for several reasons. Thirty years ago it was common to select gilts from finishing floors as market hogs were being sold. This is rarely practiced today due to concerns for biosecurity, accelerated lean growth of modern genotypes, use of specialized sire and dam lines etc. This creates a situation where unique management of replacement females is more practical. Another major reason for unique management is the sheer impact that gilt litters have on overall farm performance. Record keeping systems suggest that most U.S. farms have annual replacement rates of over 50%. If a farm replaces only 45% annually and farrows 2.2 litters per sow per year, one in every five litters will be born to a gilt. The needs of this 20% of the females differ so much from the other 80% that some large farms have gone so far as to dedicate entire units to breeding and farrowing only gilts, with those females going to other sow units following weaning of their first litter.

## Selection

While there is not room in this paper to discuss it, genetic selection must be recognized as the first criterion used in selecting potential replacement gilts. Regardless of source or age at delivery, however, there are some physical features that producers should use to avoid future problems. Replacement gilts should be selected to have 14 reasonably evenly spaced nipples that appear normal. While most sows will not need all 14 simultaneously, it is common for there to be a loss of functional udder sections, and starting with 14 will allow the sow to have 10-12 functional even if there is some loss of productivity in some sections. Gilts that have difficulty moving are likely to get worse rather than better and should be avoided. Predicting which gilts are likely to have mobility problems in the future is more difficult. Gilts with uneven toes tend to have more feet problems than even-toed contemporaries. Shape and angles of bones can also be important, and while it seems obvious, it must be said that producers should consciously avoid selecting gilts that are splay-footed, pigeon-toed, cow-hocked, sickle-hocked, post-legged, weak-pasterned, or buck-kneed (Figure 1).

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**When should a replacement gilt begin to be treated differently than a market hog?**
Data as long ago as the 1970's indicated that differential treatment of potential replacement females should begin no later than at birth. Reproductive performance of gilts raised in standardized litters of six or 14 was measured. As expected piglets in the smaller litters were heavier at 14 days (one pound difference) and at weaning at 56 days (ten pound difference). Gilts were subsequently grown out and mated, and those reared in smaller litters ovulated 1.01 more eggs and had 1.2 more embryos at 25 days of gestation. Although they were only able to farrow a small number of these gilts the numerical difference persisted in number born alive. It appeared that nutritional/environmental stress prior to 56 days of age had detrimental effects on subsequent reproduction. The lifetime supply of eggs is established prior to 40 days of age.

Other efforts since then confirm these findings where gilts which themselves have heavier birth weights and weaning weights farrow and wean larger first litters. In one project a difference in three week gilt weight of 2.2 pounds translated into a difference of .2 to .3 pigs born alive in their subsequent first litters. In other words, a gilt which weighed 18 pounds at three weeks would be expected to farrow about one-half more live pigs in her first litter than one with similar genetic make up weighing 14 pounds at three weeks of age.

Commercial producers who select their own replacement gilts should take advantage of this effect. They might consider selection of gilts from smaller litters (ten or less piglets) or cross-fostering to enhance the maternal environment of potential replacement gilts. This could be done by loading up barrows and some gilts into larger litters within 24 hours of birth. Selection of larger gilts within larger litters could also prove beneficial, and some experts suggest a minimum birthweight for gilts to be potential replacements, which will vary among populations.

**Health management**

This paper cannot cover details for every farm, and producers are encouraged to work with their veterinarian and seedstock supplier to develop a comprehensive herd health management program including incoming gilts. That said, an area of gilt management often receiving insufficient attention is isolation and acclimation. Isolation/acclimation are important whether animals are purchased or internally produced. Internal production allows greater control (or requires greater responsibility) by the producer as to scheduling, group sizes, ages, etc. Isolation/acclimation programs must minimize health differences between replacement gilts and the sow herd. These programs should be farm specific, but generally isolation consists of 30 days for replacements to be blood tested for specific pathogens, observed for signs of illness and vaccinated. Another 30 days is used for acclimation where cull animals or biofeedback are used to expose replacements to pathogens present on the sow farm. This allows the gilts to 'get sick' from any novel pathogens and to recover before they enter the breeding facility.

**Feeding**

Feeding of replacement gilts is an area where there is far from universal agreement. It is likely that details will be farm specific and vary with genetics, health, geography, facilities, season etc. With most modern genotypes ad libitum feeding until mating will not be an acceptable practice. Another unacceptable practice is feeding a finishing diet until selection and boar exposure. The former is because gilts have such phenomenal growth potential that ad libitum feeding will result in gilts that are too large. The latter is because finishing diets are designed to maximize efficient growth for a terminal animal with no regard to longevity or to reproduction. Replacement gilts need to grow, but they also need to reach puberty, conceive, gestate, nurse a litter, and breed back quickly following weaning. Many modern genotypes will continue to gain body mass through the second gestation period. In addition to their muscle growth, maturation of bones, nervous system and reproductive system must also be considered for replacement gilts.

Nursery and early finishing diets are normally adequate for replacement females. By the time a gilt reaches 150-180 pounds, however, feeding programs should deviate. The emphasis shifts to development and maturation of reproductive ability rather than growth rate and body size. This requires additional vitamins and trace minerals, similar to those added in a sow gestation diet, and should include biotin, folic acid and choline and higher levels of calcium and phosphorous.

Most research with modern genotypes indicates that gilts should be fed to weigh near 300 pounds by mating at near 220 days of age. This may require limit feeding. In many instances physically limiting feed intake is not practical, so diet modification is implemented to reduce nutrient intake. This modification typically involves addition of bulking agents such as wheat middlings, beet pulp or soy hulls. Consult with a nutritionist to assure that adequate nutrient intake is provided.

When limit feeding is implemented it is preferable to return to ad libitum feeding two or three weeks prior to mating. In some instances this has been shown to result in a flushing effect and higher ovulation rate. This works best when gilts are removed from the breeding pen at mating, because ad libitum feeding the first four days post-mating can lead to increased embryo mortality, offsetting the gains in ovulation rate.

**Housing**
Replacement females should receive special attention throughout their lives to develop the most productive gilt possible. Space allocations provided to commodity hogs is less than ideal for replacement females. Little data exist to quantify the impact of these space differences in modern facilities with modern genetics, but it is suggested that gilts receive 10-12 square feet compared to the eight square feet suggested for commodity hogs. Once detection of estrus and mating are initiated more space is suggested. During breeding, allocations of 24 square feet are often suggested, with at least 14 should be provided to gestating gilts.

More data exist on other facets of housing. Gilts subjected to extremes in heat will reach puberty later. In this context 'extreme' is used to describe temperatures above 80-85°F. Interestingly most studies find that expression of puberty is earlier in gilts raised outdoors versus those raised in confinement. Air quality may be one contributing factor, as multiple studies have demonstrated the impact of varying air quality impairments on puberty; several authors have suggested that it is at least partly due to a failure of gilts exposed to poor air quality to respond to the olfactory cues of the boar (see later section).

Group size is typically determined by factors not associated with reproduction. Most conventional group sizes fall within ranges that have been shown to have no detrimental impact on puberty; greater than three and less than 50. For practical purposes groups of 8-15 may prove ideal once daily boar exposure is initiated. This size represents groups large enough to make efficient use of time, while small enough to permit sufficient boar exposure to each gilt and allow adequate observation.

Another element of housing that receives a lot of attention is daylength or photoperiod. With so many gilts being housed indoors it is a component that would be very simple to manipulate, but the data are far from conclusive on what is optimal. Absence of light and constant light are likely impractical and undesirable. If possible it is likely best to maintain enough light to comfortably read by for 9-12 hours per day, especially when daylength is decreasing. Some evidence suggests that broad spectrum (e.g. fluorescent) lighting is better than other sources.

**Managing puberty with the boar**
The single greatest management tool to manipulate when gilts reach puberty is exposure to boars. The boar emits compounds from the submaxillary salivary gland that act as pheromones. These compounds are derived from testosterone. The standing estrus response is expressed largely in response to these pheromones, although other cues can elicit the response as well. Prepubertal gilts can respond to these pheromones by attaining puberty earlier than if they were not exposed, and a difference of two to four weeks is not unusual.

In addition to the younger age it is possible to use the boar effect to synchronize estrus in a group of gilts. Although the ideal age differs among populations, if a group of gilts receives appropriate exposure at a given age, it is possible to induce puberty in the majority of them within ten days or two weeks. If boar exposure begins too early some gilts are not capable of responding to the boar stimuli and puberty is later. If the gilts are too old some gilts have already

attained puberty prior to boar exposure. In both of these instances the dates of estrus will be spread more evenly across a three week period.

The reader is likely asking themselves several specific questions: what is the appropriate age? how big should the groups be? what do you mean by 'appropriate exposure'? Each of these is a good question and will be addressed separately below.

The appropriate age of gilts at first boar exposure varies among populations. Producers are encouraged to contact their seedstock supplier for recommendations. Most scientific studies, however, suggest that the youngest age at puberty and greatest degree of synchrony is obtained for commercial gilt lines if daily boar exposure begins when gilts are 150-165 days old. The age of the boar is also important, as it has been shown that the submaxillary salivary gland does not mature as fast as the testicle. While most boar lines are fertile at seven or eight months of age, the salivary gland is not capable of converting testosterone into pheromones until ten months of age. Boars used for detection of estrus, therefore, should be at least ten months old.

Group size for gilt development was discussed earlier. When it comes to detection of estrus groups of 8-12 are typically most appropriate. This size makes it more efficient to move groups of gilts to the boar area or dedicated heat check pens than smaller groups or individual housing. When groups are larger it is more difficult to assure adequate interaction between the boar and the gilts, and it is also more difficult to observe each gilt. Detection of estrus in gilts without getting them out of their pens (e.g. fenceline boar exposure) is not recommended because it has been demonstrated to be less efficient at initiating puberty and because the interaction with the person heat checking helps make handling the females easier as they are ready to be mated and moved. Fenceline contact has been shown to lead to a higher average age at puberty and a lower proportion cycling within a given time period than providing full contact. The magnitude of this difference depends on several factors including time of exposure, aggressiveness of the boar, number of gilts in the pen etc., but a difference in age at puberty of 15-25 days is common between full contact and fenceline exposure. Results of several studies showed that the difference between physical boar contact and fenceline exposure was about the same as the difference between fenceline exposure and no boar contact, suggesting that the benefit from the boar can be doubled by allowing full contact versus fenceline exposure.

'Appropriate exposure' is used here to describe the ideal way to expose gilts to boars in order to stimulate puberty. The ideal situation is that gilts are moved to a neutral heat detection area near the boar housing. This area has good lighting and footing, no distractions (e.g. nipple waterers etc.) and is large enough to allow gilts to move easily around the pen. The boar will be allowed into the pen with the gilts to provide 15 minutes of physical interaction with the gilts at least once daily, and during that time each gilt will be observed for signs of estrus. Estrus will be recorded to allow prediction of subsequent heat dates when the gilt may be eligible to be mated. Twice or three times per day exposure has been shown to further increase the boar effect, and while in some studies it was not significant, in others it more than doubled the proportion showing estrus within 20 days of initiation of the trial. It is important to recognize that these were controlled experiments and boar exposure was 'appropriate' each time. In other words, providing 15 minutes of exposure twice daily is better than providing it once, but providing five minutes three times daily is likely inferior to providing 15 minutes once.

So what happens if the farm is not able to provide 'appropriate exposure'? Stimulation of puberty is less than optimal. Many farms are not willing to commit the time to allow 15 minutes of daily physical boar exposure, and in these situations age at puberty will be later. Early age at puberty provides several advantages to an operation. Within a population gilts that mature later tend to have lower reproductive performance, so stimulating puberty early allows later maturing gilts to be culled before they are too far over conventional market weight. Ovulation rate increases with each successive estrus through the first four or five, so stimulating early puberty can result in more eggs to fertilize. This combined with greater uterine maturity has been shown to result in larger first litters (usually .5 to 1.5 extra piglets). If gilts receive appropriate boar exposure beginning at 160 days and are not eligible to be mated until 210 days, there are few gilts that are anestrus when eligible to be mated, resulting in reduced non-productive days. If dates of estrus are recorded it is possible to know when to expect gilts to cycle to be mated into the schedule. This facilitates some culling decisions.

On this list of advantages of 'appropriate exposure', most of the benefits derive from having an earlier puberty, while some derive from knowing when puberty or subsequent dates of estrus are for a given gilt. The latter can only be obtained by daily detection and record keeping. Some of the former, however, is obtainable by providing less than ideal boar exposure scenarios that require less labor. For example, if a farm is not willing to spend 15 minutes daily per pen of gilts, perhaps they would consider providing fenceline exposure to a mature boar for several hours daily, with or without any observation. This would be expected to result in a lesser degree of stimulation, but obviously requires less time. It is likely that the degree of synchrony would be less and that the average age of puberty would be greater than under ideal conditions, but both would be superior to not providing any boar exposure. As mentioned earlier, this might be as much as a 15-25 day reduction in age at puberty compared to gilts receiving no boar exposure.

This leads to the important differential between using boars to stimulate puberty versus using boars to detect estrus. Providing continuous fenceline exposure has some value in stimulating puberty, but can be a disaster when attempting to detect heat. Because the standing heat response requires such intense muscle contraction, it can only be sustained by the gilt for several minutes. After this time muscle fatigue sets in, and although the gilt is still in estrus she will be unable to display such for one or two hours when her muscles have had time to relax. One study was conducted to quantify this. Detection of estrus was performed in gilts twice daily, and gilts received boar exposure for over 20 minutes. In the morning on the day of first detection all gilts stood for ten minutes, but then several began to become refractory. At none of the other times did all gilts stand for even five minutes.

**Gilts that fail to cycle**

The normal distribution for puberty means a few gilts cycle early, perhaps before boar exposure, a lot cycle in the middle, and a few cycle late. Producers frequently want to know what to do with those that cycle late, or non-cyclers. There is a reason they cycled late, and in many instances the best thing to do is to cull these gilts. There are occasions, however, when the gilts were fed properly, are healthy, received adequate boar exposure, and still failed to cycle, but it is necessary to use them to reach breeding targets. There are two options to initiate cycling in these gilts. The first is to apply an acute stressor such as moving or mixing with strange pen mates.

This frequently stimulates puberty in a proportion of these gilts. The second option is pharmacological intervention with a product to stimulate follicle growth such as PG-600™ (Intervet). This product will initiate follicular growth and ovulation in many of these gilts. It must be restated, however, that these gilts are likely to have lower levels of reproductive fitness throughout their lives.

**What about stale gilts?**

Stale gilts is a term used in the field to describe gilts that exhibited puberty, for some reason were not mated, and at some point ceased to express estrous cycles. Examination of the ovaries of these gilts shows that most of them are, indeed, anestrus, having several two mm follicles but no large follicles or corpora lutea (CL). The reason for this phenomenon is not known, although it appears to be exacerbated by confinement housing. Assuming that other conditions are normal (i.e. body condition, health etc.) treating these animals like gilts that failed to express puberty (i.e. acute stress or PG-600™) seems to result in significant re-initiation of normal, fertile estrous cycles. In these gilts reproductive performance is expected to be normal.

**Getting gilts bred on schedule**

Since a gilt is used to replace a sow, having the gilt express estrus and conceive to farrow on the same schedule as the sow she is replacing is the ideal. Getting gilts to show estrus at the appropriate time is no easy task. Farms that farrow weekly have greater flexibility, but not absolute. Maintaining a large enough gilt pool to provide sufficient cycling gilts each week may be a poor use of facilities, labor and gilts. While there is not room in this paper to thoroughly cover synchronization of estrus, it is a critical area of managing replacement gilts and will be briefly discussed here. The reader is encouraged to consult other sources for greater detail.

Use of boar exposure to stimulate puberty was discussed earlier and how the greatest degree of synchrony typically occurs when first exposure occurs at 150-165 days of age. To get a group of gilts to fit a schedule, however, less synchrony may be desirable. If, for example, a farm receives replacement gilts monthly but farrows weekly an attempt is made to breed an equal number of gilts as replacements each week. In this scenario a group of gilts randomly cycling may fit the schedule better than a tightly synchronous group.

There are three hormonal compounds used for synchronizing estrus on commercial swine farms in the U.S. Each of them is a potentially useful tool, but has limitations. The one longest on the U.S. market is PG-600™ (Intervet). This is a combination of gonadotropins given as a single injection that serves to stimulate the growth and ovulation of follicles on the ovaries of non-cyclic females. It is only useful if the gilts are prepubertal, and they must be physiologically capable of cycling. Responses on some farms are quite good, but there are other farms that fail to find it useful (perhaps the gilts were already cycling or perhaps they use it on those they were unable to stimulate naturally). A fertile estrus is expected in 50-80% of prepubertal gilts within 5 days of treatment.

The second product, approved in the U.S. in 2003, is Matrix™ (Intervet). This is an orally active progestin, that when fed daily acts like the C.L. on the ovary; i.e. it makes the gilts ovary not grow new follicles. It is topdressed in an oil solution for 14 days. It is imperative that each gilt receive her full daily dose to prevent development of cysts on the ovaries. Results from several

studies indicate that, when fed to cycling gilts, 70-98% will display a fertile estrus 4-9 days after the last daily feeding. The compound in the oil is absorbable through the skin of people, so care should be taken when handling, especially by women.

The third compound used is somewhat more problematic in that it does not have label approval for this application. Lutalyse™ (Upjohn) is a prostaglandin approved for induction of farrowing in swine. It works by regressing the C.L. on the ovary which initiates the normal chain of events associated with parturition. The C.L. become responsive to Lutalyse™ on day 12-14 of gestation. After day 35-50 the C.L. become refractory to the compound. They regain sensitivity after day 108 of gestation, allowing farrowing induction. With a veterinary prescription some farms will breed a group of gilts over a three week period and then give two Lutalyse™ injections on one day to the entire group. All gilts are between 14-35 days of gestation, so the injections cause regression of the C.L. and initiate a fertile estrus in 60-85% of gilts 4-6 days later. The two greatest challenges to this approach biologically are that it only works if the gilts are pregnant, and those gilts that do not respond remain pregnant. The active ingredient is absorbable through the skin of people and is problematic for pregnant women and people with asthma.

PG-600™
-gilts must be noncyclic (prepubertal or 'stale')
-requires one injection
-some farms fail to get good results

Matrix™
-gilts must be cycling
-requires individual feeding
-when used correctly is very predictable

Lutalyse™
-requires veterinary prescription
-gilts must be pregnant for it to be a practical tool for synchronizing estrus
-greater care required by handlers
-some animals do not respond, and therefore remain pregnant

**After mating**
Mated gilts of modern genotypes are still not mature, typically being at perhaps 55-65% of mature body weight. Efforts should be made to treat them as such. While individual housing can delay puberty, mated gilts perform well in this environment or in stable groups. If they do not receive a separate diet from older sows, special attention should be given to their growth and condition during gestation. At farrowing the parity one female is at a disadvantage to older sows. While demands on her are high for maintenance, milk production and body growth, her feed intake is lower than that of older sows. Extra efforts should be made to enhance feed intake in parity one females during lactation. The ideal situation would be to provide a separate diet formulated with the consideration that feed intake is less than for older sows. In reality managing two diets in the same rooms proves challenging, but many farms are able to help parity one females by providing a topdress that results in greater nutrient density in the feed consumed.

**A timeline to consider**

Each farm is different because of variation in geography, genetics, facilities, labor and philosophies. As such each must develop their own gilt development protocols and timelines. Below is a suggested starting point that can be modified to individual scenarios.

day 0 - select based on genetic attributes and foster to smaller litter

day 120 - switch to replacement gilt feed

day 160 - select based on physical attributes and move to isolation, provide more space, and begin boar exposure

day 200 - sell as market hogs those failing to reach puberty and those with unacceptable physical attributes

day 220 - move those that have expressed estrus to breeding barn and begin breeding.

**Summary**

Gilts intended to be used as replacements should be treated as the special animals that they are. After all genetic decisions are made, they should be provided a better nursing environment, more space and separate feeds than their counterparts intended as market animals. Health should be monitored and actively managed. Through the strategic use of mature boars their age at puberty should be stimulated early. They should be mated and managed after mating as parity one females, receiving different diet than older sows. These steps require extra time, and in some cases greater investment, but the payoff in long term productivity can be great.