Reproductive Performance of First Parity Sows

Technical Report No. 11

Introduction

The first parity sow is a very unique animal that requires special handling practices compared to older sows. She is more likely to experience reproductive problems and be culled from the breeding herd. In fact, culling rates for sows after weaning their first litter are generally 10 lo 15 percent higher than for older sows.

Reproductive efficiency of first parity sows is also likely to decrease significantly when the production environment is suboptimal. Proper management can help keep the first parity sow functional longer in the breeding herd. The industry average for annual sow replacement is 30 to 50 percent. Consequently, on the average swine operation, production from first parity sows contributes substantially to the reproductive efficiency of the entire breeding herd.

A variety of physiological and management factors influence the reproductive performance of first parity females, including nutrition, genetics. environment and several other production factors. This technical report takes a closer look atthe physiology and endocrinology of the primiparous (first parity) sow and how various production factors influence reproductive performance. Swine producers and veterinarians will find this information useful to establish management conditions that meet the production demands placed upon the first parity sow.

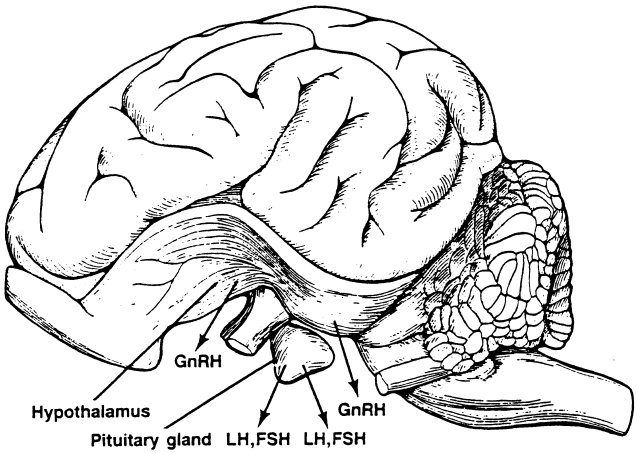
Metabolism and Reproductive Endocrinology Associated With Lactation

To begin, it is important to understand how metabolism and reproductive endocrinology affect the first parity sow during lactation and the post-weaning period.

Metabolic Demands of Lactation

During lactation, the metabolism of female swine is geared toward milk production. In fact, the demand is so great that more than 75 percent of the energy substrates in the blood stream are used by the mammary gland for milk synthesis. Nutrients necessary to meet these metabolic demands are obtained by the sow in two ways: consumption of feed or mobilization of body tissues. When nutrient supply via dietary consumption cannot fulfill the metabolic requirement for milk production, body stores of fat and protein are used to fill this requirement. When this happens, the sow loses weight.

In addition to milk production, other physiological processes must occur during lactation if the first parity female is to remain functional in the breeding herd. Two important processes are: 1) increase in body size. i.e. growth, and 2) resumption of the events that will lead estrus and ovulation after weaning, i.e. reproductive activity. Since these processes also require energy and protein, they compete with milk synthesis for nutrients.



Hormone secretions from the hypothalamus and pituitary gland activate reproduction by stimulating follicular growth on the ovaries which results in estrus and ovulation.

Although the mechanisms are not completely understood, it is well documented that during lactation, nutients are used preferentially for milk production at the expense of these other processes. Consequently, most first parity females lose weight during lactation rather than increase in body size. As a result, estrous activity does not occur until the females body has had sufficient time to begin replenishing lost body condition and redirect nutrients from the mammary glands to the reproductive organs.

Reproductive Endocrinology During Lactation and After Weaning

Reproductive activity normally involves the following sequence of events: Gonadotropin-releasing hormone (GnRH) is secreted from the hypothalamus, a specialized region of the brain. When secreted, GnRH stimulates the release of two reproductive hormones from pituitary gland—luteinizing hormone (LH) and follicle-stimulating hormone (FSH). These two pituitary hormones stimulate follicular growth on the ovaries which, in turn, results in estrus and ovulation.

During lactation, this sequence of events is inhibited by several mechanisms. Initially, a period of unresponsiveness exists for 7 to 10 days after farrowing. During this time, the hypothalamus and pituitary gland do not respond to physiological stimuli necessary for the resumption of reproductive activity. In most practical situations, this period of inhibition is of little consequence unless litters are being weaned early in lactation (10 to 14 days).

Ancther mechanism involves the nursing behavior of the piglets. The suckling stimulus inhibits the release of GnRH from the hypothalamus. Therefore, estrus and ovulation seldom occur until after weaning.

Finally, the metabolic state of the animal during lactation, at the time of weaning and during the post-weaning period, can prevent the sow from resuming reproductive activity. As mentioned earlier, estrus and ovulation probably will not occur until the female's metabolism has had sufficient time to shift the movement of nutnents from the mammary glands to the reproductive organs. It is interesting to note that the hypothalamus (and the secretion of GnRH) seems to be the most sensitive to the metabolic flux of nutrients during and after lactation. This is usually the culprit when sows become anestrus during adverse metabolic conditions.

Factors Affecting Reproductive Performance of First Parity Sows

Most of the factors known to influence the reproductive performance of first parity sows are related to the severity of the metabolic demands experienced by the female during lactation and the post-weaning period. As a result, management strategies that minimize the metabolic stress and body weight fluctuations associated with lactation usually are the most successful in terms of maintain high reproductive performance in these females.

Nutrition

Feeding During Gestation—Nutritional management during pregnancy depends on initial body weight, targeted weight gain and other environmental factors. A common goal is to have primiparous sows gain 60 to 80 pounds during their first pregnancy. This weight should be added gradually throughout gestation. An important concept to keep in mind when feeding sows during pregnancy is that the amount of feed consumed during gestation is inversely related to feed intake during lactation. This is particularly relevant for first parity females since many of the feed intake problems during the first lactation can be traced back to excessive feeding during the latter stages of gestation.

Feeding During Lactation—Under-feeding during lactation can lead to post-weaning anestrus, lower farrowing rates and smaller litters. The relationship between feed intake during lactation and the occurence of post-weaning anestrus in first-litter sows is shown in Figure 1. In general, as feed intake during lactation increases, days to estrus after weaning decrease. For this reason, females should be fed to appetite during their first lactation. Overfeeding during lactation is rarely a problem in primiparous sows.

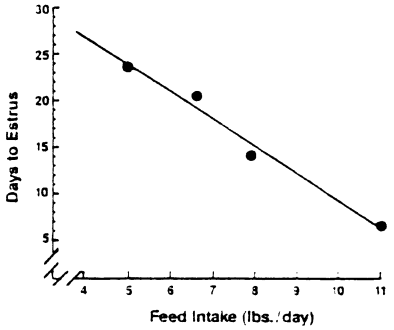


Figure 1.
Relationship between lactational feed intake and the interval from weaning to estrus in first parity sows (adapted from King & Williams, 1984).

The type of ration fed during lactation is also important. Recent studies have demonstrated that both the energy and protein content of the diet affect subsequent reproductive performance. There is a positive relationship between the amount of energy and proteln consumed during lactation and the percentage of first panity sows exhibiying estrus within seven days after weaning. While both are important, protein intake appears to be more critical and is more likely to limit reproductive performance than energy consumption.

When formulating lactation feeds for first-litter sows, consider the dietary requirement and daily feed intake of the female. The National Research Council (NRC) indicates that a lactating female requires 17.0 Mcal of metabolizable energy and about 689 grams of protein per day of which 32 grams should be lysine, an essential amino acid. Recent research has demonstrated that if the sow is nursing more than nine pigs, this requirement should be increased to 725 grams of protein per day of which 45 grams is sysine.

If a female consumes 5.3 kg (11 to 12 pounds) of feed per day, each kilogram of the lactation ration should contain 3.210 kcal of metabolizable energy, 14 percent crude protein and 0.6 percent lysine. However, first parity females rarely consume more than 4.5 kg (10 pounds) of feed per day during lactation. Therefore, the ration would need to contain 3,780 kcal of metabolizable energy, 16.5 percent crude protein and 0.8 percent lysine per kilogram to meet the dietary needs of a female at this level of daily consumption. In general, as feed intake decreases, an increase in the protein and energy content of the ration is necessary to meet Ihe nutritional requirements of the sow during lactation.

The addition of high energy feedstuffs, such as fat, is a method commonly used to increase the energy density of lacration rations. Practical limitations with meal feeds (ground feeds) allow no more than 5 percent added fat. Similarly, synthetic amino acids, such as lysine, can be added to raise the protein content of most swine feeds.

Feeding After Weaning—Some reports indicate that by restricting feed or water after weaning, reproductive performance will improve. However, most studies indicate that this preactce is detrimental to the animal and to reproductive performance. In contrast, ad libitum feeding after weaning until breeding has been shown to decrease the weaning-to-estrus interval and increase ovulation rate in first parity sows that weaned nine or more pigs. Furthermore, the "second parity drop" in litter size, often experienced by highly prolific sows, is probably influenced significantly by feed intake during and after the first lactation. Increasing feed after weaning helps primiparous sows replenish body stores of fat and protein that were lost during lactation—a process that is partially responsible for resuming reproductive activity.

Genetics

Prolificacy—-The mammary gland is a "demand and supply" organ. In other words, as the demand for milk by the nursing litter grows, production from the mammary gland increases in an attempt to meet these needs. Theoretically, this production is limited by genetics only. Therefore, females that have a high genetic potential for milk production are more likely to be subjected to greater metabolic stress during lactation than their less productive counterparts.

Figure 2 shows the relationship between 21-day litter weights in first parity sows and their subsequent reproductive performance. In general, 21-day litter weights are a good cumulative measure of a female's production potential. Regardless of genetic background, return-to-estrus intervals, farrowing rate and litter size of the next farrowing were negatively affected as 21-day litter weights increased in this study.

The important point to remember from this information is that first parity females with a high genetic potential for milk production (heavy 21-day litter weights) are more susceptible to reproductive failure than their less productive contemporaries. Management strategies such as split-weaning and early weaning effectively reduce lactational demands on the female and deserve consideration for first-parity sows with genetic potential to nurse large litters.

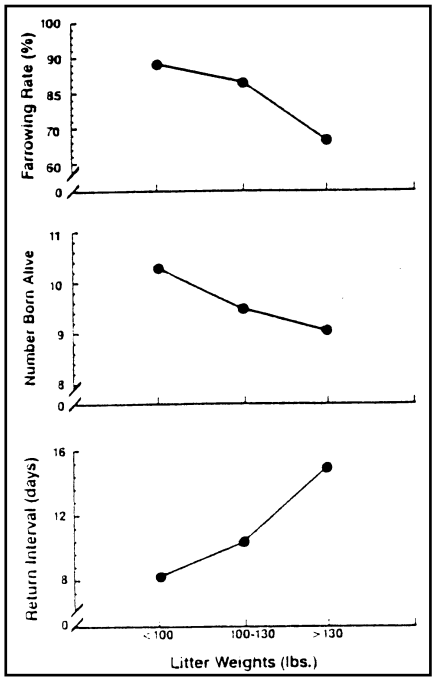


Figure 2.
Relationship between adjusted 21-day litter weights and subsequent reproductive performance in first parity sows (adapted from Flowers & Stanislaw, 1989).

Breeds—Although the genetic potential of the individual animal for milk production is probably more important than the breed, it is still important to understand how breed affects first parity sows. For example, white breeds traditionally exhibit superior mothering ability and tend to experience increased metabolic demands during lactation. Consequently, they are generally prone to suboptimal reproduction during the first parity if not managed correctly.

Climatic Environment

Ambient Temperature—High environmental temperatures (>85˚F) can disrupt the expression of behavioral estrus, lower ovulation rate, increase embryonic mortality and extend the rebreeding interval. First parity sows appear to be especially sensitive. One reason may be that lactational feed consumption can be suppressed by as much as 20 to 30 percent in primiparous sows during the summer months. Reduced feed intake such as this can complicate the reproductive problems associated with heat stress.

Thermostatically-controlled drippers in conjunction with proper ventilation can provide effective supplemental cooling for females during lactation. In addition, feeding several times per day and not allowing old feed to accumulate in feeders also helps to successfullv increase feed consumption.

Photoperiod—The importance of the photoperiod on the reproductive performance of first parity females has not been fully documented. However, studies indicate that 12 to 55 hours of light per day may be optimal to maximize reproduction of animals in total confinement units.

Other Production Factors

Weight Loss and Body Condition—Relationships among weight loss during lactation, body condition and reproductive performance in first parity sows are still being investigated. However, for a group of sows, the rate of postweaning anestrus is generally increased when weight loss during lactation is high and body condition at weaning is low. For individual sows, it is difficult to use these measures as indicators of subsequent infertility. In addition, high weight loss and poor body condition in one herd may be average in another. Reasons for these differences are not entirely understood. Nevertheless, extreme changes in body weight and condition in primiparous sows result in less than optimal reproduction and should be avoided.

Age at Farrowing—An interesting question that is often debated when a first parity sow fails to return to estrus or conceive after weaning is whether she was bred too young as a gilt.

Studies have shown that management during the first lactation probably influences subsequent reproductive performance more than the age at which a female farrows her first litter. In other words, age at first breeding (and thus farrowing) for gilts should not affect reproductive performance provided that females are managed. for minimal weight and nutnent losses during their first lactation. That's why more attention should be given to management during gestation, lactation and the postweaning period than the age at which a female is bred for the first time. According to some studies, if gilts are bred between 150 and 180 days of age, the older animals will be easier to manage than the younger ones for minimal weignt loss curing lactation. However, it is important to remember that increasing the farrowing age for primiparous sows will not circumvent poor management during lactatlon or the post-weaning period.

Estrous Cycle—Another question that receives a fair amount of discussion among swine producers is whether gilts should be bred at their first estrus or be allowed to "cycle" several times before mating. The answer to this question differs among operations and depends primarily on two things: expected reproductive performance differences and daily maintenance costs for gilts.

Ovulation rate does increase between the first and third heat periods in gilts and, as a result, so does litter size. The magnitude of this increase varies considerably among farms and is related to a number of management factors. A good rule of thumb is that one can expect a 0.3 pig increase in litter size for each additional heat period between the first and third estrus. Based on this information, the question really becomes—is the advantage gained in reproductive performance (litter size) by prolonging breeding greater than the disadvantage of having to maintain the gilts an additional 20 to 40 days (increased production expense) before they enter production? Beyond the first parity there is, at best, a weak relationship between subsequent productivity and the heat period at which a gilt was bred.

Boar Exposure After Weaning—The two primary goals of boar exposure after weaning are to: 1) stimulate ovarian activity and 2) identify females in estrus. The first involves physiological processes, while the second is related to sexual behavior. Both are influenced by how often and how much boar exposure is provided.

To stimulate ovarian activity, animals respond to the amount of boar exposure. That's why it's important to expose first parity sows to a boar immediately after weaning. Many producers like to begin boar exposure on the third or fourth day post-weaning. This practice may be acceptable for older sows, but it is not recommended for first parity females since it could result in prolonged periods of post-weaning anestrus. Daily periods of direct exposure to a mature boar for 10 to 15 minutes beginning immediately after weaning or continuous fence-line contact will help stimulate ovarian activity and decrease the return interval.

In contrast, the intensity of male-to-female contact seems to be critical for the behavioral expression of estrus (i.e. the standing reflex). Some studies indicate that continual fence-line boar exposure once a female is in estrus can actually decrease the intensity of the standing reflex and make estrus detection difficult. This is commonly referred to as habituation. Therefore, once a female begins to exhibit the initial signs of estrus, boar exposure should not be continual, but rather consist of intense periods of 10 to 15 minutes per day.

A common strategy used by many producers for first parity sows is to provide fence-line contact with a mature boar for three to four days after weaning. Then, beginning on day four, boar exposure is changed to daily periods of 10 to 15 minutes. The rationale behind this practice is that the female receives continual exposure early in the post-weaning period when it is beneficial in stimulating ovarian activity, yet is provided with intense periods of boar exposure around estrus when it's most effective for enhancing the standing reflex.

Hormonal Therapy for First Parity Sows—In the previous sections, various management strategies were discussed for maintaining a high reproductive status in first parity females. In some situations, it may be beneficial to pharmacologically initiate reproductive activity in first parity sows after weaning in order to circumbent existing or potential problems. One way to accomplish this is by treating the sows with exogenous (manufactured) hormones that mimic the normal progression of physiological events that result in estrus and ovulation after weaning. Gonadotropins such as pregnant mare serum gonadotropin (PMSG) or a combination of PMSG human chorionic gonadotropin (HCG) can be used to induce a fertile post-weaning estrus in sows. These hormones also can be used to correct anestrus problems in first parity sows that fail to exhibit estrus after weaning.

In the past, gonadotropins were used to induce ovulation in sows during lactation. However, this practice has been discontinued for several reasons. First, the response to hormonal therapy during lactation is highly variable and unpredictable. Secondly, the advantage of breeding sows during lactation has diminished because the industry is weaning pigs at three weeks of age or less. Therefore, since gonadotropins rarely stimulate a female estrus during the first two weeks post-farrowing, the use of hormones during lactation is of little value.

However, swine producers may use gonadotropins at the time of weaning in certain situations. For example, the use of exogenous hormones may be beneficial in reducing the weaning-to-estrus interval in groups of sows weaned during the summer months that have previously shown an increased incidence of delayed pos-weaning estrus.

Conclusion

Improving reproductive performance in the sow herd begins with understanding the challenges encountered by first parity sows. This is especially important because of the high culling rates and decreased reproductive efficiency associated with these sows. Since metabolic and weight fluctuations associated with lactation are highly correlated to poor reproductive performance in first parity sows, management techniques to minimize these fluctuations will be most successful. Therefore, veterinarians and producers should work together to review nutrition, genetics, environment, hormonal therapy and other production factors in order to maximize the reproductive performance of their sow herd.

Selected References

Aherne, F.X., Kirkwood, R.N. 1985. Nutrition and sow prolificacy. *J. Reprod. Fert. Suppl.* 33:169

Britt, J.H. 1986. Improving sow productivity through management during gestation, lactation and after weaning. *J. Anim. Sci.* 63:1288.

Cole, D.J.A. 1982. Nutrition and reproduction.Control of Pig Reproduction. D.J.A, Cole & G.R. Foxcroft (eds.). Butterworths, London. pp.603-619.

den Hartog, L.A., van der Steen, H.A.M. 1981. Reprocluctive traits in primiparous sows in relation to feeding level. *Neth. J. Agric. Sci.* 29:285.

Esbenshade, K.L., Britt, J.H., Armstrong, J.D., Toelle, V.D., Stanislaw, C.M. 1986. Body condition of sows across parities and relationship to reproductive performance. *J. Anim. Sci.* 62:1187.

Hemsworth, P.H., Barnett, J.L. 1990. Behavioral responses affecting gilt and sow reproduction. *J. Reprod. Fert. Suppl.* 40:343.

King, R.H., Williams, I.H. 1984. The effect of nutrition on the reproductive performance of first-litter sows. 1. Feeding level during lactation, and between weaning and mating. *Anim. Prod.* 38:241

King, R.H., Williams, I.H. 1984. The effect of nutrition on the reproductive performance of first-litter sows. 2. Protein and energy intakes during lactation. *Anim. Prod.* 38:249.

O'Grady, J.F., Lynch, P.B., Kearney, P.A. 1985. Voluntary feed intake by lactating sows. *Livestock Prod. Sci.* 12:355

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