Control of Estrus and Ovulation in Swine

Technical Report No. 13

Introduction

It is often said that the production cycle begins with breeding. In other words, the occurrence of all other management events, including marketing. is dependent on when sows and gilts exhibit estrus or "come into heat". Most swine producers want to control their production schedule. From a practical standpoint, this is accomplished by stimulating estrus in females during a predetermined time period. This is referred to as synchronization of estrus. In addition to regulating the production cycle, synchronization of estrus allows breeding tasks such as heat detection and supervision of matings to be concentrated within a relatively short interval of time. As a result, facilities, boar power and, most importantly, labor can be used effectively and efficiently.

Several different strategies have been used to control estrus and ovulation in swine. This technical report takes a closer look at the physiology and endocrinology involved with regulation of estrus and ovulation, as well as the relative merits of several synchronization schemes, Swine producers and veterinarians will find this information useful in developing management strategies for the control of estrus and ovulation in swine.

How is Estrus Synchronized?

From a physiological perspective, synchronization of estrus involves manipulation of the time course over which follicles eventually mature and ovulate. This usually is achieved in one of two ways: (1) stimulation of follicular development in a large number of females at the same time; or (2) prevention ol the growth of follicles for short periods of time, then synchronization of their subsequent development by removal of the inhibition. These physiological situations can be achieved with a variety of managerial and pharmacological procedures. Unfortunately. the current "state of the art", so to speak, is that no single synchronization technique works in every type of animal all the time. Thus, on a whole-herd basis, a combination of several techniques usually is more effective than the use of a single procedure.

Group weaning. Group weaning is the most common method of estrus syncnronlzation in sows and serves as the basis for production schedules on most swine farms. Consequently, many producers probably already use this form of synchronization technology. Lactation is a natural period of inhibition for follicular development primarily due to the nursing activity of the litter. Once weaning occurs the inhibition is removed, follicular development resumes, and sows usually exhibit estrus in 4 to 10 days. Group weaning should be thought of as "coarse control" for the period of sexual receptivity in a group of females. For example, if a group of sows is scheduled to farrow over three weeks. but needs to be rebred within a single week. then weaning all the litters on the same day should result In most sows returning to heat within a 7 day period. provided none are weaned less than two weeks after farrowing.

Boar Exposure. Boar exposure is another way to synchronize estrus in both sows and gilts, and, similar to group weaning, it is a common practice within the swine industry. Boar exposure triggers normal endocrine changes in the female that are associated with the development of follicles. While most prepuberal gilts older than 140 days of age will respond to boar exposure, the synchrony of this response appears to be optimum when gilts are between 170 and 190 days of age. In other words. the same percentage of females usually reach puberty regardless of age of first boar exposure, but those between 170 and 190 days of age do so in a considerably shorter period of time than older or younger females. The success of boar exposure for synchronization of estrus in gilts varies among farms and is influenced by a number of genetic and environmental factors.

In addition, boar exposure should be used in conjunction with group weaning of sows. As mentioned earlier, weaning removes an inhibition of follicular development, while boar exposure provides positive stimulation. Boar exposure after weaning is necessary to enhance the synchrony of the heat periods in sows. For best results, daily exposure should begin immediately after weaning and continue until the female exhibits heat.

Gonadotropins. Gonadotropins are naturally occurring hormones that initiate changes involved with follicular growth. In other words, increased production of gonadotropins is the primary reason sows come into heat after weaning and gilts respond to boar exposure. Consequently, administration of gonadotropins to certain types of females at a given time is an effective synchronization strategy. Prepuberal gilts given gonadotropins usually show estrus in 4 to 10 days after injection, with the average being six days. Sows given gonadotropins at weaning exhibit a similar response. Pregnant females, as well as sows and gilts exhibiting normal estrus cycles, cannot be synchronized effectively with gonadotropins because the elevated progesterone levels of pregnant or cycling sows and gilts inhibit FSH (PMSG)and LH (HCG) activity. A variety of management factors influence the synchrony of estrus including age and lactation length. P.G. 600® is a combination of two naturally occurring gonadotropins (400 I.U. PMSG and 200 I.U. HCG), and approved for use in gilts and sows.

Synthetic Progestagens Synthetic progestagens are usually fed orally or implanted under the skin of animals. They are effective in synchronizing estrus in gilts and sows that are exhibiting normal estrus cycles. They are not effective in prepuberal gilts and have limited usefulness in sows after weaning. Synthetic progestagens mode of action is to prevent follicular development. Synchronization is achieved after its removal due to the resumption of follicular growth. The most common way it is used in the swine industry is as a top-dressing that is fed to females for 14 to 16 days. Upon its removal from the diet, females usually exhibit estrus in 7 to 10 days. At the present time, no synthetic progestagagens are approved for use in swine for synchronization of estrus.

Prostaglandin F2-alpha (PGF) Prostaglandins are naturally occurn compounds that are involved in a number of important physiological processes. PGF is responsible for causing luteolysis (destruction of corpora lutea)in swine. Luteolysis results in a decrease in concentrations of a hormone called progesterone. One of progesterone's biological actions is to prevent follicular growth. In fact, one reason why sows do not exhibit estrus during pregnancy is due to the production of progesterone. In general, administration of PGF when progesterone is elevated results in the removal of a hormonal inhibition of follicular development. Accordingly, estrus normally follows within 5 to 7 days.

PGF can be used to synchronize estrus in cattle. However, it does not effectively synchronize estrus in female swine during the estrus cycle. This is due to the fact that cattle are sensitive to PGF for the majority of their estrus cycle, while the responsive period in swine is only a few

days. In other words, an injection of PGF on just about any day of the estrus cycle will result in luteolysis and the resumption of follicular development in cattle. However. in swine this only occurs over a short period of time and requires large amounts to be administered. PGF has been used with some success to synchronize estrus in swine via induced abortion of females during early pregnancy (>15 days of gestation). However, in most practical situations, this is viewed as being counterproductive and often is limited in its effectiveness. PGF is not effective in synchronizing estrus in weaned sows or pre-puberal gilts.

When Estrus is Synchronized, Isn't Ovulation also Synchronized?

The answer to this question is "No". Estrus is the period of sexual receptivity that lasts, on the average in swine, for 48 to 72 hours. Ovulation is the time period during estrus when eggs are released. It is generally accepted that ovulation in the pig begins 36 to 44 hours after the onset of estrus, and lasts between 1 and 3 hours. In addition, the majority of follicles (68-95%) appear to ovulate over a short period of time, while a minority ovulate over a longer time interval. However. the occurrence of ovulation during estrus is extremely variable as indicated from the studies summarized in Table 1. Notice that in one study ovulation occurred, on the average, 24 hours after estrus, while in another it began 44 hours after the onset of heat. Furthermore, comparing all the studies in Table 1, ovulation was observed anywhere from 2 hours before to 96 hours after the onset of estrus. In other words, when an animal is detected in heat. she may have already ovulated or may ovulate at any time over the next four days. Consequently, ovulation can occur over an extended period of time even when females exhibit estrus on the same day.

How is Ovulation Synchronized?

Given the normal variation associated with the ovulatory process even with a synchronous estrus, synchronizatlon or control of ovulation is much more difficult. The most successful strategies for controlling ovulation involve stimulation of follicular growth followed by induction of ovulation via the sequential administration of several naturally occurnng hormones. In most of these strategies, pregnant mare serum gonadotropin (PMSG) is given to stimulate follicular growth and human chorionic gonadotropin (HCG) is administered to actually cause ovulation. PMSG (P.G. 600®) is usually given to sows at weaning or on day 15 of the estrus cycle to mature females that are exhibiting regular estrus periods. For the best synchrony of ovulation, HCG is given 80 to 96 hours after the PMSG. Animals are bred at 12 and 24 hours after the injection of HCG. Farrowing rates and litter size are not reduced in animals treated in this manner. It is important to remember that HCG mimics the hormonal changes that induce ovulation. Consequently, the timing of the HCG injection determines the timing of ovulation in females treated in this way.

Which Estrus Synchronization Strategy is the Best?

The answer to this question depends primarily on the relative effectiveness of group weaning, boar exposure and use of gonadotropins in a given operation.

*P.G. 600® (400 I.U. PMSG and 200 I.U. HCG) is the only federally approved source of PMSG for use in swine. There are several HCG products approved for use in other species, but none for use in swine. Please consult with your vetennanan.

Use of PGF and progestagens probably are not practical or economically feasible at the present time. From a practical standpoint, choices for synchronization of estrus in sows are limited to group weaning and group weaning plus gonadotropins, while those for prepuberal gilts include boar exposure and boar exposure plus gonadotropins.

Since most producers already practice group weaning and boar exposure. production records should provide information with regard to the effectiveness of these two strategies for synchronizing estrus in sows and gilts, respectively. If a more synchronous response is desired, then it is advisable to determine the response of a herd to exogenous gonadotropins. This can be done by injecting a group of weaned sows and/or prepuberal gilts with gonadotropins and determining the proportion of females that exhibit estrus over a given period of time. By following this strategy. producers can determine for themselves the degree of synchrony that can be achieved with each method within their herd. When purchased semen is used in A.I. programs, information about a herd's response to these three teclnniques is critical. This is because the delivery of semen must be coordinated with the estrus periods of females. If the arrival of semen does not coincide with estrus, then purchased semen is not used, or semen stored for extended periods of time is inseminated. In both situations. additional costs are incurred and reproductive performance is compromised. Most commercial studs collect, process and ship semen on specific days. Consequently, most producers have to anticipate when sows will be in estrus when semen is ordered, or devise strategies to ensure that estrus occurs during a predetermined time period that coincides with semen delivery.

In most research trials, use of gonadotropins in conjunction with group weaning or boar exposure increases the synchrony of estrus when compared with either technique alone. Consequently, its use may be more attractive in situations where an exceptionally high degree of synchrony is necessary, such as with purchased semen.

Which Synchronization Technique for Ovulation is the Best?

The use of PMSG and HCG has proven to be effective for the precise control of ovulation. In some situations, control of ovulation with this technique is so precise that single inseminations given two hours after HCG have resulted in farrowing rates and litter sizes comparable to those achieved with multiple matings,

Conclusion

A variety of strategies are available for the control of estrus. Many, such as group weaning and boar exposure are common practices in the industry. The key to the successjul use of these strategies in breeding programs is to (a) understand how and on what type of animals they can work; (b) evaluate the relative effectiveness of each within a herd.

Table 1: Estimates of the Onset and Duration of Ovulation in Pigs[b]

	Mean	Range[c]	Reference[d]
Onset[e] (in hours)	41.7	30-45	Signoret et al., 1972
	37.6	23-48	Weitze et al., 1990
	47.5	17-68	Soede, 1992
	24.4	–2-50	Soede, 1992
	44.4	24-96	Weitze et al., 1992
Duration (in hours)	2.0	1-3	Pitkjanen, 1958
	1.0	1-3	Betteridge & Raeside, 1962
	2.1	5-4	Signoret et al., 1972
	4.6	2-7	Soede, 1992
	1.8	8-3	Soede, 1992

[b]Reprinted with permission from Flowers & Esbenshade, J. Reprod. Fert., Supp.48.
[c]Values either represent actual ranges reported or calculated ranges from the standard deviation (± 1 Standard Deviation).
[d]For complete references, see Flowers & Esbenshade, J. Reprod. Fert. Suppl. 48.
[e]Onset refers to the interval from the onset of estrus to the initiation of ovulation.

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