MANAGING TODAY'S REPRODUCTIVE FEMALE

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INTRODUCTION

Successful breeding herd reproductive performance has become increasingly more difficult to manage during the past decade. Simultaneous advances have been made in pigs/sow/year, predominantly due to management, and in leanness (growth rate and carcass characteristic), predominantly due to genetics. Today, we are managing a more prolific, leaner, and larger mature sow than we did before 1990.

The substantial increase in production efficiency has not come with out some sacrifices. More and more operations are reporting cases of decreased sow longevity, anestrual problems, and inconsistency in overall conception or farrowing rates. Because a single infertile sow or gilt cannot influence overall reproduction to the extent that an infertile boar will, it's easier to overlook reproductive problems with the breeding herd until the problem is causing substantial economic loss. Management considerations in optimising female reproductive performance include genetics, nutrition, environment, health, stress and of course, breeding. However, reaching and maintaining reproductive performance targets extends beyond these factors to include: production scheduling, choice of a mating system, good record keeping, breeding barn design and skilled, proven personal. Presented here is comprehensive look at present management strategies for optimising breeding herd reproductive performance. Although each management factor listed here could in itself be addressed in much more detail, the following will briefly address a specific oversight in each area that should pertain to all swine farms.

MANAGEMENT CONSIDERATIONS FOR TODAY'S FEMALE

Genetics

There are numerous maternal lines used in the industry world-wide and although selection for prolificacy is common across all maternal line programs, selection pressure for changes in carcass lean and fat have been less consistent across maternal lines. In some maternal lines much progress has been made in decreasing fat and increasing muscle. For example, average backfat thickness in U.S. Yorkshires females decreased by about two tenths of an inch from 1991 to 1997 (Long, 1998). Several maternal lines used in the industry today are classified as "high-lean" (>.320 g per day fat-free lean, while other equally productive and useful maternal lines are slightly above "average" (270 to 320 g per day fat-free lean) in their genetic ability to deposit lean (Table 1).

Table 1. Variation in the physical maturation of gilts.

	Measurement		
	Wt, kg	Backfat, mm	ADG (kg) or Age (d)
NPPC Gilt Development Project-180 d (Long, 1999)			
▪ Line A	108.0	21.6	0.69
▪ Line B	106.1	23.6	0.72
▪ Line C	105.2	22.4	0.75
▪ Line D	112.5	24.9	0.74
▪ Line E	109.8	19.8	0.74
University of Minnesota-P1 Farrowing (H.Yang, 1998)			
▪ PIC Camborough 22™	165	15.8	329
NPPC Maternal Line Test-P1 Farrowing (Goodwin and Boyd, 1998)			
▪ Lowest Line	187	18.3	354
▪ Highest Line	215	25.4	370
Michigan State University-Puberty (Lyvers unpublished)	139	17.6	195

Lean growth curves are routinely used to plan nutrition programs for terminal market hogs, matching nutrients to lean and fat deposition potential. Growth curves have equal usefulness in rearing maternal line replacement females. Accurate estimations of lean and fat tissue accumulations several times during rearing provide targets at which nutritional programs can be aimed.

The genetic merit of the breeding stock that you choose in your operation should be documented and made available for you. Along with merit, the information provided should include some estimation of key behaviour characteristics that indirectly effect reproduction, which is commonly overlooked. Some examples of these behaviours include: (1) age at puberty for determining when to move gilts, induce estrus (PG600), and breed, (2) lactation feed intake under optimal conditions, (3) estrus length for gilts and sows in establishing insemination strategy, and (4) an estimate of female longevity. It is important to remember that farm-to-farm differences will exist and therefore validation of characteristics that indirectly affect reproductive performance will improve the management level of breeding females and the consistency of reproductive performance.

Gilt Development Programs

Research reports indicate that nutrition during the rearing (grow-finish phases) of the gilt may influence the length of her reproductive life. Feeding programs for gilts and sows should be aimed at the female possessing a targeted amounts of body fat, bone, and lean at criticall points in time such as selection, first breeding or conception, parity one gestation, parity one farrowing, and parity one weaning. Maximum longevity is obtained by incorporating the best combination of nutritional regimes during the periods preceding each one of these events. The longevity of very lean genotypes may be improved by the provision of a moderate protein, high-energy diet during rearing and the longevity average lean genotypes may be improved by limiting energy intake during development. In the later case, energy restriction during rearing most consistently results in fewer feet and leg disorders. Disagreement among studies evaluating the effect of gilt body composition at first breeding on longevity suggests that controlled feeding and excellent management during acclimation and throughout parity-one gestation and lactation will lessen the effect of rearing practices on lifetime performance.

Sow Mortality

It is not uncommon to see typical herd mortality rates of between 5 and 10 percent or even greater in many swine operations. It appears that reproductive failure accounts for approximately 10 % of sow death in these operations (Geiger *et al.*, 1999), however, it is likely that a substantially greater number of females are culled due to a perceptive reproductive failure versus actually dieing. Fallouts due to reproductive failure or trauma are apparently difficult to control as numerous factors have been associated with both sow mortality and culling rates. Many of these factors are indirectly related to the areas discussed throughout this text, however, it is generally considered that that underlining determinant in most farms that have above average mortality and culling rates due to reproductive failure is largely related to failure in basic animal husbandry skills and observatory skills in the care of animals. We are obviously dealing with a much different animal today as well as different housing conditions in the US and Canada. Both of these changes should be considered in the management of animal movement, nutrition, health monitoring and treatment, and productively targets for effectively controlling economic losses from sow mortality and excessive non-genetic culling.

Nutrition

Perhaps the most influential nutritional affect on reproduction is the relationships between lactation feed intake and return-to-estrus interval (Reviewed by Einarsson and Rojkittikhun, 1993). Failure to recognize this relationship will result in increase non-productive sow days and inefficient pig flow through gestation and breeding. Increasing feeding frequency, avoiding excessive energy intake during gestation, high farrowing room temperatures and water restrictions are key management factors to consider when attempting to optimize lactation feed intakes.

Increase Feeding Frequency

When producers switch from feeding two times per day to three times per day, most experience a 10 to 15 percent increase in sow feed intake. There are some farms in North Carolina that actually feed four or more times per day in the summer. The main thing to remember is that when you increase the frequency of feeding, you must decrease the amount that you feed each time. For example, if you are feeding 2.7 kg twice a day (5.4 kg total), then when you increase to three times per day, you may want to feed around 2.7 kg at the first feeding and 1.8 kg at each subsequent feeding (6.4 kg total).

The reason this strategy works is related to the normal increase in body temperature that occurs after a sow consumes a meal. Theoretically, there won't be as big an increase in a sow's body temperature after she eats 2 kg (as after she eats 2.7 kg) because there will be less feed to be digested. Consequently, this could be very important for sows whose body temperatures already may be in the upper end of the thermo-neutral range due to high temperatures in their environment.

Keep Feed Fresh

Sows tend to be picky eaters compared to most animals. In warm conditions, feed is more likely to spoil, especially if it contains high levels of fat. Increasing the feeding frequency in conjunction with feeding slightly smaller meals is an excellent way to keep feed fresh.

Try Wet Feeding

Wet feeding is a common practice to increase feed intake in many finishing operations and can be implemented during lactation. Success with this strategy may vary greatly among operations, but it has been reported to boost sow feed intake by as much as 15 percent. One drawback is that wet feed does not stay fresh in the trough for very long and molds will also accumulate without regular cleaning. It may be beneficial to acclimate females to this change of diet during late gestation.

Add Fat to the Diet

As a result of poor feed intake, many sows are not able to meet the metabolic demands of lactation and may fall into a severe negative energy balance. This factor probably accounts for most of the reproductive disorders during periods of elevated temperatures. One way to ensure that sows are consuming enough energy, even though they are eating a smaller quantity of feed, is to add fat to the lactation diet. Supplemental fat (7 to 10 percent animal or vegetable fat) will increase the dietary metabolic energy content of the feed.

There are two important considerations in adopting this practice. First, a diet containing high amounts of fat will become rancid more rapidly than a traditional diet with only 1 to 2 percent fat. Sows will not eat rancid feed. Therefore, feeding smaller quantities more often and smelling feed leftover in the sow feeder at each feeding to check for spoilage should be a standard practice. Second, because sows are consuming less feed, dietary levels of essential vitamins and minerals also need to be boosted to compensate for less feed consumed on a daily basis.

Give Water Constantly

High ambient temperatures will increase water requirements. Increased water consumption coupled with increased urinary water loss is one mechanism by which pigs lose body heat. An increase in ambient temperature from 12°-15° C to 30°-35° C will cause pigs to drink more than 50 percent more water. Nursing sows need to consume 30 to 40 litres of water every day, and gestating sows need 11 to 19 litres. One rule-of-thumb to follow is a water-to-feed ratio of 5:1. Fresh, constant water is also critical during breeding and gestation. The watering system should deliver a minimum of 1.0 litres per minute and ideally 2.0 litres per minute. Sows will quickly become frustrated if the flow rate is low, and this will reduce their appetite for dry feed. Water temperature and quality are also important. During periods of high temperatures, pigs will consume almost double the quantity of cool water (10º C) as warm water (27º C).

Reducing Embryo Mortality

Prenatal mortality may be as high as 40 percent in sows. The majority of this embryo loss occurs during the first two to three weeks following breeding. Factors associated with embryo loss include stage of pregnancy, disease, age of dam, genetic factors, nutrition, external environment, intrauterine environment, and stress—including heat stress. During the first 30 days following breeding, it is imperative that the following recommendations be put into effect to avoid increased embryo mortality:

1. avoid late estrual inseminations,
2. minimise unnecessary stress by mixing females only at weaning,
3. refrain from or even stop moving females in gestation to different locations, and
4. don't raise or lower feeding levels within the first 30 days after breeding with expectations of improving reproductive performance. Provide a good, level plane of nutrition during and after breeding. The strategies also should be used through the year.

Late Insemination

Following breeding, several processes occur to optimally prepare the uterus for implantation. A postbreeding inflammatory response occurs in the uterus of the pig to remove nonfertilizing spermatozoa and bacteria. In addition, during early to mid-estrus, uterine contractions help to physically remove the products of this inflammation.

The first step in limiting embryo loss is to avoid late inseminations. The simplest way to prevent late estrual inseminations is to ignore the "target" number of inseminations and breed females totally on the basis of a strong, standing heat response. Another way to reduce mistimed inseminations is to determine the average estrous length in your weaned sows, gilts, and repeat breeders and based on these averages, shorten the last insemination interval. For example, if you normally service sows AM day 1, AM day 2, AM day 3, change your schedule to AM day 1, AM/PM day 2. Thorough heat-checking before performing subsequent inseminations will help prevent poorly timed, late artificial inseminations, which may interfere with uterine preparation for implantation.

Mixing Females

Once fertilisation occurs in the oviducts, pig embryos descend into the uterus very 24-48 after ovulation. However, implantation does not occur until day 13 and full attachment not until day 28. During this time, the pig is highly susceptible to stress factors, such as movement and temperature. If females are to be mixed, this should be performed on the day of weaning to prevent unnecessary stress on the female. Any unnecessary stress following breeding can result in embryo detachment and loss.

Moving Females

After breeding and around day 30 of pregnancy, females may be moved to a different location; however, mixing sows and gilts at any time during or following breeding greatly increases the chances of subsequent embryo mortality. Temperature changes also are likely to increase embryo mortality, and during early pregnancy females should be protected from heat or cold in order to avoid unnecessary stress. Make sure that cooling and heating systems are routinely maintained and functional. You should have a backup system in place (i.e., hoses and spray nozzles) in case of equipment failures.

Nutrition

Sows and gilts should be provided enough feed following breeding to keep them on an even plane at maintenance levels or slightly above for thin females. The pre-mating nutritional status appears to be a greater determinant of embryo numbers and survival than post-mating ration in gilts. Using this strategy requires "flushing" them with an extra 1 to 2 pounds of feed during the estrus cycle before mating. This can be attempted for sows as well, though most postweaned sows voluntarily restrict their own feed intake. Keep in mind that high feed intake during the 30 days following breeding may have a negative impact on swine embryos, especially in pregnant gilts.

Because gestating sows are limit fed there are no extra measures to take in feeding during periods of heat stress. Just ensure the female is consuming feed daily (hopefully around 4 to 5 pounds, depending on diet formulation). Appropriate action to boost appetite may be required, similar to the procedures used during lactation.

Environment

Physical and social environment have been shown to influence reproduction. Management strategies that can reduced stress and allow for some social interaction with other animals will enhance the well being of animals and consequently, reproductive performance. Importantly, stress prior to, during, and following breeding can result in higher incidences of embryo mortality. One of the most common mistakes in management is a failure to recognise that during breeding and gestation, females are also susceptible to heat stress when temperatures reach and exceed 27 –29°C for short or extended periods of time (Flowers, 1997). Heat stress has its most detrimental effect on reproductive performance during two critical stages of the gestation period, the first 30 days and the last 30 days. Increasing ventilation rates, installing cooling systems such as drip cooling, geothermal cooling or evaporative cooling systems are popular methods in alleviating heat related suppression of lactation feed intake.

Health

Identifying ways to reducing operational costs is generally considered a good managerial characteristic. However, the price for overlooking the complexity of herd health and its reproductive success can be high. During recent times, porcine reproductive and respiratory virus (PRRS) has been responsible for causing considerable amounts of reproductive failure on countless numbers of swine operations. Although there is still considerable controversy with regard to managing this disease, most would agree that management practices such as all-in-all out production, lengthy quarantine and testing, restricting people traffic, in-house gilt development, maintaining a closed herd, and vaccination (to a lesser extent) can all help reduce the impact of this and other reproductive syndromes.

Mycotoxins are also a common cause for reproductive failure in some herds, Aflatoxins and Zearalenone are most notable for causing reproductive problems which may include: estrogenic females, pseudopregnancy, embryonic death, and reduced piglet gain. Routine testing of feed samples and maintaining proper storage conditions for cereal grains are essential preventative measures for reducing the risks of mycotoxin problems. Although there numerous other health factors that can reduce reproductive performance (such as Lactation Failure (MMA) and Uterine Endometritis), today's female probably is not much different that females of the past with regard to the effect disease has or in controlling it. The only difference today compared to the past is that herds are often much larger and a simple depopulation is much less likely to solve the problem. Producers must be able to recognise and communicate potential health problems to their veterinarian or other professionals. Veterinarians are useful resources in evaluating breeding herd records, determining vaccination programming, periodic farm review, and training farm labour (injections, material handling, observations).

Production Scheduling

Season of the year, disease, environment, age, and genetic composition influence the number of females showing estrus and conceiving at a particular time. The number of replacement gilts needed to complete a farrowing group must be estimated in advance. As many as three replacement gilts may need to be selected during periods of stress for each farrowing crate to be filled. Keeping more gilts in the pool at any one time will increase the chance of obtaining more than enough pregnant females for a predetermined schedule. However, space in the gilt pool is often allotted based on the average annual need. Increasing the number of available gilts without simultaneously increasing space allowance most likely will result in additional stress on the gilts through crowding, which may ultimately increase the incidence of anestrus.

Potential Therapeutic Intervention

Historically, gonadotropins and progestens have been used with limited success to improve reproductive performance in swine. Nevertheless, application of these hormones in specific swine management areas has helped reduce the reproductive lag associated with heat stress and negative energy balances during lactation. Hormonal strategies using PG600® (400 I.U. PMSG + 200 I. U. hCG), Regumate® (progesterone), and Lutalyse® (prostaglandin) may help counteract poor reproductive responses in limited cases. PG600® can be injected at weaning to stimulate follicular growth, speed return-to-estrus intervals, and reduce the incidence of anestrus. Some producers treat only problem groups of sows, such as those with low feed consumption during lactation or low parity, to improve the efficiency of this technology. However, cost is a major consideration, and this approach may show benefits only in herds where extended wean-to-estrus lengths (more than 10 days) or high frequencies of anestrus occur. PG600® is most commonly used to stimulate puberty in 175+ day-old pre-pubertal gilts. This is generally very effective and may also be useful during periods of high ambient temperatures to stimulate a first estrus in incoming gilts where cyclicity is suppressed. Lastly, prostaglandins, which are commonly used to induce parturition, are believed to speed uterine recovery when injected post-farrowing. However, prostaglandin used alone has not reduced the incidence of anestrus or extended wean-to-estrus interval (WEI).

Extended WEIs and anestrus following weaning in parity 1 sows are probably the most noticeable effect of poor lactational feed intake, short lactation lengths, and heat stress on reproduction. The combination of heat stress, parturition, lactation, and poor feed intake contribute to poor reproduction in all sows; however, P1 females also have a metabolic demand for growth. One strategy to minimise these impacts on overall herd reproduction is to adjust female replacement schedules to avoid large numbers of P1 farrowings during July and August. It may also be possible to treat this subpopulation of females with hormonal therapy during lactation and at the time of weaning to stimulate the reproductive system. A single injection of PG600® at the time of weaning has been effective in reducing WEI in sows. However, a recent field report suggests that a vulvular injection of 1/2 cc. of Estrumate (not currently labeled for swine use) within 24 hours after farrowing in conjunction with PG600® at weaning may be even more effective at reducing WEI and the incidence of anestrus than the use of either of these components alone.

Continual feeding of Regumate® (for 14 days) suppresses follicular growth and estrus until withdrawn. Regumate® usage appears to be useful in estrus synchronization of cycling females (especially gilts) and may be a useful strategy to improve reproductive performance after a short lactation in sows (feed the hormone throughout lactation and withdraw at weaning). In this situation, Regumate® is fed for 14 days and followed by an injection of prostaglandin on the morning of Day 15. But cost and the delivery system are major limitations of this regimen, especially if sows are not consuming feed during periods of heat stress. NOTE: Regumate® and Estrumate® are currently not approved for swine use and is produced in an oil-base form that is difficult to handle.

BREEDING STRATEGIES FOR TODAY'S FEMALE

The three direct areas of female management in the breeding process are heat detection, quality of insemination, and frequency and timing of inseminations. One of the most common mistakes in managing these processes is in assuming that this is required to perform these tasks are easily learned. Dr. Billy Flowers conducted an evaluation of six different technicians' skills, as measured by experience, in 1995 (Flowers, 1995). The results from this evaluation showed that herd reproductive performance (as measured by the number of piglets produced from 230 matings) can vary significantly between breeding technicians, regardless of experience. Regardless of how many times a person has either supervised or performed a natural service or artificial insemination, some technicians will not succeed in producing a consistently high number of offspring from these matings. Therefore, careful supervising and evaluation of breeding barn personal, even the experienced technicians, is a must. Obviously, apples must be compared to apples, and therefore each individual technician should have equal opportunities in number of matings at similar times and under similar conditions to be fairly evaluated. Not everyone, regardless of their personality, experience and knowledge, will succeed in this area of reproductive management of females.

The use of AI can allow for a higher degree of quality control than natural service, specifically, semen quality and genetic improvements. AI users however, are totally responsible for fertile semen that is deposited into the uterus, which is unlike natural service where the boar controls these occurrences. Accurately timing multiple inseminations can be difficult and, is the fundamental in the success of AI. Missed timed inseminations leads to lower fertility and many of the problems associated with farrowing rate and litter size can be attributed to poorly timed and performed inseminations. Rozeboom *et al.*, (1997) showed that when the last of multiple inseminations is performed during late estrus, lowered farrowing rates and litter size will occur. A common mistake in many operations is a failure to ensure that female are actually in standing heat while performing what is considered to be the last AI. Direct female-to-male contact (at least nose-to-nose) at every heat check and breeding is a key components in effectively using multiple inseminations. Even though insemination frequency improves reproductive performance, breeding the sow when she's not longer in estrus does not. Become familiar of herd estrual behavior, implement an AI schedule and do not assume that it's correct for each female!

Counteracting the Negative effects of Reduced Lactation Lengths

Significant improvements in wean-pig diets, disease eradication strategies, and sow performance have simultaneously driven producers to gradually decrease average lactation lengths throughout the past decades. Many producers in the U.S. now wean sows between 18 and 21 days after farrowing, which is in striking contrast to the more traditional 42 day and 28 day lactation lengths in the 70s and 80s. Perhaps no other management decision can impact sow performance, facility utilisation and pig flow in a swine operation as much as lactation length. And even though there appears to be clear health and performance benefits for pigs following a short lactation length (12-14 d) there is at this point, physiological limitations to reducing lactation lengths much below 17 days while still achieving constancy in reproductive performance, return-to-estrus intervals, farrowing rate and subsequent litter size.

Early weaning (12-14 days vs. 18-24 days) has clear advantages to piglet health and growth performance. However, losses in reproductive performance may quickly negate these benefits and farm profitability could suffer as a result since realised benefits on sow performance are much considerably less today when compared to large decreases in lactation lengths (i.e. from 5-6 weeks to 3 weeks) that producers implemented during the 70s and 80s. In herds that experience difficulty in maintaining consistent levels of sow performance after making the transition from a conventional to early weaning strategy, consider the following guidelines for managing the early weaned female:

1. Conduct a thorough retrospective analysis of your production records, identify the lowest lactation length tolerable on your specific operation and try not to deviate from it at weaning.
2. When weaning, reduce the range of lactation lengths so that most sows fall within a lactation length that is compatible with satisfactory reproductive performance for your operation (i.e. 14-16 days vs. 12-18 days).
3. Focus on maximising feed intake during lactation and reducing heat stress.
4. Identify sub-populations of females such as Parity 1 females or females with poor lactation feed intakes and provide extra lactation time or therapeutic intervention.
5. Carefully weigh the benefits of early weaning with the cost of reduced sow performance before converting from a traditional weaning system or construction of a new facility.

CONCLUSIONS

Today's female is considerably leaner, later maturing and larger, and more productive per farrowing. The most common mistakes in managing breeding females generally occurs when one fails to recognise that management changes must how accompany the physical and physiological changes of the female itself. Genetics, nutrition, health, environmental factors and to a lessor degree, breeding strategies, all have major influences on the reproductive dynamics, behaviours and reproductive performance of the breeding herd. The reason that very few farms consistently reach and maintain a high level of reproductive performance is because management fails to understand how changes in these management areas described here can impact reproductive process even though we are dealing with much different beast today than in the past.

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