

Nutrition and Feeding for Optimum Reproductive Performance

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Introduction

Since 1970, sow reproductive performance and prolificacy has improved dramatically. Today's sow is genetically quite different. She is larger framed, with less back fat and more lean body tissue, besides having higher reproductive demands. The prolific, high-lean sow can raise more pigs per year, but also produce more milk resulting in heavier pigs at weaning. However, swine operations have a higher culling rate from their high-lean breeding herds. Therefore, several management practices need to be changed to ensure longevity especially the nutritional programs and feeding patterns of the reproducing female.

The prolific, high-lean, later-maturing sow has different nutrient requirements than the traditional sow. Today's sow requires a much more nutrient dense diet based on her body composition, growth pattern, and feed intake. This paper will focus on the nutrition and feeding programs of the breeding herd to improve reproductive performance. The focus will not be in one reproductive area because all facets of sow productivity impacts another subsequent period in the life cycle. The nutrition and feeding topics to be discussed will be 1) the boar to maximize semen quality and quantity, 2) replacement gilt development to ensure longevity, 3) gestation feeding patterns,

4) feeding during the re-breeding period, and 5) maximizing lactation feeding intake.

The Boar

The main goal when feeding boars is to optimize semen quality and quantity as well as maintain the boar in the herd. However, minimal research has been done to determine appropriate nutrition to develop and maintain boars. Therefore, the majority of seed stock producers and commercial boar studs fed developing boars about 10 % greater nutrients than growing market gilts in order to maximize growth performance and bone structure (Table 1).

Researchers have looked at enhancing semen quality. One area is in vitamin and trace mineral nutrition as research has shown that feeding higher dietary concentrations of selenium (0.5 ppm) and vitamin E (220 IU/kg) from weaning can improve boar semen quality, but the greater effect seemed to be from selenium. Selenium appears to have affects on sperm motility and abnormalities.

A grain-soybean meal diet fortified similarly to a gestation diet is generally satisfactory for meeting the nutrient needs of the mature boar. The daily feeding rate should be changed to reflect differences of season, condition, and workload of the boar. Boars under

heavy workload should be fed 6 lb/hd/d. Care should be taken to avoid underfeeding nutrients especially protein when limit feeding boars (< 4 lb/hd/d).

Replacement Female

More replacement gilts are showing up in the breeding herd due to an average culling rate of 30 to 40 %. The high culling rate is associated with several different reproductive failures that are more likely caused by not meeting the nutritional demands of the high-lean sow and the management practice of early-weaning pigs from the sow at less than 18 d. However, most swine producers feed their replacement gilts the same finishing diet that the market hog receives.

It is reasonable to expect that replacement gilts needs are different from the pigs, which are being raised for slaughter. Finishing diets are designed for cost efficiency and rapid growth, which may not provide adequate nutrients for the development needed to prepare the breeding female for a long life of pig rearing. Diets formulated specifically for the development of replacement gilts should contain higher concentrations of Vitamin A, Vitamin E, calcium (Ca), phosphorus (P), selenium (Se), copper (Cu), and zinc (Zn) compared to market hogs to ensure higher body reserves of specific nutrients that are needed during future reproductive purposes and to enhance the passive immune response. Dietary concentrations of Ca and P need to be high enough to allow for maximum bone mineralization and can be later mobilized if fetal and lactation demands exceed dietary nutrient intake. Reproductive performance and longevity

can be improved by feeding higher Ca and P concentrations to gilts. The recommended dietary nutrient requirements for replacement gilts are a minimum of 0.8% Ca (18 g daily), 0.7% total P (15 g daily), and 0.4% available P (Table 2).

If the protein and amino acid requirements are not met during gilt development, a delay in age in which the gilt reaches puberty may occur. Most finishing diets have adequate concentrations of protein (15 % crude protein) and amino acids (0.7% total lysine or 25 g daily) to satisfy the developing gilt. Replacement gilts should be limit feed from the time they reach 220 to 230 lb until about two weeks prior to mating to improve the sow's longevity. It is well established that flushing (feeding high amounts of feed for a short time prior to mating) increases ovulation rate and litter size compared to restricting feed intake during estrus. To flush females, feed intake can be increased to 6 to 8 lb per head daily for two weeks prior to breeding. Typically, gilts are bred at 280 to 300 lb or after their third estrus.

Gestation

After the female is bred, the nutrition and feeding program becomes more variable and should be based on each sow's body composition. The body fat content should be closely monitored because either excessive body condition or low-fat reserves will be detrimental to the subsequent reproductive cycle. Therefore, the gestation diet needs to control weight gain as well as provide enough nutrients to support fetal development.

Gestating females are limit-fed (4 to 5 lb of feed per day and an extra 1 to 2 lb if housed outside) in order to minimize excessive weight gain. First parity gilts should receive an extra 10 to 15 % (5 to 6 lb of feed per day) to compensate for their physical protein growth needs. Older sows (parity > 5) that are large framed have a higher maintenance requirement along with a lower body fat content and could possibly require a higher feed intake. However, overconditioned females will ovulate fewer eggs and have smaller litter sizes.

A gestation diet containing 14 % crude protein diet (0.7% total lysine, 0.9% Ca, 0.8% total P, and 0.45% available P) will be adequate for first parity females that are compensating for both muscle and fetal growth, however, older (parity 2 and greater) females probably only require a 12 to 13 % crude protein diet (0.6% total lysine, 0.9% Ca, 0.8% total P, and 0.45% available P).

Historically, an increased level of feed intake during early gestation (d 0 to 30) has been associated with an increase in early embryonic mortality, therefore, it is recommended that following breeding until approximately d 30, feed intake should be restricted to about 4 to 4.5 lb of feed daily, which will maintain the current body condition. The ideal time to put body fat on underconditioned females is during d 30 to 70 of gestation. Increasing the dietary protein intake between d 75 and 105 of gestation does not benefit mammary development, and increasing the dietary energy intake is detrimental to the development of mammary secretory tissue. Thus, if additional energy intake is observed in late gestation that mammary development may be impaired, which could reduce milk production. However,

it has been suggested that increased feed intake during the last weeks of gestation will increase pig birth weights as well as, stretched the stomach making it easier to maximize the feed intake during lactation.

The incorporation of dietary fat the last 10 to 14 days of gestation has been should to improve pig survival, particularly in litters with low birth weights. An average pig birth weigh of 3 to 3.2 lb is a good indicator that the gestation-feeding program is adequate. The bottom line, if feed intake is too high during gestation that lactation feed intake will decrease and impact subsequent reproductive performance. Another good nutritional management practice to enhance lactation feed intake is to transition the gestating female over to the lactation diet 1 week prior to farrowing.

Weaning to Rebreding

Lactation feed intake and getting sows back onto feed during pre-breeding is important in reducing wean-to-estrous intervals. At the time of weaning, there is a dramatic reduction in feed intake and body weight as milk production stops causing mammary tissue to dehydrate. Typically, sows with a low body-fat content will frequently have a longer weaning to rebreeding interval, a low lactation feed intake is perhaps more responsible for poor breeding performance after weaning than is low body-fat content.

It is important to reach a feed consumption level of up to 4 to 6 lbs per day so there is no interference with mechanisms such as hormone excretion from the intestinal tract. Feed intake and fiber are two factors that seem to be key

to helping limit the inhibitory effect of feedback hormones being reabsorbed from the intestinal tract. Sows in a catabolic state do not reverse this metabolic process quickly. Feeding high protein concentrations during this time period (ex. Lactation diet) will likely have little or no effect other than waste costly amino acids. Feeding a gestation diet containing some fiber and encourage weaned sows to consume as much as possible helps eliminate excreted hormones from the intestinal tract.

An elevated feed intake from weaning to estrus (flushing) may also be beneficial for sows that have lost a great deal of body weight during lactation, plus increase the ovulation rate. However, once bred, the feed intake should be immediately lowered to the established gestation feed intake level. The gestation diet is a satisfactory feed to provide during this rebreeding period.

Lactation

During the relatively short lactation period, today's high-producing, maternally-lean sows are expected to recover from farrowing, maximize milk production, eat 20 + lb of feed per day and rebreed before traditional sows were typically weaned. The lactating sow produces 15 to 30 lb of milk per day resulting in daily nutrient requirements that are about 3 times higher than during gestation. For highly, prolific sows, nutrients from body tissue reserves and feed are used to support lactation. This results in loss of body weight (negative nutrient balance).

Excessive body weight loss can lead to short-term reproductive problems such as extended weaning-to-estrus

interval and smaller subsequent litter size. Long-term problems include a higher culling rate of the sow herd resulting in a low average parity; reduced pigs weaned per reproductive lifetime and higher costs per pig produced. Increasing feed intake and/or increasing nutrient concentration in the lactation diet can minimize the amount of body weight loss and maintain high milk production, which will subsequently improve reproductive performance. Swine producers need to ensure that maximum lactation feed intake is achieved by having sow cards that allow daily feed intake to be recorded. This is especially important when more than one person does the sow feeding. These high-producing, maternally lean females lose more muscle and less fat than low-lean genotype lines.

Lactation feed intake impacts subsequent weaning to service interval, farrowing rate, litter size and litter weight gain. The goal for the entire lactation feed intake is about 16 lb of feed per day for parity 1 females and 20 lb of feed per day for parity 2 or greater females. However, the average lactation feed intakes on an average swine operation is in the range of 10 to 12 lb/d and 17 to 18 lb/d for parity 1 and parity 2+ sows, respectively. A swine producer can determine the ideal daily lactation feed intake for each sow by using the following assumption that a sow needs 4 lb of feed per day for maintenance plus 1 lb of feed/day/pig nursed.

The goal is for lactating females to reach ad libitum feed intake in approximately 3 to 5 days post-farrowing by following a gradual step-up feeding program. The best lactation feeding programs usually maximize feed

intake by providing the female with several small feedings during the day that will keep the feed from getting spoiled, but not restrict intake. When producers switch from feeding 2 times per day to 3 times per day, an increase of 10 to 15 % in feed intake is observed. This practice of feeding smaller amounts of feed more frequently is especially beneficial during the summer months as the increase in body temperature that occurs after a sow consumes a meal won't be as big when 4.5 lb of feed is fed versus 6 lb of feed.

The feeding practice that most producers find helpful is to feed a minimum amount of feed (3 to 6 lbs) the first day of farrowing. Total feed offered on each subsequent day should increase by 2 to 3 lb per day or approximately 1 lb per feeding until ad libitum intake is achieved. However, if a sow appears to clean up all the feed provided at each meal, then increase the feed allowance. The step-up feeding program is only a baseline schedule to follow and can be adapted to satisfy each individual swine operation. An example is shown in Table 3 and Table 4 for first parity and multiparous females, respectively. If there is some feed (> 2 lb) left from the previous meal, no feed should be added or the old feed can be removed and offer the same amount of feed as fed at the last meal.

There are many other factors that limit lactation feed intake such as water accessibility (water flow should be 1,500 ml/min), type of feeder used, and ventilation rates (poor air quality).

Each sow is an individual and no single nutrition or feeding program will meet every sow's lactation needs. Typically, the lactation diet will be formulated to contain a minimum concentration of 17.5 % crude protein,

0.9 to 1.0 % total lysine, 0.9 % Ca, 0.8 % total P, and 0.5 % available P. The lactation diet's nutrient composition should provide minimum daily intakes of 45 to 50 g of lysine and 16 Mcal of metabolizable energy at ad libitum intake. Most parity 1 and some under-conditioned parity 2 females need about 1.2 % lysine in the diet. Therefore, to ensure that parity 1 females are meeting their nutrient needs, a swine producer can either use two different lactation diets varying in lysine and protein concentration or use a soybean meal top dress to the whole herd lactation diet for the parity 1 gilts. Top dressing with 0.5 lb of soybean meal can change a lactation diet from a 1.0 % to 1.2% lysine diet.

Concluding Thoughts

A high quality breeding herd nutrition and feeding program can fit into the management scheme of any operation and will more than likely improve productivity. The bottom line is the more feed you can get into the sow when she is in the farrowing crate, the better condition both physically and nutritionally when it comes time to breed her back. Overall, good lactation performance is not just a post-farrowing process, but encompasses the entire reproductive cycle. Success in pork production necessitate and efficient and well-managed breeding herd program. Today's prolific, high-lean sow may be tomorrow's average sow. Therefore, knowing how to feed and manage the breeding herd, whether today or tomorrow, will enable swine producers to be competitive and successfully meet the challenges encountered.

Some recommendations to maximize lactation feed intake:

- Keep farrowing room temperature between 65-70 °F
- Do not overfeed during gestation
- Ensure that water intake is not restricted
- Provide fresh, high quality feed daily (3 meals/d)
- Remove spoiled and day old feed every morning
- Proper feeder design for accessibility
- Keep lights on at least 10 to 12 hr/day
- Avoid fibrous-low energy diets
- Handle sows gently
- Record feed intake

Table 1. Nutrient Requirements for Boars (as-fed basis).

Item, %	Development Phase			
	Early	Mid	Late	Mature
Protein	22	20	18	16
Lysine	1.2	1.1	1.0	.85
Ca	.95	.85	.8	.9
tP	.75	.65	.75	.8
aP	.49	.4	.49	.5

Table 2. Nutrient Requirements for Replacement Gilts (as-fed basis).

Item, %	Development Phase, lbs			
	50+	100+	150+	250+
Protein	18	17	16	15
Lysine	1.0	.9	.8	.7
Ca	.85	.8	.75	.75
tP	.75	.7	.65	.65
aP	.49	.45	.4	.4

Table 3. Feeding program for genetically lean “first parity gilts” during lactation.

Day of Lactation	Pounds of Feed		
	AM	PM	Total/day
Day 1	4	0	4
Day 2	3	3	6
Day 3	4	4	8
Day 4	5	5	10
Day 5	6	6	12
Day 6	7	7	14
Day 7 to wean	8	8	16

Table 4. Feeding program for genetically lean “multiparous sows” during lactation.

Day of Lactation	Pounds of Feed		
	AM	PM	Total/day
Day 1	6	0	6
Day 2	4	4	8
Day 3	5	5	10
Day 4	6	6	12
Day 5	7	7	14
Day 6 & 7	8	8	16
Day 8	9	9	18
Day 9 to wean	10	10	20