



Replacement Gilt and Boar Nutrient Recommendations and Feeding Management

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Introduction

The nutritional program for replacement gilts has a direct effect on sow lifetime productivity. How females are fed in development affects prolificacy and consistency of future reproductive cycles and can predispose them to feet and leg problems during later parities. Increased culling of breeding females due to problems with reproductive performance, health, or structural soundness can be very expensive. Purchasing premium-priced replacement gilts adds to the cost of production, while producing and raising gilts from within the herd takes considerable time, management, and an investment of resources.

The management and rearing of replacement gilts has become more challenging in recent years due to selection emphasizing increased litter size and carcass leanness. Selection in many maternal lines for leanness to meet the consumer's demand for leaner pork has resulted in a decrease in sow appetite, complicating meeting nutritional demands with larger litters. Breeding stock companies are trying to balance appetite with reductions in backfat in their selection programs, but today's genetics have an increased risk of inadequate body nutrient reserves that will be required throughout the sow's reproductive lifetime, particularly during lactation. Therefore appropriate nutrition and management strategies must be implemented and maintained for maximizing performance of the modern replacement female.

For those operations that rear and maintain boars for either semen collection or natural service, development of the young boar, including proper nutrition, is also important to ensure optimal reproductive performance while managing body size. Therefore, it is imperative that attention be placed on providing adequate nutrition and management during rearing of replacement breeding animals in order to reduce input costs and increase production efficiency in pork production systems.

Objectives

The objective of the feeding program for replacement gilts and boars is to increase body reserves of key nutrients during the finishing period while optimizing mature body size in order to achieve maximal reproductive productivity and longevity.

Management and Feeding Goals During Gilt Rearing

Many factors can affect the age a gilt reaches puberty, including genotype, housing environment, lighting regime, movement, nutrition and feed intake, and exposure to a mature boar [1,2]. Number of ovulations increases during the first three estrous cycles after reaching puberty, then remains relatively constant [3]. Therefore, gilts should be mated on their second (preferred) or third estrous cycle to maximize litter size and future reproductive performance while minimizing additional non-productive days that would accrue if mating later.

The overall goal of a gilt rearing program is to mate gilts at a moderate weight (around 300 lb at 200 days of age) and to allow them to continue to grow through their first gestational period [4]. Extremes in body condition often result in decisions to cull females throughout their reproductive lifetime. Gilts and sows that do not accumulate adequate energy stores tend to have lower litter weaning weights, poorer return to estrus, smaller subsequent litter size, and physical weakness. In modern lean genotypes, a minimum of 0.5 inches (12 mm) backfat at farrowing appears to be adequate to prevent “thin sow syndrome” problems while maximizing feed intake in lactation. Conversely, fat females greater than 0.8 inches (20 mm) backfat tend to experience anestrus, dystocia, depressed appetite in lactation, poorer milk production, and locomotive failure [5].

Energy and Protein Effects on Reproductive Development and Performance

Very little is known or understood about the influence of nutrition during the early growth period (i.e. nursery) on subsequent reproductive performance and longevity in replacement gilts. Under-nutrition at an early age can influence subsequent reproductive development, but the effects may only be evident when early growth has been severely stunted and the animal fails to compensate in later phases [6]. In general, when the nutrient supply is adequate for commercially acceptable growth rates, there appears to be no effect of nutrition during the growing period on age at puberty [2].

Moderate to severe restriction of energy (60 – 80% of ad lib feed intake) will, however, delay the onset of puberty in gilts [7]. Full-feeding during rearing increases number of ovulations and potential litter size in gilts [3]. Flushing gilts (feeding a high energy or feed intake level prior to breeding) that were previously restriction-fed increases ovulation rate to the level that would be obtained if the gilt was maintained on a high level of diet intake [8,9]. The optimum duration of the high-energy flushing regime appears to be 11-14 days before the expected date of estrus or mating and can increase number of eggs ovulated by 1-2 [10]. The increased eggs ovulated sets the maximum potential litter size. After mating, it is advisable to reduce feed or energy level to gestation like amounts because of the increased chance of embryonic mortality due to increased progesterone clearance observed with high feed intake [3].

Moderate protein restriction during the rearing period does not appear to influence age at first estrous in gilts, although severe protein restrictions or the imbalanced intake of essential amino acids have been demonstrated to delay the onset of puberty [3,8,11]. Neither the level of dietary protein [12] nor the source of protein [13] during pre-puberty has a significant effect on ovulation rate or embryonic mortality. With longer periods of protein deprivation (greater than one cycle) ovulation rate is reduced and some individuals become anestrus [14,15].

Energy and Protein Effects on Lifetime Productivity and Longevity

The ability to keep females productive through several parities is essential to maximizing the efficiency of a breeding program. Higher culling rates result in an increased proportion of gilts in the herd, while gilts generally have smaller litter sizes compared to later parity sows, and thus a decrease in overall herd productivity occurs. Optimum energy (and feed) intake during rearing depends largely on gilt body composition [16]. For very lean gilts, a moderate protein, high-energy diet during rearing optimizes lean growth while encouraging accumulation of body fat stores, improving lifetime performance. Several studies indicate that gilts with a high capacity for lean growth are often more difficult to increase body fat stores, but also if gilts achieve a body weight of at least 300 lb and a minimum P2 backfat of 0.5 inches (12 mm), increasing fat level does not substantially improve lifetime retention [17,18]. However, average lean gilts may need to have energy restricted slightly during development to avoid excessive body conditioning that can lead to increased farrowing difficulty, decreased feed intake and milk production during lactation, and increased locomotive problems later on due to greater body weight.

The goal of restricting energy and protein intake during rearing is to limit mature body size, thereby minimizing feet and leg problems due to increased body weight. Although gilts reared on lower energy diets tend to farrow more litters before being culled [17,18], they also tend to reach puberty later.

Gilts can be fed ad libitum until mating or limit fed beginning around 180 – 200 lb bodyweight. In high-lean genotypes, voluntary feed intake is often somewhat reduced in relation to energy requirements

compared to medium- and low-lean females, so ad libitum feeding to ensure adequate body fat stores is preferred with high lean genotypes. In medium- or low-lean genotypes, gilts will tend to consume more energy than is needed to achieve ideal body condition, thus becoming too fat, so limit feeding is advised with those genotypes after selection has occurred. Regardless of the feeding approach used, replacement gilts' feed needs to meet the energy, amino acid, mineral, and vitamin needs for growth and development. The feeding program should be designed to ensure that gilts do not become overly fat or grow too fast, resulting in increased body weight and potential feet and leg problems due to excessive weight.

Minerals and Vitamins for Replacement Gilts

One of the primary goals of replacement gilt nutrition is to increase mineral stores through maximizing bone mineralization. Although maximizing bone strength does not necessarily improve structural soundness [19], it is generally recommended that Ca and P levels be provided at levels greater than grow-finish concentrations in order to prevent females from experiencing locomotive problems later on due to excessive depletion of mineral stores during lactation periods. Feeding higher levels of Ca and P than needed, however, is costly and also creates environmental concerns, and therefore extreme excesses should be avoided. Greater copper and zinc concentrations should also be fed with higher Ca and P concentrations when feeding to maximize bone mineral reserves. These minerals are required and stored in developing fetuses during late gestation, thus creating an increased drain on maternal stores (20). Several reports suggest that other trace minerals and vitamins, such as zinc, riboflavin (21) and folic acid (22) have roles in early embryo development and therefore may affect embryo survival. Greater selenium and vitamin E intake and retention may provide benefits later in the sow's reproductive life by maximizing the animal's immune system response and preventing lactation complications such as mastitis [5]. Other vitamin and mineral requirements of the replacement gilt are generally similar to those of the grow-finish pig.

Nutrient Recommendations and Feeding Strategies

Nutrient recommendations for replacement maternal-line gilts are provided in Table 1. We believe the nutrient recommendations provided will result in a "best-cost" feeding strategy for most producers in most situations, resulting in optimal reproductive productivity and longevity, although conditions may exist that require deviation from these recommended levels (i.e. outdoor housing with temperature ranges outside the animal's thermo-neutral zone). Consult with a nutritionist to determine if adjustments from these feeding recommendations are warranted for your operation. Replacement females should be fed different from normal grow-finish market hogs by at least 180 lb body weight in order to allow adequate time to build the body reserves that are needed for lifetime productivity. Feeding strategies should include increasing mineral levels to build bone strength. Total calcium and phosphorus levels should be increased by 0.1% units each over levels that would be provided for similar grow-finish pigs headed to market.

Amino acid levels are provided rather than dietary protein recommendations because pigs require amino acids, which are found in protein, rather than protein itself. Lysine is the first limiting amino acid in grain-soybean meal-based diets. Lysine recommendations are provided on a total basis and a standardized ileal digestible (SID) basis. Formulating diets on a SID basis allows one to account for differences in the availability of amino acids in the diet and more closely meets the pig's amino acid needs while minimizing nitrogen excretion. All other essential amino acids are presented on a SID basis, and were determined based on amino acid ratios that were developed for growing-finishing pigs and are presented in PIG Factsheet #07-02-03 (Understanding Swine Nutrient Recommendations in the National Swine Nutrition Guide). Similarly, digestible and available phosphorus levels are provided in addition to total phosphorus recommendations. Using digestible or available levels in diet formulation allows greater flexibility in ingredient and enzyme usage while minimizing excess supplementation and excretion of phosphorus that can lead to environmental concerns and increases diet cost.

Ranges are presented for recommended additions of salt, trace minerals and vitamins to replacement gilt and boar diets (Table 2) to offer feed manufacturers and producers greater flexibility in preparing and utilizing products based on our recommendations. This approach affords more flexibility and convenience and often reduces costs associated with handling and storing multiple products. In addition, the ranges acknowledge that information gaps exist in trace mineral and vitamin nutrition of pigs, making it difficult to establish firm recommendations. Except for salt, the minimum values represent the total amount required

in the diet according to the NRC [19]. Upper values do not represent safe or tolerance levels, but instead a reference point above which further additions will not likely improve performance. Formulators should avoid the minimum and the highest nutrient concentrations in Table 2 in favor of intermediate values.

Specific recommendations for trace mineral and vitamin additions to replacement gilt and boar diets are shown in Table 3. The values represent our best estimate of trace mineral and vitamin needs of replacement breeding stock in practical situations. These values are based on NRC requirements to which a safety margin has been added and current research findings sense the NRC was published in 1998. These levels assume that natural feedstuffs provide none of the nutrient of interest. Those seeking nutritional information for manufacturing basemixes and premixes for swine diets may go to PIG Factsheet #07-02-06 (Trace Minerals and Vitamins for Swine Diets).

The key to gilt development is to optimize protein and mineral deposition, while allowing appropriate levels of fat development to occur such that females can utilize these nutrients later on in lactation. During the lactation period, energy in particular cannot generally be consumed in adequate quantities to meet the needs of the young sow and growing litter, and therefore body stores will be relied upon to meet the increased need over intake for milk production [23]. At approximately 270 lb, feeding levels should be adjusted based on lean-growth potential of the gilts. High-lean gilts can be provided ad-libitum access to a moderate protein diet, while medium-lean gilts should be limit-fed to prevent excessive condition/fatness prior to breeding. Feed intake levels provided in Table 1 assume a corn-soybean meal diet is fed containing 1.52 Mcal ME/lb.

Ad-libitum Feeding for High-Lean Gilts

Ad libitum, or full-feeding means that replacement gilts are self fed and no limit is placed on feed intake. Full-feeding a moderate protein diet is done to slow lean tissue growth (muscle deposition) while increasing body fat accretion. This method of feeding has been shown to be effective in improving longevity in genetically lean gilts [24]. High-lean gilts have greater lean growth rates, but also tend to having reduced feed intakes. Full feeding gilts up to the time of mating ensures adequate tissue deposition, sufficient size, young age at first estrus, and maximal number of ova shed [25]. Once gilts are selected, they should be provided a diet that meets the nutrient recommendations outlined in Tables 1 & 2.

Feeding modern high-lean gilts for ad libitum consumption is most practical for the majority of production systems, particular when gilts are housed in groups. Limit feeding of new gilts in pens may cause the least dominant animals to not get full access to feed and therefore have small litter size or not cycle as early. When replacement gilts are fed ad libitum, they should be monitored to make sure that they are not becoming too large or too fat or thin which can cause problems. Consult your genetic supplier to determine ideal body condition, as this will vary across different genetic lines and breeds.

Limit Feeding for Low- and Medium-Lean Gilts

Another option for nutritional management that may be more appropriate for low- and medium-lean maternal gilts is limit feeding. Limit feeding is done by restricting energy intake. The goal of restricting energy intake during the gilt development period is to limit mature body size, minimizing feet and leg problems associated with females that are too fat and too heavy [5]. Restricting nutrient intake during development may increase longevity in sows. Replacement gilts that are fed a restricted energy intake beginning as early as 180 lb up to 180 days of age tend to have a higher percentage farrowing and remaining in the herd through four parities than gilts that are fed a normal ad libitum gilt development diet [4].

Limit feeding involves providing replacement gilts an ad libitum diet until a month or two before breeding. The ad libitum diets are



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similar to growing-finishing diets, allowing maximum expression of their genetic potential for growth rate and backfat. Feed intake is then restricted to approximately 85 – 90% of ad libitum until 10 – 14 days before mating. An example of a limit-fed diet is provided as diet 6L in Table 1. When restricting the diet, energy should be restricted but not amino acids, vitamins or minerals – therefore, concentrations of these nutrients needs to be adjusted upwards in the diets accordingly. There are several factors that influence the amount of feed required when limit feeding, including animal activity, opportunity to huddle together, and use of bedding. Gilts maintained indoors require about 10% less feed than gilts maintained outdoors. During winter, requirements are about 25% greater for gilts kept outdoors [26].

At 10 – 14 days prior to breeding, “flush” gilts by increasing feed intake to ad libitum amounts. Increasing the gilt’s allowance by 50% or greater via “flushing” has been shown to increase ovulation rates and subsequently increase the number of piglets born by as much as 1 pig per litter when gilts were being limit fed during the gilt development phase [25]. High-energy feeding must be discontinued immediately after mating to prevent an increase in embryonic mortality due to increased progesterone clearance observed with high feed intake.

Producers may have difficulty feeding a restricted diet to replacement females because of facility design. When gilts are housed and fed in groups, it is difficult to be sure that the correct amount of the diet is ingested on an individual basis because all gilts do not consume feed at the same rate. Unless producers have individual stalls or an electronic feeding system available for potential breeding herd replacement females, it will be difficult to implement a restricted feeding program, when gilts are fed in groups [27]. Feeding a high-fiber diet that is lower in energy concentration is an energy restriction alternative that allows for an increase in daily feed intake closer to ad libitum levels. This feeding strategy may partially alleviate competition and variability in individual feed intake in group feeding situations, due to increased consumption time, gut fill, and satiety of gilts, but may also present challenges related to feed delivery systems and manure handling.

Nutrition During Rearing for Replacement Boars

Boars generally attain puberty between 5 and 8 months of age, when they are approximately 175 – 250 lb. Sperm production in the testes begins at around 2 months of age, but are immature, and at low concentrations for several months (28). Fertility is low at puberty, but increases to a plateau at around 15 – 18 months of age. Relatively little is known about specific nutrient requirements of the boar during development, as significantly less research has been done on boars, especially during rearing, compared to other stages of production in swine. However, reducing feed intake by 30 % of ad libitum intake prior to attainment of puberty has been shown to significantly increase the age of puberty (28). Additionally, unless replacement boars are severely undernourished in either energy or protein intake, there does not appear to be any lasting damage to reproductive capacity later in life.

Most young replacement boars are offered feed close to ad libitum during rearing, and as they reach puberty and sexual maturity, intake levels are then restricted after selection has occurred. Similar to replacement gilts, it is desirable to allow replacement boars to grow near maximal levels in order to evaluate their performance potential and desirability for use in breeding programs. Additionally, boars have greater lean accretion rates than gilts, and therefore require greater levels of amino acids and some minerals. Nutrient recommendations for replacement terminal line boars are provided in Tables 2-4. The values in Table 4 represent a much greater increase in amino acid (15 – 20%) and moderately greater increase in mineral requirements (0 – 8%) compared to similar size replacement gilts on a diet concentration basis. These differences allow for maximal growth performance and mineralization of bones during the development period, and reflect differences in lean growth accretion and voluntary feed intake. However, in practice, many young boars are provided a diet similar to that for replacement gilts.

| Table 1. Amino acid, calcium and phosphorus recommendations for maternal-line replacement gilts (as-fed basis) ^{ab} | | | | | | | |
|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------|------------|------------|------------|-----------------|--------------|
| Type of diet | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6F | Phase 6L |
| Body weight, lb | 45 to 90 | 90 to 135 | 135 to 180 | 180 to 225 | 225 to 270 | 270 to breeding | 270 to flush |
| Assumed feed intake, lb/day | 3.1 | 4.0 | 4.7 | 5.3 | 5.7 | 5.9 | 5.0 |
| Dietary metabolizable energy, Mcal/lb | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 |
| | -----% of diet----- | | | | | | |
| Lysine, total | 1.15 | 1.04 | 0.95 | 0.85 | 0.74 | 0.65 | 0.77 |
| Standardized ileal digestible | | | | | | | |
| Lysine | 1.02 | 0.92 | 0.84 | 0.74 | 0.64 | 0.56 | 0.67 |
| Threonine | 0.64 | 0.58 | 0.54 | 0.48 | 0.43 | 0.38 | 0.46 |
| Methionine | 0.30 | 0.27 | 0.24 | 0.22 | 0.19 | 0.17 | 0.21 |
| Methionine + cysteine | 0.59 | 0.53 | 0.50 | 0.45 | 0.40 | 0.35 | 0.42 |
| Tryptophan | 0.16 | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | 0.11 |
| Isoleucine | 0.56 | 0.51 | 0.46 | 0.41 | 0.35 | 0.31 | 0.37 |
| Valine | 0.66 | 0.60 | 0.54 | 0.48 | 0.42 | 0.36 | 0.44 |
| Arginine | 0.41 | 0.35 | 0.30 | 0.25 | 0.22 | 0.19 | 0.23 |
| Histidine | 0.33 | 0.29 | 0.27 | 0.24 | 0.21 | 0.18 | 0.21 |
| Leucine | 1.02 | 0.92 | 0.84 | 0.74 | 0.64 | 0.56 | 0.67 |
| Phenylalanine + tyrosine | 0.96 | 0.86 | 0.79 | 0.70 | 0.61 | 0.54 | 0.64 |
| Phenylalanine | 0.61 | 0.55 | 0.50 | 0.45 | 0.39 | 0.34 | 0.40 |
| Calcium | 0.81 | 0.75 | 0.71 | 0.67 | 0.65 | 0.65 | 0.75 |
| Phosphorus, total ^c | 0.81 | 0.75 | 0.71 | 0.67 | 0.65 | 0.65 | 0.75 |
| Phosphorus, available | 0.38 | 0.34 | 0.32 | 0.29 | 0.29 | 0.29 | 0.34 |
| Phosphorus, digestible | 0.35 | 0.32 | 0.29 | 0.26 | 0.26 | 0.26 | 0.32 |
| | -----g/Mcal ME ^d ----- | | | | | | |
| Lysine, total | 3.43 | 3.10 | 2.83 | 2.54 | 2.21 | 1.94 | 2.30 |
| Standardized ileal digestible | | | | | | | |
| Lysine | 3.04 | 2.74 | 2.50 | 2.22 | 1.92 | 1.67 | 2.00 |
| Threonine | 1.92 | 1.73 | 1.60 | 1.44 | 1.29 | 1.14 | 1.36 |
| Methionine | 0.88 | 0.80 | 0.72 | 0.64 | 0.58 | 0.52 | 0.62 |
| Methionine + cysteine | 1.77 | 1.59 | 1.50 | 1.33 | 1.19 | 1.05 | 1.26 |
| Tryptophan | 0.49 | 0.44 | 0.40 | 0.36 | 0.31 | 0.27 | 0.32 |
| Isoleucine | 1.67 | 1.51 | 1.37 | 1.22 | 1.06 | 0.92 | 1.10 |
| Valine | 1.98 | 1.78 | 1.62 | 1.44 | 1.25 | 1.09 | 1.30 |
| Arginine | 1.22 | 1.04 | 0.90 | 0.76 | 0.65 | 0.57 | 0.68 |
| Histidine | 0.97 | 0.88 | 0.80 | 0.71 | 0.61 | 0.54 | 0.64 |
| Leucine | 3.04 | 2.74 | 2.50 | 2.22 | 1.92 | 1.67 | 2.00 |
| Phenylalanine + tyrosine | 2.86 | 2.58 | 2.35 | 2.09 | 1.82 | 1.61 | 1.92 |
| Phenylalanine | 1.83 | 1.65 | 1.50 | 1.33 | 1.15 | 1.00 | 1.20 |
| Calcium | 2.42 | 2.24 | 2.12 | 2.00 | 1.94 | 1.94 | 2.24 |
| Phosphorus, total ^c | 2.42 | 2.24 | 2.12 | 2.00 | 1.94 | 1.94 | 2.24 |
| Phosphorus, available | 1.13 | 1.01 | 0.95 | 0.87 | 0.87 | 0.87 | 1.01 |
| Phosphorus, digestible | 1.04 | 0.95 | 0.87 | 0.78 | 0.78 | 0.78 | 0.95 |

^aAll diets are full-fed under themoneutral conditions except diet 6L, which is limit-fed and is used in place of diet 6F for limit-feeding programs.

^bSufficient data are not available to indicate that requirements for other nutrients are different from those in Table 3 for animals of these weights. Provide breeding herd levels of trace minerals and vitamins beginning at about 270 lb.

^cTotal phosphorus recommendations should be used as a guideline only; those recommendations may not be obtained when formulating practical diets on an available or digestible phosphorus basis which is recommended. Also, total phosphorus recommendations will not be achieved when phytase is included in the diet.

^dRecommended amount relative to dietary metabolizable energy (ME) density; energy values of ingredients from PIG factsheet #07-07-09 (Composition and Usage Rate of Feed Ingredients for Swine Diets) were used in the calculations.

Table 2. Ranges for recommended dietary additions of salt, trace minerals and vitamins from concentrates, base mixes or premixes for replacement gilts and boars^{ab}

| Type of diet | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---------------------------------------------|---------------|---------------|---------------|---------------|---------------|-----------------|
| Body weight, lb | 45 to 90 | 90 to 135 | 135 to 180 | 180 to 225 | 225 to 270 | 270 to breeding |
| Assumed feed intake, lb/d | 3.2 | 3.9 | 4.8 | 5.4 | 5.7 | 5.9 |
| Dietary metabolizable energy, Mcal/lb | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 |
| Minerals | | | | | | |
| Salt, % | 0.2 to 0.4 | 0.4 to 0.6 |
| Sodium, % | 0.1 to 0.2 | 0.15 to 0.25 |
| Chloride, % | 0.08 to 0.2 | 0.12 to 0.3 |
| Copper, ppm | 4 to 20 | 4 to 20 | 3 to 20 | 3 to 20 | 3 to 20 | 5 to 20 |
| Iodine, ppm | 0.14 to 0.4 | 0.15 to 0.5 |
| Iron, ppm | 60 to 180 | 60 to 180 | 50 to 180 | 40 to 180 | 40 to 180 | 80 to 200 |
| Manganese, ppm | 2 to 30 | 20 to 45 |
| Selenium, ppm ^c | 0.15 to 0.3 |
| Zinc, ppm | 60 to 180 | 60 to 180 | 50 to 180 | 50 to 180 | 50 to 180 | 50 to 200 |
| Vitamins | | | | | | |
| Vitamin A, IU/lb | 600 to 4000 | 1800 to 7000 |
| Vitamin D ₃ , IU/lb | 70 to 400 | 90 to 700 |
| Vitamin E, IU/lb | 5 to 20 | 20 to 40 |
| Vitamin K, mg/lb ^d | 0.25 to 2 | 0.25 to 3 |
| Riboflavin, mg/lb | 1 to 10 | 2 to 8 |
| Niacin, mg/lb | 5 to 25 | 5 to 25 | 3 to 25 | 3 to 25 | 3 to 25 | 5 to 35 |
| Pantothenic acid, mg/lb | 4 to 20 | 4 to 20 | 3 to 20 | 3 to 20 | 3 to 20 | 5 to 20 |
| Choline, mg/lb ^e | 0 | 0 | 0 | 0 | 0 | 250 to 500 |
| Biotin, mg/lb ^f | 0 | 0 | 0 | 0 | 0 | 0.1 to 0.3 |
| Vitamin B ₁₂ , mg/lb | 0.005 to 0.02 | 0.005 to 0.02 | 0.002 to 0.02 | 0.002 to 0.02 | 0.002 to 0.02 | 0.007 to 0.02 |
| Folic acid, mg/lb ^g | 0 | 0 | 0 | 0 | 0 | 0.6 to 1.8 |
| Vitamin B ₆ , mg/lb ^h | 0 | 0 | 0 | 0 | 0 | 0 to 2.25 |

^aAll diets are fed under thermoneutral conditions.

^bMinimum values generally represent the quantity recommended by the NRC (1998). Upper values do not represent safe or tolerance levels, but instead a reference point above which further additions will not likely improve performance.

^cMaximum legal addition is 0.3 ppm.

^dMenadione activity.

^eNRC requirement is 136 mg/lb in the complete diet for phases 1 to 5 and this amount is met by traditional feedstuffs so none is supplemented.

^fNRC requirement is 0.023 mg/lb in the complete diet for phases 1 to 5 and this amount is met by traditional feedstuffs so none is supplemented.

^gNRC requirement is 0.136 mg/lb in the complete diet for phases 1 to 5 and this amount is met by traditional feedstuffs so none is supplemented.

^hNRC requirement is 0.45 mg/lb in the complete diet for phases 1 to 5 and this amount is met by traditional feedstuffs so none is supplemented.

Table 3. Specific recommended dietary additions of trace minerals and vitamins from concentrates, base mixes or premixes for replacement gilts and boars

| Type of diet | Grower | Finisher-1 | Finisher-2 | Finisher-3 |
|---------------------------------------|-----------|------------|------------|-----------------|
| Body weight, lb | 45 to 135 | 135 to 225 | 225 to 270 | 270 to breeding |
| Dietary metabolizable energy, Mcal/lb | 1.52 | 1.52 | 1.52 | 1.52 |
| Minerals | | | | |
| Sodium, % ^{a,b} | 0.15 | 0.15 | 0.15 | 0.2 |
| Chloride, % ^{a,b} | 0.15 | 0.15 | 0.15 | 0.2 |
| Copper, ppm | 12 | 10 | 8 | 16 |
| Iodine, ppm | 0.25 | 0.20 | 0.15 | 0.30 |
| Iron, ppm | 125 | 100 | 75 | 165 |
| Manganese, ppm | 6 | 5 | 4 | 30 |
| Selenium, ppm ^c | 0.25 | 0.20 | 0.15 | 0.3 |
| Zinc, ppm | 125 | 100 | 75 | 165 |
| Vitamins | | | | |
| Vitamin A, IU/lb | 2500 | 2000 | 1500 | 4000 |
| Vitamin D ₃ , IU/lb | 250 | 200 | 150 | 300 |
| Vitamin E, IU/lb | 15 | 12 | 9 | 30 |
| Vitamin K, mg/lb ^d | 1 | 0.8 | 0.6 | 2 |
| Riboflavin, mg/lb | 4 | 3 | 2 | 4 |
| Niacin, mg/lb | 11 | 9 | 7 | 15 |
| Pantothenic acid, mg/lb | 7 | 6 | 5 | 10 |
| Choline, mg/lb | 0 | 0 | 0 | 250 |
| Biotin, mg/lb | 0 | 0 | 0 | 0.1 |
| Vitamin B ₁₂ , mg/lb | 0.01 | 0.008 | 0.006 | 0.01 |
| Folic acid, mg/lb | 0 | 0 | 0 | 0.75 |
| Vitamin B ₆ , mg/lb | 0 | 0 | 0 | 0 |

^aSalt is usually added at the rate of 6 to 7 lb/ton in grower-finisher diets and 10 lb/ton in breeding herd diets to help provide a significant portion of the *total* dietary sodium and chloride recommendations.

^bRecommendations for sodium and chloride represent *total* dietary amounts, not additions.

^cMaximum legal addition is 0.3 ppm.

^dMenadione activity.

| Type of diet | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 |
|---------------------------------------|-----------------------------------|-----------|------------|------------|------------|------------|
| Body weight, lb | 45 to 90 | 90 to 135 | 135 to 180 | 180 to 225 | 225 to 270 | 270 to 300 |
| Assumed feed intake, lb/d | 3.1 | 4.0 | 4.7 | 5.3 | 5.7 | 5.9 |
| Dietary metabolizable energy, Mcal/lb | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 | 1.52 |
| | -----% of diet----- | | | | | |
| Lysine, total | 1.35 | 1.20 | 1.12 | 0.99 | 0.88 | 0.79 |
| Standardized ileal digestible | | | | | | |
| Lysine | 1.20 | 1.07 | 0.99 | 0.87 | 0.77 | 0.69 |
| Threonine | 0.76 | 0.67 | 0.64 | 0.57 | 0.52 | 0.47 |
| Methionine | 0.35 | 0.31 | 0.29 | 0.25 | 0.23 | 0.21 |
| Methionine+cysteine | 0.70 | 0.62 | 0.60 | 0.52 | 0.48 | 0.43 |
| Tryptophan | 0.19 | 0.17 | 0.16 | 0.14 | 0.12 | 0.11 |
| Isoleucine | 0.66 | 0.59 | 0.55 | 0.48 | 0.42 | 0.38 |
| Valine | 0.78 | 0.69 | 0.64 | 0.57 | 0.50 | 0.45 |
| Arginine | 0.48 | 0.40 | 0.36 | 0.30 | 0.26 | 0.23 |
| Histidine | 0.39 | 0.34 | 0.32 | 0.28 | 0.25 | 0.22 |
| Leucine | 1.20 | 1.07 | 0.99 | 0.87 | 0.77 | 0.69 |
| Phenylalanine+tyrosine | 1.13 | 1.00 | 0.93 | 0.82 | 0.73 | 0.66 |
| Phenylalanine | 0.72 | 0.64 | 0.60 | 0.52 | 0.46 | 0.41 |
| Calcium | 0.86 | 0.80 | 0.76 | 0.72 | 0.68 | 0.68 |
| Phosphorus, total ^c | 0.86 | 0.80 | 0.76 | 0.72 | 0.68 | 0.68 |
| Phosphorus, available | 0.46 | 0.39 | 0.34 | 0.31 | 0.30 | 0.30 |
| Phosphorus, digestible | 0.45 | 0.38 | 0.33 | 0.30 | 0.29 | 0.29 |
| | -----g/Mcal ME ^d ----- | | | | | |
| Lysine, total | 4.03 | 3.58 | 3.34 | 2.95 | 2.63 | 2.36 |
| Standardized ileal digestible | | | | | | |
| Lysine | 3.59 | 3.18 | 2.96 | 2.61 | 2.30 | 2.06 |
| Threonine | 2.26 | 2.00 | 1.90 | 1.69 | 1.54 | 1.40 |
| Methionine | 1.04 | 0.92 | 0.86 | 0.76 | 0.69 | 0.64 |
| Methionine+cysteine | 2.08 | 1.84 | 1.78 | 1.56 | 1.43 | 1.30 |
| Tryptophan | 0.57 | 0.51 | 0.47 | 0.42 | 0.37 | 0.33 |
| Isoleucine | 1.98 | 1.75 | 1.63 | 1.43 | 1.27 | 1.13 |
| Valine | 2.33 | 2.07 | 1.92 | 1.69 | 1.50 | 1.34 |
| Arginine | 1.44 | 1.21 | 1.07 | 0.89 | 0.78 | 0.70 |
| Histidine | 1.15 | 1.02 | 0.95 | 0.83 | 0.74 | 0.66 |
| Leucine | 3.59 | 3.18 | 2.96 | 2.61 | 2.30 | 2.06 |
| Phenylalanine+tyrosine | 3.38 | 2.99 | 2.78 | 2.45 | 2.19 | 1.98 |
| Phenylalanine | 2.15 | 1.91 | 1.78 | 1.56 | 1.38 | 1.23 |
| Calcium | 2.57 | 2.39 | 2.27 | 2.15 | 2.03 | 2.03 |
| Phosphorus, total ^c | 2.57 | 2.39 | 2.27 | 2.15 | 2.03 | 2.03 |
| Phosphorus, available | 1.37 | 1.16 | 1.01 | 0.93 | 0.90 | 0.90 |
| Phosphorus, digestible | 1.34 | 1.13 | 0.98 | 0.90 | 0.87 | 0.87 |

^aAll diets are full-fed under thermoneutral conditions.

^bSufficient data are not available to indicate that requirements for other nutrients are different from those in Table 3 for animals of these weights. Provide breeding herd levels of trace minerals and vitamins beginning at about 270 lb.

^cTotal phosphorus recommendations should be used as a guideline only; those recommendations may not be obtained when formulating practical diets on an available or digestible phosphorus basis which is recommended. Also, total phosphorus recommendations will not be achieved when phytase is included in the diet.

^dRecommended amount relative to dietary metabolizable energy (ME) density; energy values of ingredients from PIG factsheet #07-07-09 (Composition and Usage Rate of Feed Ingredients for Swine Diets) were used in the calculations.

Summary

Sow lifetime productivity is a major concern for most breeding herds, and proper nutrition during the development period provides a base for successful reproductive performance later on, both for gilts and boars. Providing a strong development program will have a positive effect on lifetime productivity. Nutrient and feeding recommendations for rearing animals are provided to enhance the expression of genetic growth potential early on and maximize reproductive development while minimizing mature body size by restricting feed and/or energy intake later in development. Feeding programs should be implemented to prevent replacement breeding animals from growing too fast or becoming overly conditioned, as this can lead to feet and leg problems, anestrus, behavioral anestrus, and eventual poor mothering. The recommendations provided in this guide are simply that and may not work for every farm. Recommendations should be evaluated by pork producers and breeding unit managers to determine if they are appropriate to be implemented in their operation.

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Frequently asked Questions

If I flush my gilts what can expect in improved reproductive performance?

Flushing gilts (feeding a high energy or feed intake level prior to breeding) that were previously restriction-fed increases ovulation rate to the level that would be obtained if the gilt was maintained on a high level of feed intake. The optimum duration of the high-energy flushing regime is 11-14 days before the expected date of estrus or mating. Flushing can increase number of eggs ovulated by 1-2. The increased eggs ovulated sets the maximum potential litter size, so up to 1 additional pig born could be observed at farrowing. It is important to decrease the feed intake after mating to gestation levels, because of the increased chance of embryonic mortality due to increased progesterone clearance observed with high feed intake will negate any benefit to flushing the gilts.

What is the optimal backfat level prior to mating my gilts?

In modern lean genotypes, a minimum of 0.5 inches (12 mm) backfat at breeding appears to be adequate to improve sow lifetime productivity. Conversely, medium lean gain females require closer to 0.7-0.8 inches (18-20 mm) backfat to optimize her productivity.

Can I feed my replacement gilts the same diets as my grow-finish pigs?

The key to gilt development is to optimize protein and mineral deposition, while allowing appropriate levels of fat development to occur such that females can utilize these nutrients later on in their first lactation and future parities. Replacement females should be fed different from normal grow-finish market hogs by at least 180 lb body weight in order to allow adequate time to build the body reserves that are needed for lifetime productivity. Feeding strategies should include increasing mineral levels to build bone strength. Total calcium and phosphorus levels should be increased by 0.1% units each over levels that would be provided for similar grow-finish pigs headed to market. Failure to maximize tissue reserves prior to entering the breeding herd may reduce her lifetime productivity.