DNA GENETICS
FOCUSED ON WHAT MATTERS

NUTRITION REQUIREMENTS

FOR SOWS AND GILTS

The DNA sow is highly prolific. To capture the genetic potential of the DNA female, the following guidelines were developed. Producers and nutritionists will need to adjust based on the available feedstuffs and productivity of the herd.

GESTATION REQUIREMENTS

In the pre-breeding and breeding period, it is important that gilts and sows be in a positive energy balance. In many cases this means that sows are fed ad libitum from weaning to breeding. This will help sows build up body protein that was lost in the previous lactation cycle and provide energy for follicle development. For the first 30 days post-breeding, it is also recommended to reduce the feed from ad libitum but keep the females in a positive energy balance to increase the ability to establish pregnancy and to reduce the risk of embryonic mortality. After the first positive pregnancy check, the amount fed should be adjusted to body condition. The maintenance requirement of the sow represents approximately 80% or more of her energy requirements up until day 90 of gestation. At that time, fetal growth rate increases exponentially and increases the need for additional lysine. It is a common industry practice to "bump feed" approximately two pounds extra feed at that time, however, positive results in litter birth weights are only typically seen in gilt litters. Regardless of how a producer decides to feed their herd, it is extremely important to make sure the sow and gilt are not over conditioned entering farrowing as that will lower lactation feed intake (Young, et al., 2004). Examples of visual representation of sow body condition scores can be found in **Figure 1**. The recommendations in **Table 1** and **Table 2** are based on the NRC (2012) sow gestation model and should be used as a guideline for dietary energy intake to promote optimum litter growth and limiting the number of over conditioned sows.

FIGURE 1. SOW VISUAL BODY CONDITION SCORE

TABLE 1. RECOMMENDED DIETARY FEEDING LEVELS[a]

	Weaned to Breeding	Bred to Day 30	Day 31 to 60	Day 61 to 90	Day 91 to 114
	Dietary ME Intake, Mcal/day				
Gilts	8.7	5.7	5.4	5.4	5.4
Sows	8.7	6.1	5.7	5.7	5.7
	Dietary NE Intake, Mcal/day				
	Weaned to Breeding	**Bred to Day 30**	**Day 31 to 60**	**Day 61 to 90**	**Day 91 to 114**
Gilts	6.4	4.2	4.0	4.0	4.0
Sows	6.4	4.5	4.2	4.2	4.2
	Estimated Feed Intake, Lbs.(kg)/day[b]				
	Weaned to Breeding	**Bred to Day 30**	**Day 31 to 60**	**Day 61 to 90**	**Day 91 to 114**
Gilts	6.00 (2.72 kg)	4.00 (1.81 kg)	3.75 (1.70 kg)	3.75 (1.70 kg)	3.75 (1.70 kg)
Sows	6.00 (2.72 kg)	4.50 (2.04 kg)	4.00 (1.81 kg)	4.00 (1.81 kg)	4.00 (1.81 kg)

[a]Energy requirements was based on the NRC (2012) Gestating Sow Model and should be used as a guideline. Use of other ingredients and estimation models may provide a different energy estimation. It is assumed that gilts and sows are housed in a thermal neutral environment and may need more energy if the environment is below their thermal neutral zone. [b]Dietary energy of 1,462 Kcal/lbs. ME (3225 Kcal/kg ME) was used to create the estimated feed intake per day. Feed intake levels will need to be adjusted based on the actual dietary energy used in production.

The swine industry is currently undergoing a transition to group housed sows to meet consumer preference contracts. One of the worries of producers that are mandated to make this housing transition is how to maintain the previous level of production and economic efficiency (Buhr, 2010). Since this transition includes retrofitted and new construction barns it becomes difficult to give producers a standard answer on best management practices. Factors such as pen size, flooring type, feeding system, and the ability to group sows with similar body condition scores, may impact farm success. One of the major challenges that most producers face in group housing situations is how to decrease aggression among pen mates to improve animal welfare and worker safety. Increasing the fiber in the diet, especially when space allowance is limited, has been shown to improve sow welfare (DeDecker et al., 2014) as well as increasing the feeding amount for a limited time post mixing (Greenwood et al., 2019). Another consideration is energy requirements of sows housed in a group vs. stalls (DeRouchey et al., 2013). Using the NRC (2012) to establish energy requirements of the sow assumes that if sows are housed in thermal neutral environment with similar activity levels then the requirement would be identical regardless of housing options. One caveat is that sows in groups would be able to huddle together and conserve body heat which would potential lower their maintenance energy needs. Since a large portion of the energy consumed per day goes to meet maintenance requirements this savings could potentially offset any cost of increased activity level in group housed sows. Due to the complexity of each individual farm environment our assumptions are based on sows housed at their thermoneutral zone with identical activity regardless of housing options.

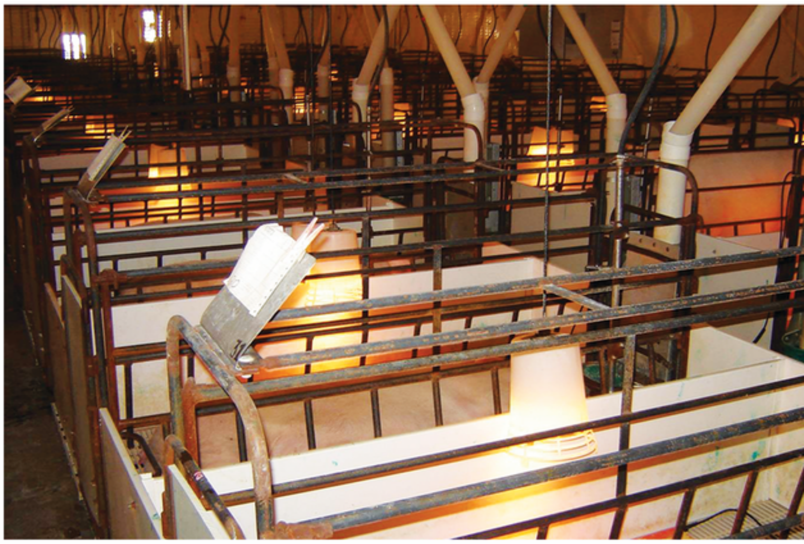
TABLE 2. GESTATION NUTRIENT REQUIREMENTS

	Gilts	Parity 2+
SID Lysine requirements (g/d)[a]	12	11

[a]SID Lysine requirement is based on the NRC (2012) Gestating Sow Model. Anticipated total litter size used for the gilt and sow are based on common production statistics in a healthy herd.

PRE-FARROWING

There has been more interest recently in determining the optimum feeding of the sow during the transition period before farrowing. Historically, gilts and sows were limited fed once per day when placed in the farrowing stall and feeding deliveries per individual stall were not increased until after the sow had farrowed her litter. It is commonly known that the farrowing process is an energy demanding activity with intense uterine contractions. As litter size increases the sow energy status may be compromised which causes the farrowing interval to increase. During the prolonged farrowing duration, the stillbirth rates are likely to increase if there is no assistance during farrowing. Recently, feeding the gilt and sow pre-farrowing has become a controversially issue with producers installing ad libitum feeding systems in the farrowing rooms. Improvements to piglet growth rate and litter weaning weights have been shown when sows were fed ad libitum prior to farrowing (Cools et al., 2014; Gourley et al., 2020). This may be due to an increase in colostrum yield in sows given a greater feed allowance (Decaluwé et al., 2014). While implementing ad libitum feeders may save on labor, we would urge caution on giving sows ad libitum access to feed more than three days pre-farrowing as they may become over-conditioned and experience negative results (Cools et al., 2014; Decaluwé et al., 2014). More importantly, Feyera et al. (2018) observed that sows given access to feed within 3 hours of parturition experienced a shorter farrowing interval and less stillbirths. This is likely due to sows having more energy and nutrients available for the farrowing process when a meal is consumed closer to the onset of farrowing. We would recommend that producers find a way to increase the feeding frequency per day pre-farrowing by either working the sow to encourage more feed intake or shifting farrowing personnel to be able to feed more times throughout the day.



LACTATION REQUIREMENTS

It is well established that insufficient nutrient intake far below a female's requirement during lactation results in excess body reserves loss, high wean to first service intervals and reduced litter weaning weight. It is not unusual for the modern highly prolific sow to be in a negative energy balance during peak milk yield (**Figure 2**). This demonstrates the need for management to develop strategies to encourage higher feed intake to minimize loss of body reserves. Also, it has been reported that a greater amount of SID Lysine is needed to minimize body protein loss than to maximize litter gain. The dietary requirement for energy and amino acids of the lactating animal is determined by her weight, milk yield (i.e. litter growth rate) and feed intake (**Table 3** and **Table 4**). However, few commercial producers weigh sows and litters to establish an optimal requirement. Therefore, we always attempt to make feed available to the sow to encourage ad libitum intake and maximize energy and lysine intake. Maximizing lactation feed intake has also been shown to be highly correlated with an increase in litter weaning weight (**Figure 3**).

It is not uncommon for gilts to typically consume as much as 20% less feed than sows over the lactation period. Consequently, it can be more common that the lactating gilt is deficit in energy and lysine intake. If maximum milk production is not reduced, it will result in a significant loss of body protein and fat. This results in an extremely "thin" gilt post-weaning that is more likely to be culled due to an increased weaning to estrus interval, lower conception rates and lower born live at subsequent farrowing. Nutrition programs with higher nutrient levels designed specifically for young herds or herds with parity segregation, will often improve reproductive performance of younger parity sows and longevity in the herd.

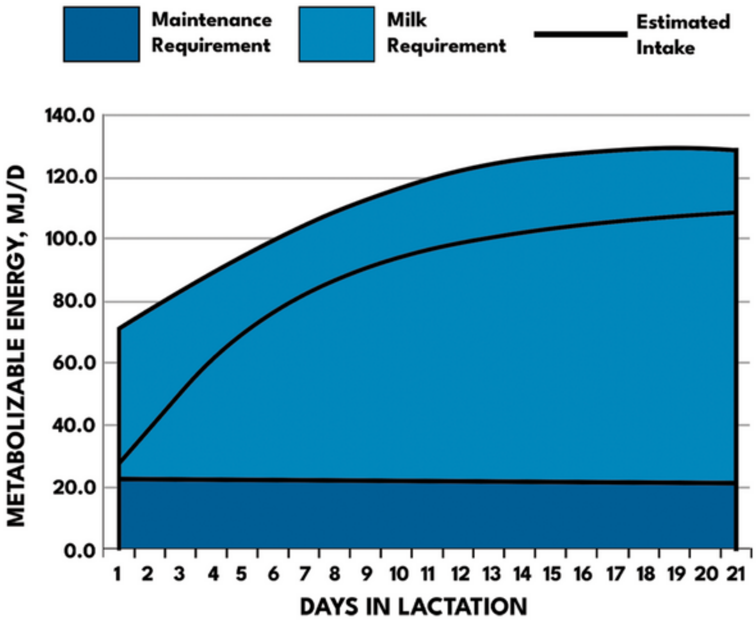


FIGURE 2. Energy requirement estimation for sows rearing 14 piglets per litter and 14 lbs. (6.4 kg) piglet weaning weight in a 21-day lactation period. Tokach et al. (2019).

The most effective way to increase nutrient intake in the sow is to increase daily lactation feed intake. However, variation in lactation feeding is highly impacted by the animal husbandry skills of the personnel in farrowing. The differences in lactation intake between farms is most apparent in the first week of lactation as some farms adopt a feeding strategy that slowly increases feed allowance over the first week of lactation. This strategy tends to reduce the overall lactation feed intake and forces sows to breakdown body reserves to meet the energy and amino acid requirements of milk production (**Figure 4**). The goal is to get the females on full feed as soon as possible after farrowing. While a larger number of farms have installed ad lib feeders in recent years, it is advisable to monitor consumption to determine if individuals need treatment. Special emphasis needs to be placed on getting sows to stand up a minimum of three times per day to observe if sows are sick or lame and appropriate treatments can be implemented. This will also ensure that every sow has an opportunity to drink and eat three times a day and encourage bowel movements to prevent constipation. Also, excessive stale feed needs to be cleaned out of the feeders. To help personnel, it is a good practice to work with your nutritionist or veterinarian to develop a "lactation feeding protocol." **Table 5** serves as an example feeding protocol.

TABLE 3. AMINO ACID REQUIREMENTS (% of SID LYS)[a]

	Gestation	Lactation
Methionine + Cysteine	70	55
Threonine	71	63
Tryptophan	19	19
Isoleucine	60	56
Valine	70	68

[a]The optimal ratios of amino acids to Lysine is assumed on multiparous sows.

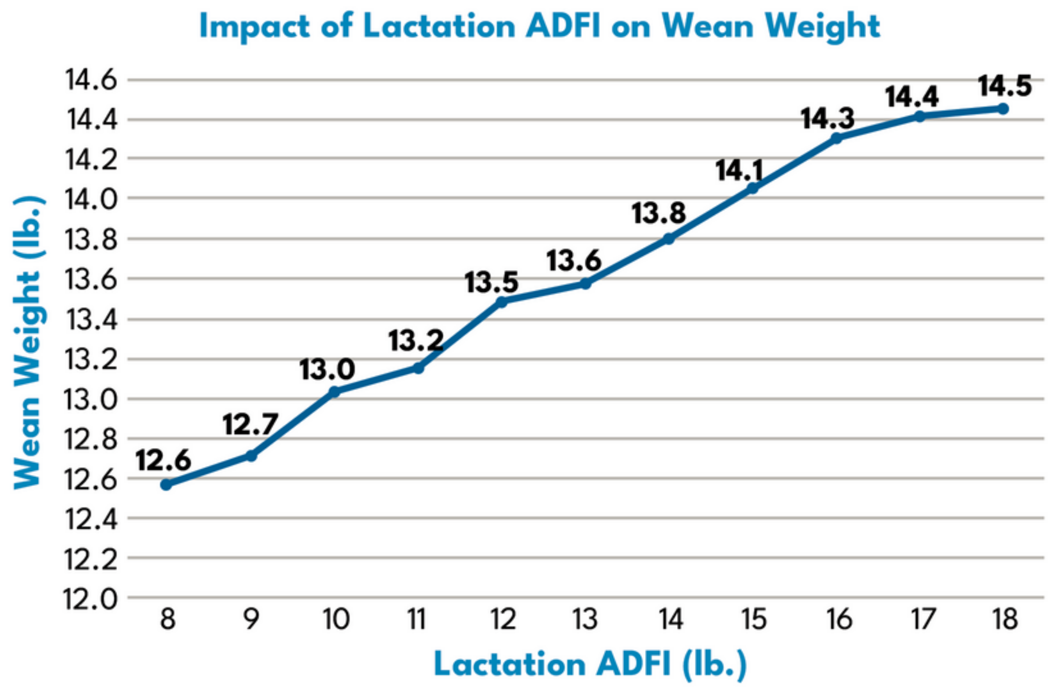


Figure 3. Effects of sow lactation feed intake on adjusted 21-day litter weaning weight. Data collected from 2,983 litters at United Animal Health Research Farms in June 2018-October 2019.

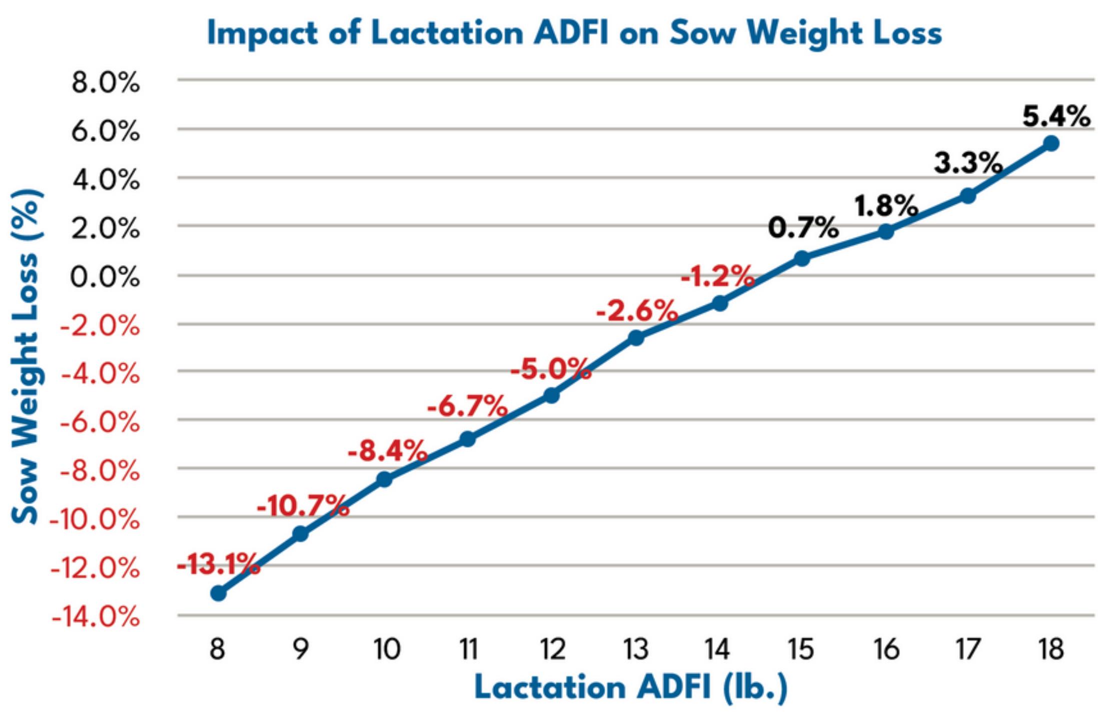


Figure 4. Effect of sow lactation feed intake on post-farrowing body weight loss. Data collected from 2,983 litters at United Animal Health Research Farms in June 2018-October 2019.

Table 4. Dietary Recommendations for Lactating Sows and Gilts

	Pigs weaned per mated female per year					
Reproductive performance	25.2	26.4	27.6	28.8	30	31.2
Weaned (n)	10.5	11.0	11.5	12.0	12.5	13.0
Piglet growth rate (lbs./d)	0.5	0.5	0.5	0.5	0.5	0.5
Piglet growth rate (kg/d)	0.23	0.23	0.23	0.23	0.23	0.23
Litter growth rate (lbs./d)	5.25	5.50	5.75	6.00	6.25	6.50
Litter growth rate (kg/d)	2.38	2.49	2.61	2.72	2.83	2.95
Lactation ADFI (lbs.)	13.5	13.5	13.5	13.5	13.5	13.5
SID Lysine requirements (g/d)[a]	51.3	54.4	57.4	60.5	63.5	66.6
Dietary SID Lys (%)	0.84	0.89	0.94	0.99	1.04	1.09
Dietary Total Lysine (%)	0.97	1.03	1.09	1.15	1.21	1.26
Mineral requirements (%)[b]						
Total Calcium	0.90	0.90	0.90	0.90	0.90	0.90
Available Phosphorus	0.45	0.45	0.45	0.45	0.45	0.45
STTP Phosphorus[c]	0.50	0.50	0.50	0.50	0.50	0.50

[a]SID Lysine requirement (g/d) was established from published studies on litter growth rate and reported from Tokach et al. (2019). The amount of SID Lysine needed to minimize body protein loss has been shown to be higher than the requirement to maximize litter growth rate. It is recommended to add approximately 10% to the grams per day requirement if minimizing body protein loss in lactation is a goal.

[b]Recommended phosphorus values are based on use of phytase in the diet. Available Phosphorus requirements are established from NRC (2012).

[c]Standardized total tract digestible phosphorus.

Table 5. Example Feeding Protocol[a]

Day	First Feeding	Mid-Day	End of Day
0	Farrow		3-6 lb.
1	If <2 lb. in feeder, add 8 lb. If >2 lb., do not feed	If <2 lb. in feeder, add 8 lb. If >2 lb., do not feed	If <2 lb. in feeder, add 8 lb. If >2 lb., do not feed
2	Repeat day 1	Repeat day 1	Repeat day 1
3[b]	Ad lib	Ad lib	Ad lib

[a] If constipation is a problem, laxative should be administered daily for three days prior to their due date and given until they farrow.
[b]The goal is to reach 24 lb. of lactation feed consumed daily. If they reach this goal the baseline feeding can be increased to 9 lbs., etc.

Table 6. Added Mineral / Vitamin Recommendations for DNA Sows (US Measures)[a]

	Unit	Sows Gestation	Sows Lactating
MINERALS			
Calcium (total)	%	0.90	0.90
Phosphorus (available)	%	0.45	0.45
STTP Phosphorus	%	0.47	0.47
Sodium	%	0.20	0.25
Chloride	%	0.40	0.40
Potassium	%	0.25	0.26
Magnesium	%	0.20	0.20
Iron	mg/lb.	36	36
Copper	mg/lb.	9	9
Manganese	mg/lb.	14	14
Zinc	mg/lb.	45	45
Iodine	mg/lb.	0.09	0.09
Selenium	ppm	0.30	0.30
VITAMINS			
Vitamin A	IU/lb.	4080	4080
Vitamin D3	IU/lb.	750	750
Vitamin E	IU/lb.	40	40
Vitamin K3	mg/lb.	2.0	2.0
Thiamine (B1)	mg/lb.	0.68	0.68
Riboflavin (B2)	mg/lb.	3.50	3.50
Pyridoxine (B6)	mg/lb.	2.25	2.25
Vitamin B12	μg/lb.	16	16
Niacin	mg/lb.	20	20
Biotin	μg/lb.	113	113
Choline	mg/lb.	250	250
Pantothenic acid	mg/lb.	16	16
Folic Acid	mg/lb.	0.91	0.91

[a] Assumes the usage of phytase. Recommended phosphorus values are based on use of phytase in the diet. Available phosphorus requirements are established from NRC (2012). Standardized total tract digestible phosphorus.

Table 7. Added Mineral / Vitamin Recommendations for DNA Sows (Metric)[a]

	Unit	Sows Gestation	Sows Lactating
MINERALS			
Calcium (total)	%	0.90	0.90
Phosphorus (available)	%	0.45	0.45
STTP Phosphorus	%	0.47	0.47
Sodium	%	0.20	0.25
Chloride	%	0.40	0.40
Potassium	%	2.51	2.62
Magnesium	%	0.20	0.20
Iron	ppm	80	80
Copper	ppm	20	20
Manganese	ppm	30	30
Zinc	ppm	100	100
Iodine	ppm	0.20	0.20
Selenium	ppm	0.30	0.30
VITAMINS			
Vitamin A	IU/kg	9000	9000
Vitamin D3	IU/kg	1650	1650
Vitamin E	IU/kg	90	90
Vitamin K3	ppm	4.4	4.4
Thiamine (B1)	ppm	1.50	1.50
Riboflavin (B2)	ppm	7.70	7.70
Pyridoxine (B6)	ppm	5.0	5.0
Vitamin B12	ppb	35	35
Niacin	ppm	44	44
Biotin	ppb	250	250
Choline	ppm	550	550
Pantothenic acid	ppm	35	35
Folic Acid	ppm	2.0	2.0

[a] Assumes the usage of phytase. Recommended phosphorus values are based on use of phytase in the diet. Available phosphorus requirements are established from NRC (2012). Standardized total tract digestible phosphorus.

Literature Cited

Buhr, B.L., 2010. Economic impact of transitioning from gestation stalls to group pen housing in the U.S. pork industry. Univ. of MN, Department of Applied Economics staff paper.

Cools, A., D. Maes, R. Decaluwé, J. Buyse, T.A.T.T.G. van Kempen, A. Liesegang, and G.P.J. Janssens. 2014. Ad libitum feeding during the peripartal period affects body condition, reproduction results and metabolism of sows. Anim. Reprod. Sci. 145:130-140.

Decaluwé, R., D. Maes, A. Cools, B. Wuyts, S. DeSmet, B. Marescau, P.P. De Deyn, and G.P.J. Janssens. 2014. Effects of peripartal feeding strategy on colostrum yield and composition in sows. J. Anim. Sci. 92:3557-3567.

DeDecker, A.E., A.R. hanson, P.M. Walker, J.L. Salak-Johnson. 2014. Space allowance and high fiber diet impact performance and behavior of group-kept gestating sows. J. Anim. Sci. 92:1666-1674.

DeRouchey, J., M. Tokach, K. Stalder, and D. Levis. 2013. Group housing systems: Nutritional considerations. Nat. Pork Board. Des Moines, IA

Feyera, T., T.F. Pedersen, U. Krogh, L. Foldager, and P.K. Theil. 2018. Impact of sow energy status during farrowing on farrowing kinetics, frequency of stillborn piglets, and farrowing assistance. J. Anim. Sci. 96:2320-2331.

Gourley, K.M., A.J. Swanson, R.Q. Royal, J.M. DeRouchey, M.D. Tokach, S.S. Dritz, R.D. Goodband, C.W. Hastad, and J.C. Woodworth. 2020. Effects of timing and size of meals prior to farrowing on sow and litter performance. Transl. Anim. Sci. 4:724-736.

Greenwod, E., C.A. Dickson, and W.H.E.J. van Wettere. 2019. Feeding strategies before and at mixing: The effect on sow aggression and behavior. Animals. 9(1):23-40.

NRC. 2012. Nutrient requirements of swine. 11th ed. Natl. Acad. Press, Washington, D.C.

Tokach, M.D., M.B. Menegat, K.M. Gourley, and R.D. Goodband. 2019. Review: Nutrient requirements of the modern high-producing lactating sow, with an emphasis on amino acid requirements. Animal. 13(12): 2967-2977.

United Animal Health. 2020. Internal data.

Young, M.G., M.D. Tokach, F.X. Aherne, R.G. Main, S.S. Dritz, R.D. Goodband, J.L. Nelssen. 2004. Comparison of three methods of feeding sows in gestation and the subsequent effects on lactation performance. J. Anim. Sci. 82:3058-3070.