AXIOM DAM LINE GUIDE

TECHNICAL AND NUTRITIONAL

AXIOM

FOREWORD
ENSURING SUSTAINABLE PERFORMANCE

Driven by our passion for swine genetics, we at AXIOM are committed to supporting you in the field, and strive to meet your requirements on a daily basis.

This guide aims to share our expertise and to support you in developing your dam line potential, and contains recommendations focused on securing both livestock and breeder welfare.

We wish to consolidate our commitment to combining scientific rigor, on-site performance, and added value for all the players in the pig production industry.

Guillaume Naveau
General Manager - AXIOM

To assist you with the management of AXIOM dam lines, this technical guide serves as a comprehensive and practical reference tool.
It presents you with the key husbandry practice, management and feeding recommendations to maximize our lines' genetic potential.

It primarily aims to guarantee the production of heavy and strong piglets, while securing sow longevity and performance. Line robustness and animal welfare are at the core of our selection strategy.

The recommendations in this guide are derived from extensive work conducted jointly by our engineering and R&D teams.
AXIOM also provides its expertise and nutritional recommendations to optimize gilt and sow performance and welfare.

Finally, as each farm has specific characteristics, the local production conditions and the type of raw materials must be considered on a context-specific basis. That is why we and our partners develop solutions tailored to each situation.

Laurent ROGER
Technical and Marketing Director – AXIOM

> **Flash the code for feedback and reviews from breeders on Axiom genetics**

CONTENTS

1.GILTS
GENERAL PARTICULARS & TARGET OBJECTIVES

> Gilts are the core of any sow herd.

They require suitable feeding and housing conditions in a clean and well ventilated environment for optimum productivity, good longevity and strength.

A group of gestating sows includes about 20% of gilts.

Their introduction into the herd and the feeding pattern from the time of introduction into the herd through to the first farrowing must be carefully managed to maximize performance and longevity.

Other factors in the management of AXIOM replacement gilts also come into play:

- Growth
- Ossification
- Immune system development
- Early puberty
- Socialization
- Fertility
- Prolificacy
- Mammary development
- Longevity

> Gilt Target Objectives

KPIs	Objectives
Age at 1st AI	255 days (> 241 d)
Weight at 1st AI	150 - 160 Kg
BFT at 1st AI	13 - 14 mm
Weight at 1st farrowing	220 - 230 Kg (including litter)
BFT (RENCO ref.) at first farrowing (+1 mm if 28 days in lactation)	16 - 19 mm

The aim is to optimize the animals' reproductive and longevity performance.
Inseminating gilts too early (<240 days) will reduce their prolificacy performance.

When too small, the gilts have fewer backfat reserves to sustain suitable milk production.

Our backfat thickness (BFT) recommendations are provided to ensure good ovulation, smooth farrowing, good lactation with suitable reserves, and better feed intake during lactation.

1.GILTS
SERVICING EFFECTS

> Effects of servicing gilts when too young or too light

Too young

Insufficient reproductive organ development

Insufficient body backfat reserves

Impaired ovulation quality

Embryonic loss and impaired lactation yield

Excess growth and unsuitable diet

Limb weakness

Gilt too fat or too lean

Reproductive issues

Culling and/or low performance

1.GILTS
MANAGEMENT & QUARANTINE

> Gilt Quarantine Management

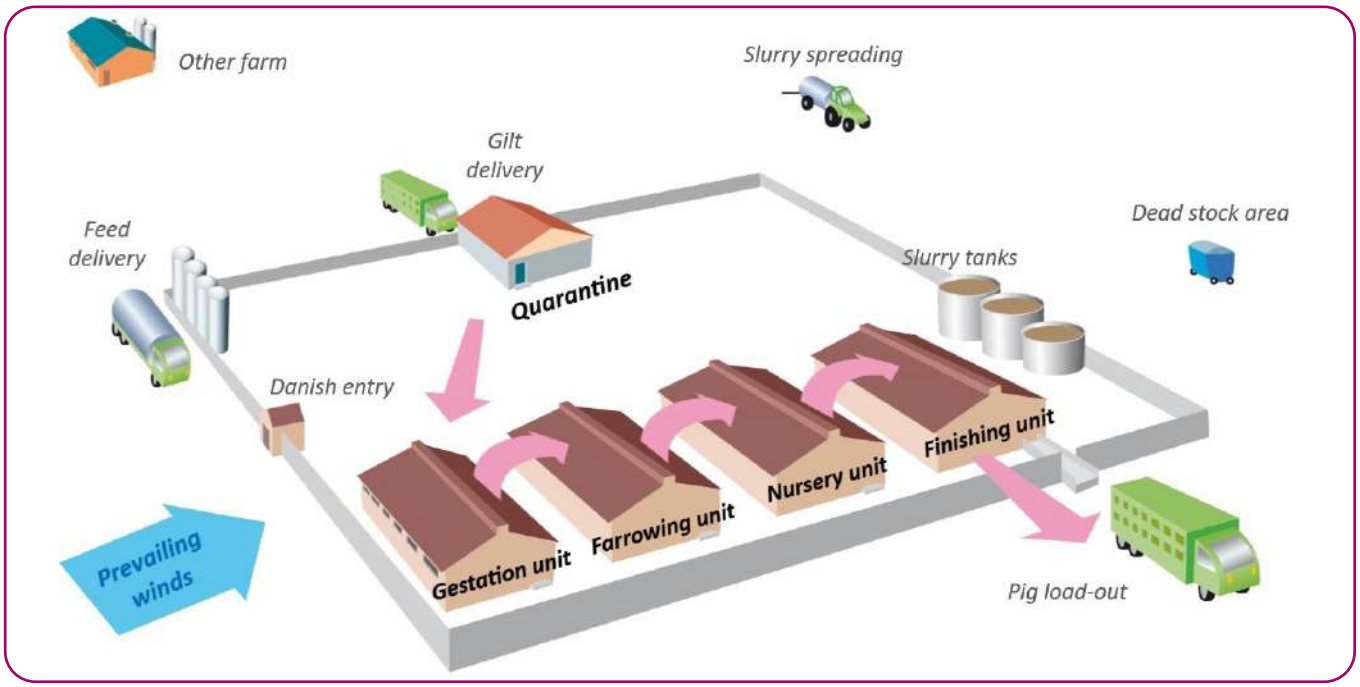
Following the various growth stages that imply different weight gains will help meet the growth and fat deposition objectives, the key factors of AXIOM's gilt performance and career.

> Your gilts weigh 120 Kg on delivery
Monitoring and Socialization

- The quarantine area is isolated from the rest of the farm (potential contaminant vector)
- Use a foot bath at the entrance of the quarantine area (replaced twice weekly)
- During this period of time, visit the quarantine area after tending to the rest of the livestock
- Wash hands and wear a coverall, boots and specific equipment
- During the first two weeks, check for the onset of any physical signs to prevent contamination across the entire farm
- Every day, spend 5 to 10 minutes in the gilt pens
- Squat down and stroke the animals to socialize them

> Quarantine

In the pig production industry, **gilt quarantine management** is key to livestock health management and to securing the successful integration of the sows to be.



Mitigating the introduction of diseases in the facility.

Monitoring gilt health.
Daily monitoring (temperature, appetite, behavior).
Early disease diagnosis.

1.GILTS
NUTRITION AND GROWTH

Acclimatize the gilts to the new environment (diet, microbial flora, local pathogens).

1. **Deworming** on arrival. (On veterinary advice),
2. **Vaccination:** according to the herd protocol (parvovirus infection, erysipela, circovirus, etc.),
3. **Active immunization:** controlled contact with feces or nasal discharge from sows in the herd or with creep feed waste from piglets in the farrowing unit.

Sometimes, introduction of "sentinel sows" or exposure to the herd's microbial agents (on veterinary advice).

Gilt preparation:
Heat synchronization, lighting, weighing, body condition assessment (BFT)

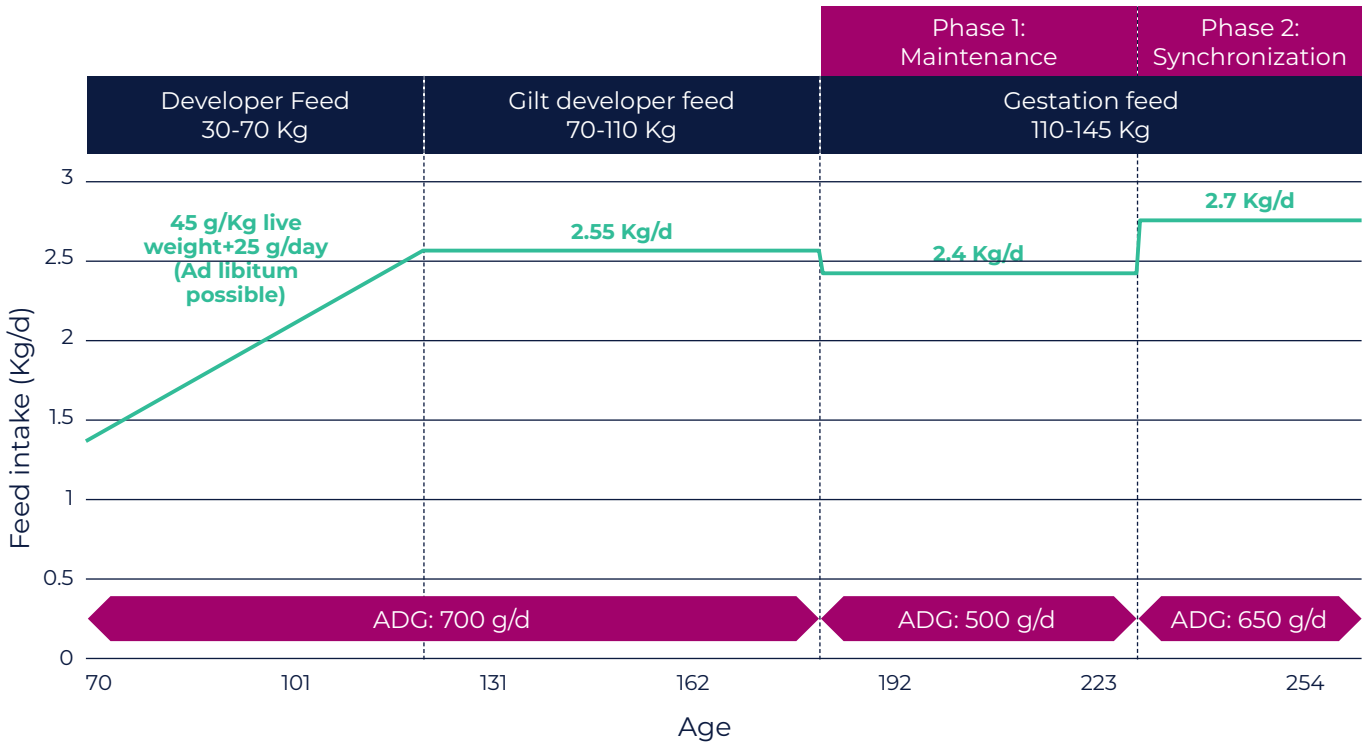
Limit growth to 500-550 g/d during this period.
Supply of gestation or gilt developer feed (Appended dietary recommendations).

The monitoring period involves restricting weight gain and ensuring good limb health. Feeding with a gestation diet limited to 2.4 Kg supports this monitoring period.

During the gilt heat synchronization period, increasing the feed intake by 300-400g/day stimulates ovulation.

> Your gilts are delivered weighing about 30 Kg or you rear your gilts on your farm

Growth objective, feeding curve and type of feed per phase:



- **Up to 60 to 70 Kg (or 110 to 130 days),** gilts can be fed with finisher feed.
- **From 70 to 110-115 Kg**, due to the particulars of the future breeding stock, we recommend using special gilt feed and restricting their intake. This diet covers the gilts' additional mineral, trace element and vitamin requirements. If too high, the energy intake at this stage can lead to excess weight gain.

When the animals grow too fast, their muscle and adipose tissue develop instead of other tissue, in particular the bones, legs and joints.
Furthermore, the heavier the animal at the beginning of AI, the heavier it will be when it finishes its growth. Overly heavy animals require more maintenance and a greater feed intake throughout their life while performance is not increased.

- **Up to 140 Kg (or 180 to 230 days)**, i.e. a 50-day period, growth must be controlled and weight gain should not exceed 20 to 25 Kg. The growth objective is 500 g/day, which is much lower than in the previous period, to achieve a target weight of about 140 Kg.

ADG reduction is achieved by transitioning to a gestation diet, supplied in daily amounts between 2.3 and 2.4 Kg. This diet usually has a lower protein and amino-acid content than the gilt developer feed.

In fact, feed restriction combined with a lower protein content diet reduces muscle development. The animals' diet must contain a sufficient mineral, vitamin and trace element content to cover their requirements. In some cases, trace element and vitamin supplementation may be required.

- **3 weeks prior to insemination**, during the progestagen distribution period, we recommend increasing the feed quantity to ensure fat deposition without excess muscle development. This will also improve ovulation quality. The growth objective is 650 to 700 g/day to achieve a weight of 150 Kg at the first AI.

The feed intake must therefore be significantly increased, i.e. a daily quantity of gestation feed of about 2.7 Kg.

Regular BFT and weight checks help adjust the feeding curve to bring it as close as possible to our recommendations at various ages.

1.GILTS QUARANTINE

> Quarantine on slatted floors or on straw bedding: focus on comfort and health

Quarantine on slatted floors

- Slatted floor (solid floors should be avoided)
- Cleaned and disinfected building prior to delivery
- Suitable ventilation, drafts should be avoided
- Ambient temperature at 20-22°C (heating in winter)
- 6 to 7 gilts per pen
- 2 sq.m per gilt minimum
- Free access to water (1 drinker for 8 animals)
- Access to the feeder (30 cm per gilt)
- Lighting (300Lux/sq.m) for 14-16 h per day

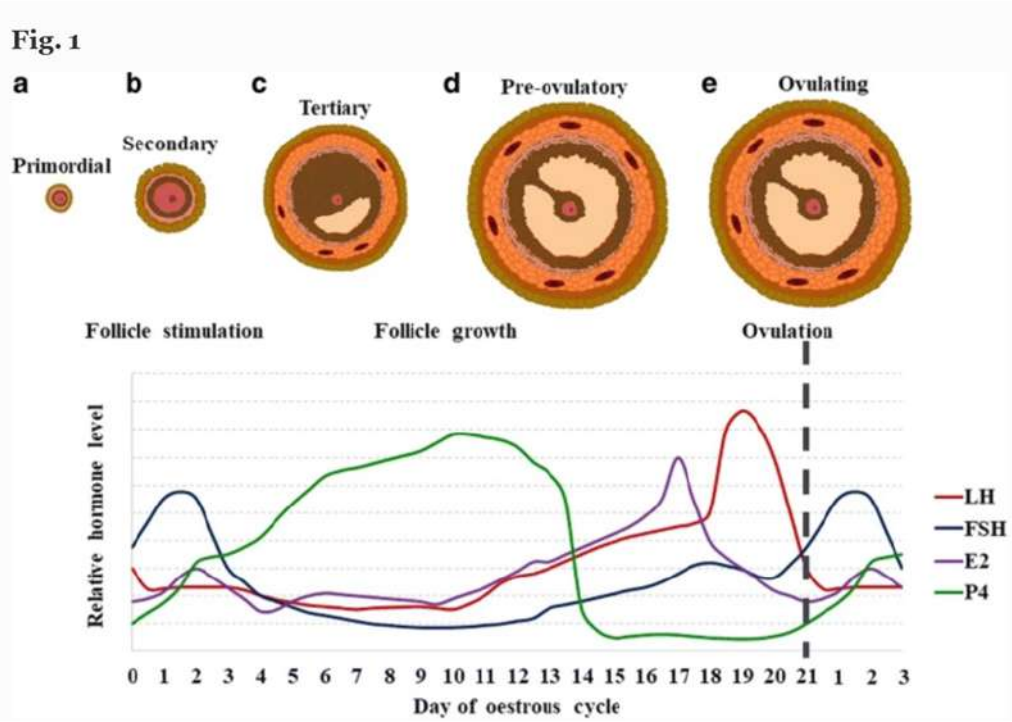
"It should be possible to sit with the animals while reading the newspaper"

Quarantine on straw bedding

- 5 Kg of straw per sq.m. (Pay attention to quality: mycotoxin)
- Mucked-out building run on an all-in, all-out basis
- Ventilated, drafts should be avoided
- Temperature > 14°C (possibility of creating creep areas)
- 6 to 7 gilts per pen
- 2 sq.m per gilt minimum
- Free access to water (1 drinker for 8 animals)
- Access to the feeder (30 cm per gilt)
- Lighting (300Lux/sq.m) for 14-16 h per day

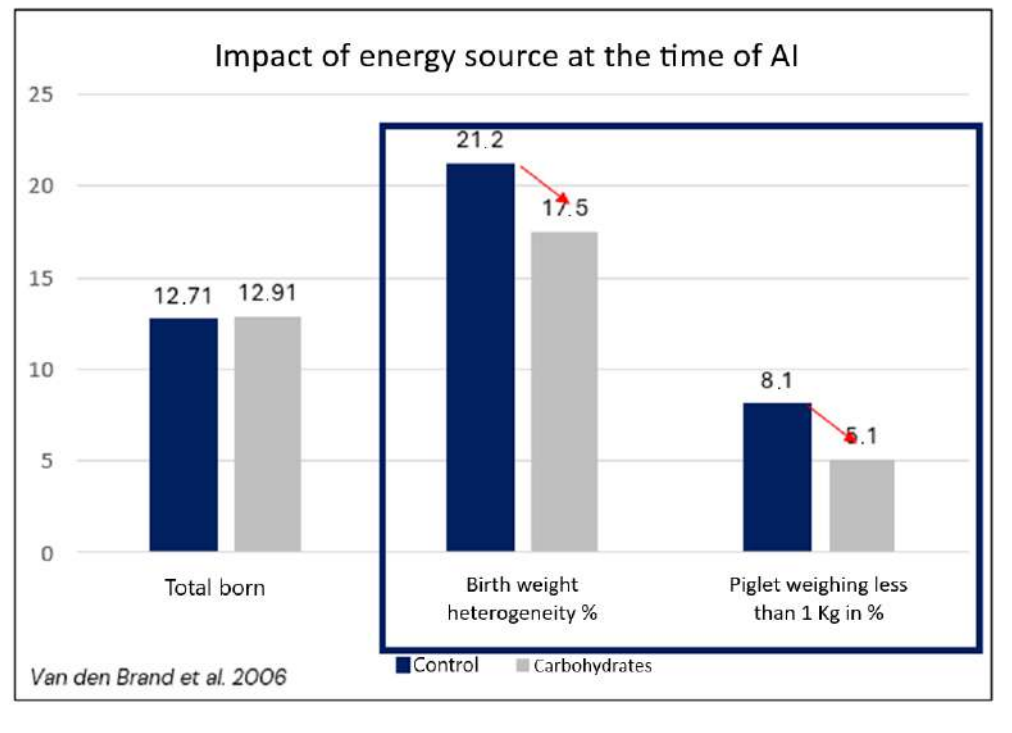
> Focus on Flushing

Due to their outstanding ovulation capacity, AXIOM produces hyperprolific sows.
The ovulation capacity can be heightened by the pre-insemination nutritional strategy.
In addition to suitable lighting, AXIOM teams suggest carbohydrate and antioxidant supplementation just before insemination.



Flushing

S Jarrrett and coll., JAS and biotechnology 2018



Effect of the energy source at AI on litter quality at birth

Van den Brand et al. 2006

Gestating Gilt Management

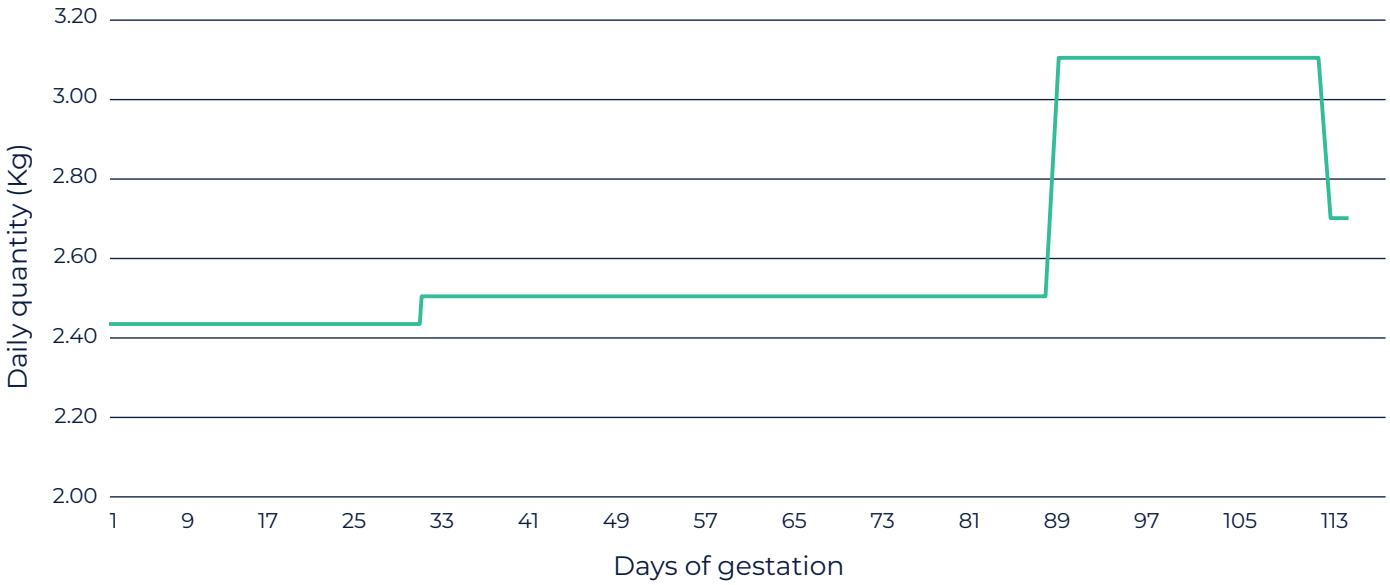
First gestation is a crucial phase as the gilts are still growing.

- Their feed intake must support their body condition development.
- It should be suitably balanced to prevent excess weight or fat while sustaining growth, bone and muscle development and proper embryonic growth.
- The weight and BFT objectives are indicators of the gilt's ability to farrow smoothly and to maximize feed intake during lactation.

These objectives must be met in order to maximize milk production, prevent excess weight loss and avoid second-litter syndrome.
To meet these objectives, we have drawn up a feeding curve in conjunction with the Institut Français du Porc (IFIP). It incorporates the energy requirements necessary for the gilts' weight gain and growth during their first gestation period, housing according to European production conditions (free-range gestating sows), and the integration of energy requirements related to sow activity.

The diet recommended during the gilts' gestation period is a gestation diet that meets the appended nutritional specifications.

Gilts - Feeding Plan During Gestation



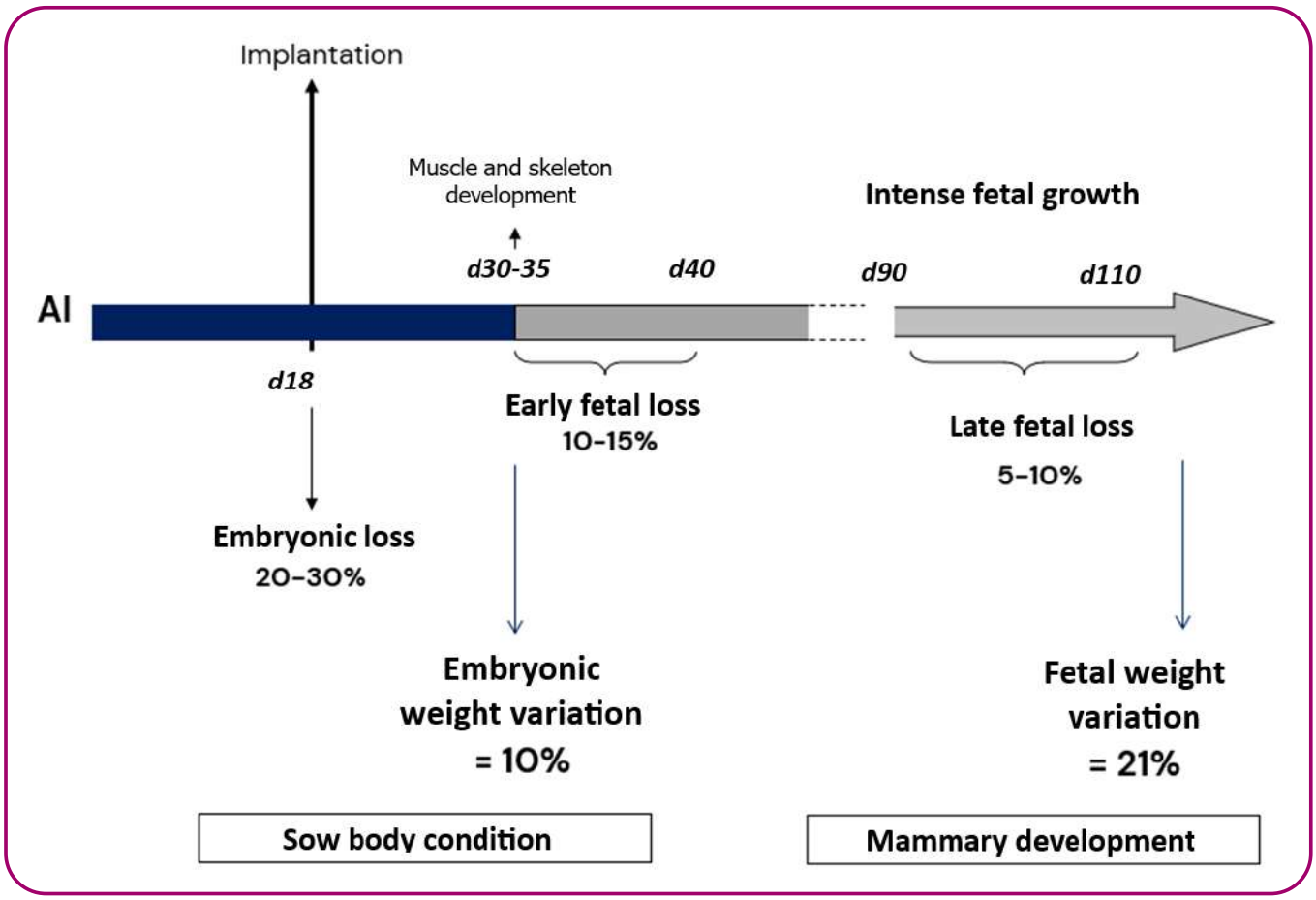
2. GESTATING SOWS
GENERAL PARTICULARS AND FEEDING PATTERN

> Objectives

The primary objectives of the feeding curve during gestation can be broken down into the 3 following phases:

Early gestation	Mid gestation	Late gestation
Promoting **embryonic implantation** and replenishing body reserves	Covering maintenance and growth requirements, **limiting weight gain, keeping healthy feet and limbs**	Covering the litter's growth requirements **without body condition loss** Promoting mammogenesis

> Feeding Pattern for Gestating Sows

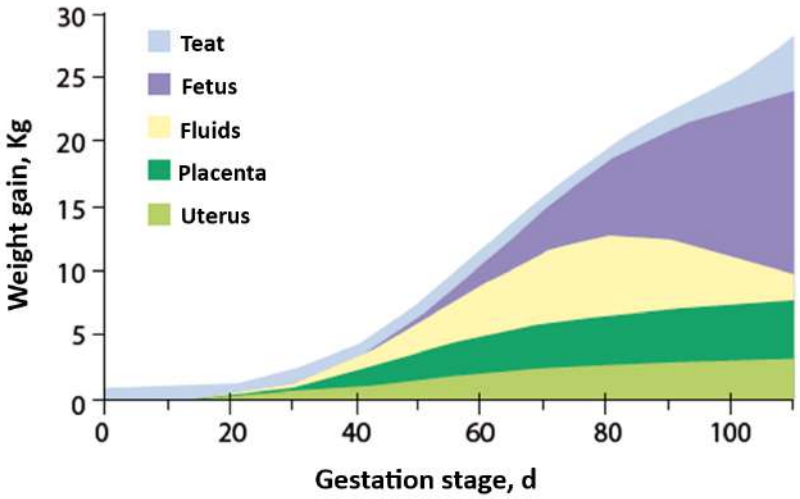


It should allow for sows to recover their body condition during the first month of gestation.

The mid-gestation phase must optimally meet each animal's maintenance requirements and limit growth and fat development. In this respect, the temperature conditions can affect the animals' maintenance requirements, and in some regions, a season-based diet approach may be necessary.

> Weight Gain Distribution according to Gestation Phase

Weight Gain Distribution according to Gestation Phase



Considering the high prolificacy of AXI-OM dam lines, fetal requirements must be carefully addressed during the last month of gestation as fetal weight doubles over this period of time. Therefore, increasing net energy and digestible amino acid intake over this period is essential to achieve a suitable piglet birth weight, minimize the number of small piglets in litters and ensure good mammogenesis.

> Adjusting Net Energy Intake in Gestating Sows

Thermal Comfort of Sows and Housing Conditions (Group or individual housing)
For group-housed sows, the thermoneutral zone lies between 16 and 20°C *(Verstegen et Curtis, 1988)*. The value is greater in individual pens, with a thermal comfort zone between 20 and 23°C *(Noblet et al., 1988)*.

Below 18°C, the daily intake must therefore be adjusted between 70 g and 290 g, depending on the housing conditions and temperature, to ensure that part of the feed is used for the sow's thermoregulation requirements without drawing on its body reserves. Energy density can also be adjusted with winter vs. summer feeds with +0.2 MJ net energy per sow.

Further Maintenance Requirements, Group-Housed Sows

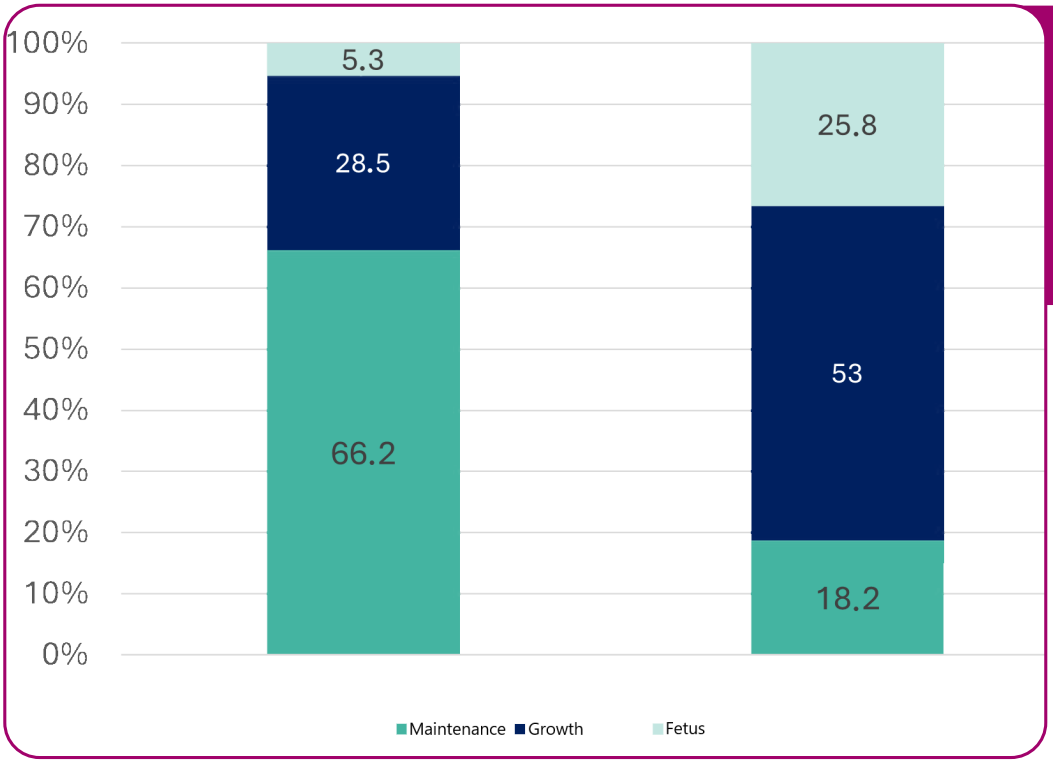
Sow weight (Kg)	Additional standing time (hours per day)		
	+1 h	+ 2 h	+ 3 h
150	60	121	181
200	75	150	224
250	88	177	265

Nutritional intake (in g/day for feed with a formula of 12.8 MJ/Kg metabolizable energy – 9.2 MJ/Kg NE sow) required to cover the additional activity of a gestating sow beyond 4 hours in a standing position (calculated according to Noblet et al., 1993).

Gestating Sow Nutrition Overview

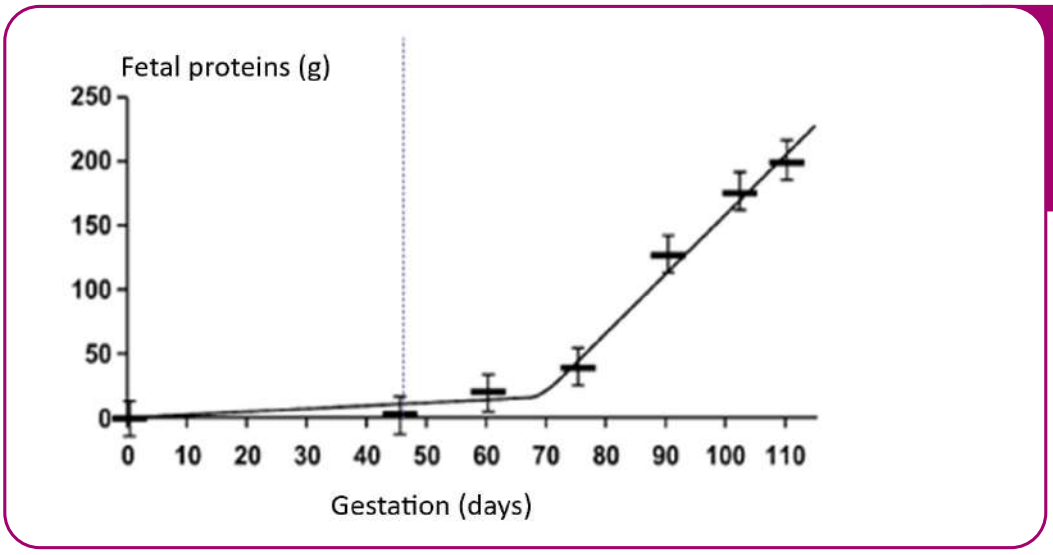
As mentioned above, the first evaluation criterion is the gestating sow's energy requirements. The sow's energy requirements are primarily related to its growth, body condition recovery and maintenance, accounting for over 90% of the total requirements. However, only 18% of the digestible lysine requirements are used for maintenance, the remaining 82% are split between the sow's growth, fetal growth and mammogenesis.

This means that the digestible amino acid requirements are significantly higher in the late gestation phase.



Breakdown of Net Energy and Digestible Lysine Requirements during Gestation

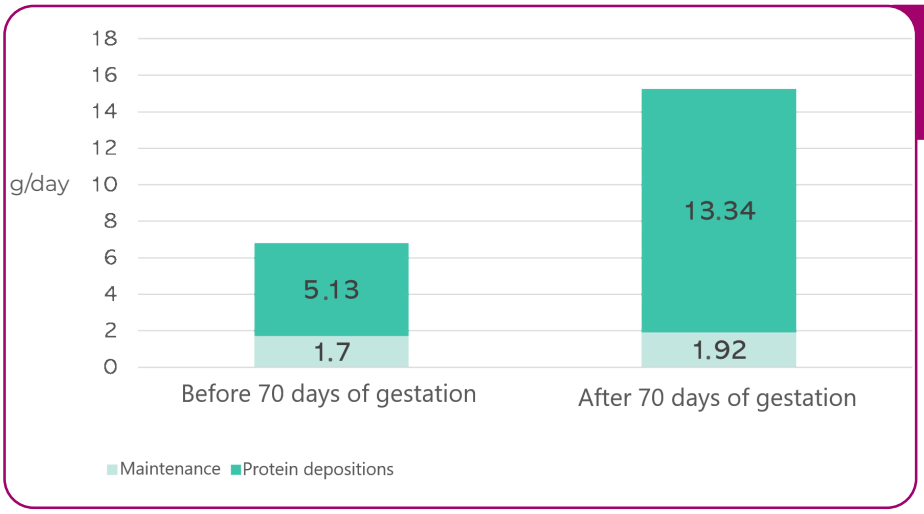
Mac Pherson and coll., JAS 2004



Fetal Protein Deposition during Gestation

Kim and Coll., JAS 2010

2. GESTATING SOWS
GESTATION DIET



Digestible Lysine Requirements (Primiparous Sows) during Gestation

By way of example, the digestible lysine requirement may more than double between early and late gestation. Digestible lysine content in the feed and in g/day should also be adjusted according to the farm's numerical productivity.

The sow's weight and backfat thickness during weaning are key indicators for determining the feeding plan for the subsequent gestation. To best accommodate each gestating sow's requirements, we recommend an individual feeding curve, taking into account each animal's BCS and parity.

> Sow Weight and BCS According to Parity

Parity	Weaning weight (Kg)	BFT at AI (mm)	Weight at farrowing (Kg)	BFT at farrowing (mm)
1	155	13-14	225	16-19
2	180	13-14	245	16-19
3	200	13-14	270	16-19
4	220	13-14	290	16-19
5	240	13-14	300	16-19
6+	250	13-14	310	16-19

2. GESTATING SOWS
GESTATION DIET

Assessment of Primiparous Sow Requirements per Gestation Phase

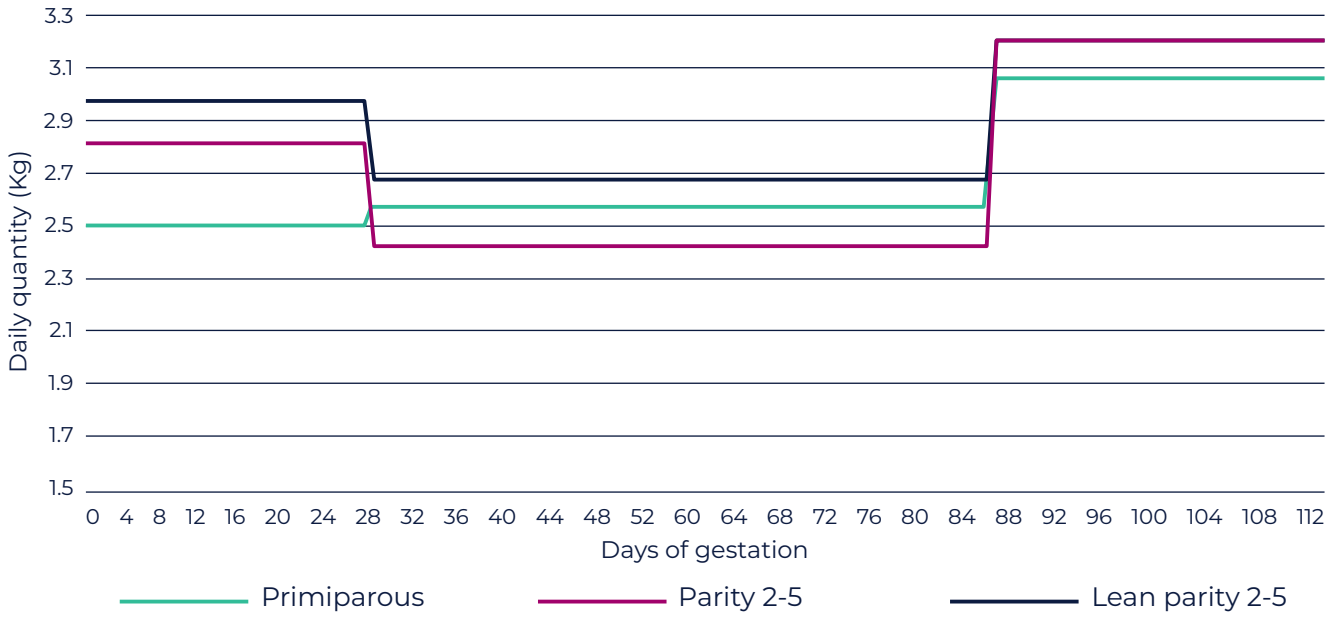
Parity	15 total born		20 total born	
GESTATION	SiD Lys g/day	MJ NE/sow	SiD Lys g/day	MJ NE/sow
0-28 DAYS	8.4	25.5	10.1	26.8
29-84 DAYS	9.5	22.3	11.3	23.7
94-114 DAYS	16.6	25.8	19.2	28.1

Assessment of Parity 2-5 Sows per Gestation Phase

Parity	15 total born		20 total born	
GESTATION	SiD Lys g/day	MJ NE/sow	SiD Lys g/day	MJ NE/sow
0-28 DAYS	6.8	31.3	9.8	33.5
29-84 DAYS	7.1	21.9	8.8	23.3
94-114 DAYS	13.2	26.5	17.2	29.5

Distribution Curve Profile during Gestation (Example)

Below is a feeding curve example during gestation. It is only provided as an example and should be adjusted according to farm-specific context, numerical productivity, and environment (temperature, group-housed sows, etc.)



2. GESTATING SOWS
GESTATION DIET

Each farm is different, and a number of factors can affect the sows' body condition: season-based temperature or climate changes, floor type, raw material selection and quality and energy density in the diet.

Considering these variables, we recommend monitoring the efficiency of the feeding pattern with **regular backfat thickness measurements** and tailoring it to each farm. The *appendices* contain average gestation nutritional recommendations with a single feed.

Two-phase feeding during gestation: Some farmers may supply 2 gestation feeds. This strategy provides better coverage of the intake required to replenish the sow's body reserves in early gestation. It also meets the specific late gestation requirements - minerals and amino acids in particular -, to sustain the sows' body reserves, limit catabolism and secure heavy and even piglets at birth.

As such, this strategy facilitates the management of dynamic digestible amino acid intake. For example, digestible threonine requirements vs. lysine are greater in late gestation sows compared to early gestation sows, in relation to the quality-based requirements of mammogenesis and the development of immunoglobulins that make up the colostrum.

	Total lysine (g/d)		Total threonine (g/d)		Threo/lys (%)	
GESTATION PERIOD	First month	Last month	First month	Last month	First month	Last month
2ND PARITY	13.1	18.4	7	13.6	**53**	**74**
3RD PARITY	8.1	13	5	12.3	**62**	**95**

Kim and Coll., JAS 2009 / CL Levesque and Coll., JAS 2011 / Samuel and Coll., 2010 et Levesque and Coll., 2011

3. NURSING SOW DIET
TRANSITION DIET BETWEEN GESTATION AND LACTATION

> Transition between Gestation and Lactation

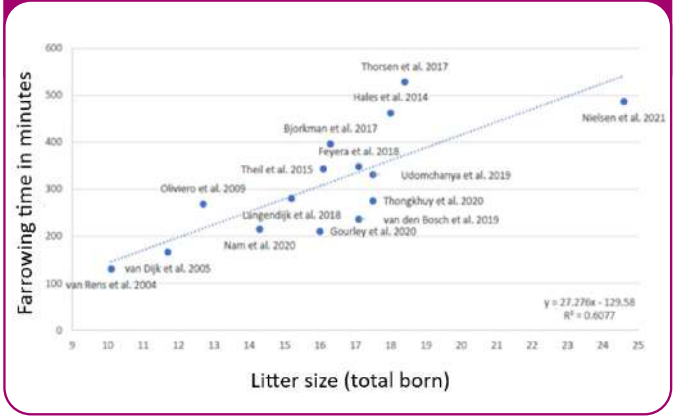
Prior to farrowing, sows have high nutrient requirements. They are faced with major physiological changes.
Where possible from a technical and heath standpoint, we recommend providing lactation feed upon transfer to the farrowing unit. This helps to cover late gestation requirements and reduce catabolism in pre-farrowing sows, which could compromise the onset of colostrum and milk production (Postpartum Dysgalactia Syndrome, PDS).

This is sometimes not possible as the lactation feed has higher concentrations than the gestation feed, which has a lower fiber content. Constipation issues prior to farrowing should be prevented.

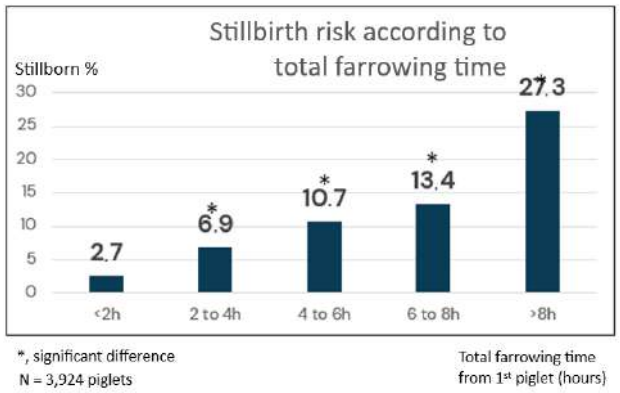
> Transition Feed

Higher prolificacy is often associated with a longer farrowing duration, and therefore, with a greater risk of delivering stillborn or weak piglets.

Farrowing duration in relation to litter size
M. Van den Bosch and coll., Animals 2023, 13, 910



Stillbirth risk in relation to total farrowing duration
Kirkwood R.N. et al. / Thai J Vet Med. 2021

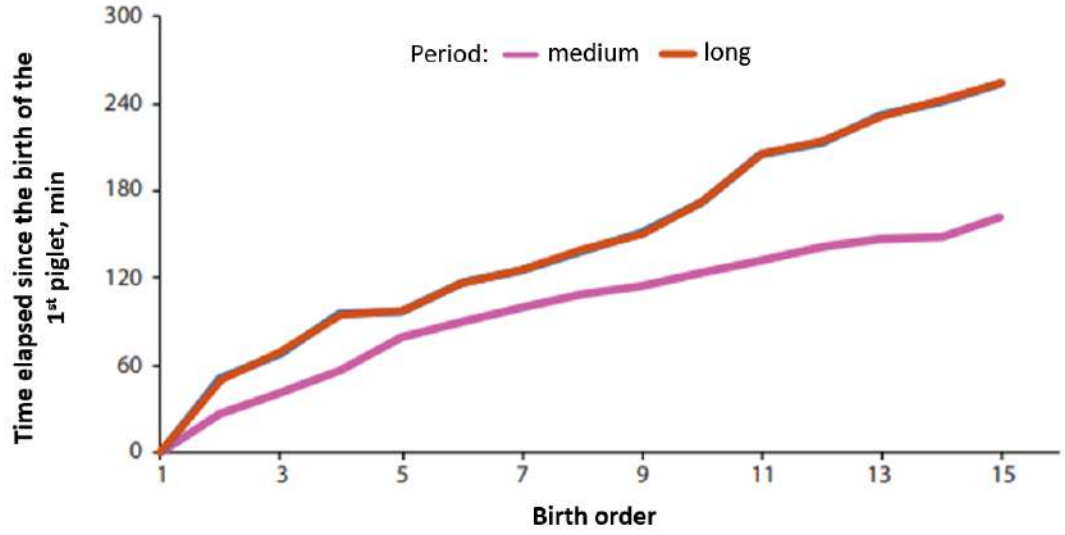


Supplying a transition diet has specific nutritional features tailored to the sow's physiology for this transition phase (see appendix). This diet provides a sufficient fiber intake, sufficient amounts of digestible amino acid, and primarily helps to manage the mineral allowance (calcium and electrolyte balance) to promote good farrowing dynamics by a stimulated use of bone calcium reserves (see appendix). Axiom recommends its introduction to reduce the risks of long farrowing periods and stillborn piglets. This naturally requires some organization (storage, handling).

The transition strategy can also be used to adjust vitamin D intake quality, with studies showing the benefits of some forms of vitamin D (25 OHD3) – hydroxylated vitamin D) on reducing farrowing duration.

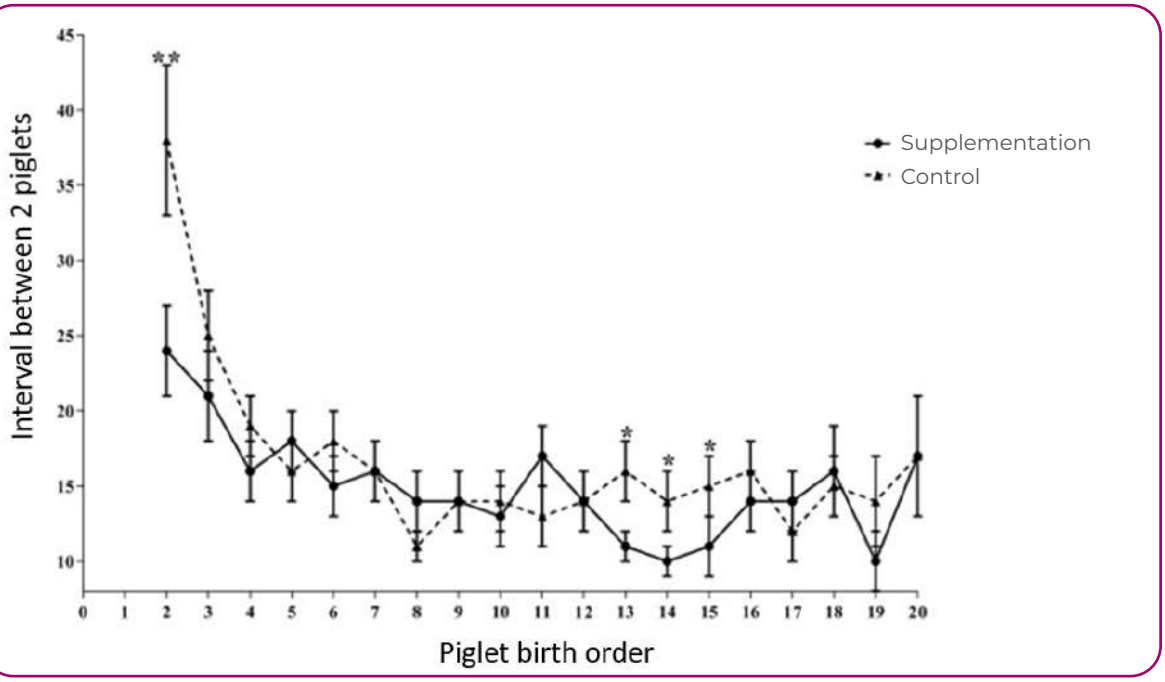
3. NURSING SOW DIET
TRANSITION DIET

Sows with a low sugar level are prone to prolonged farrowing and a higher number of stillborn piglets. **The last meal should not be too far apart from farrowing.**
Ideally, the time between the meal and the onset of farrowing should be 3 hours (short farrowing duration, low stillborn rate and little assistance) and, if possible, **no more than six hours.**



Incidence of the time elapsed since the last meal on the farrowing rate

According to a recent study (R.F. Carnevale et al, animal 2024), energy supplementation of sows at the very onset of farrowing (200 g of a combination of carbohydrates and glycerol) improves the farrowing rate (shorter interval between piglets): stronger piglets ingest significantly more colostrum.

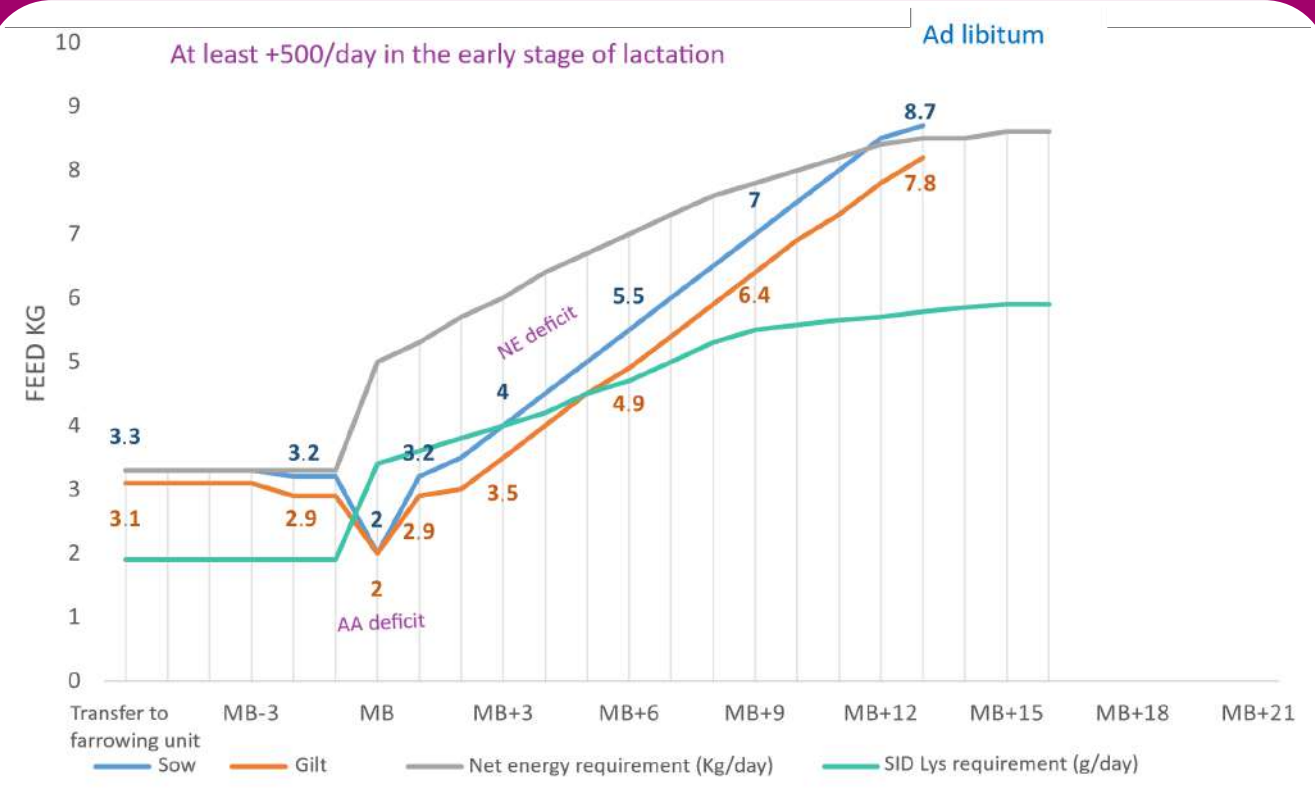


> Lactation Diet

The lactation feeding pattern has two main objectives:

- Covering the lactation requirements for increasingly larger litters (14 weaned piglets and more), and achieving a litter weight at 21 days > 80 Kg and at 28 days >=105 Kg.
- Preventing excess body reserve losses related to reproduction issues during the next cycle, and in particular, muscle loss (proteins).

Average Protein and Energy Requirements in Sows in the Early Lactation Phase



In the early lactation phases, every animal has an energy and protein deficiency. This leads to body condition loss in the lactating sow as the feed ingestion capacity is lower than its requirements.

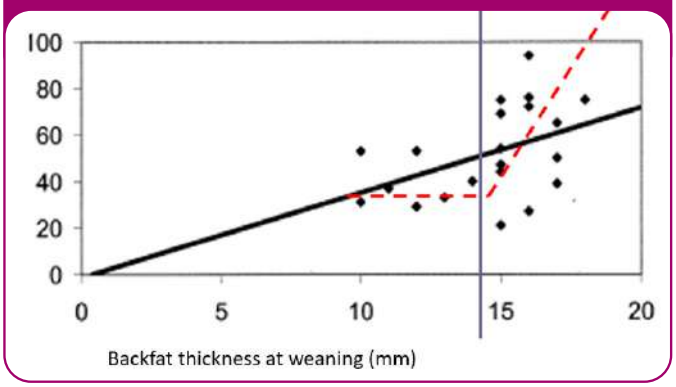
This is particularly critical in first-parity sows, whose reserve levels and ingestion capacity are reduced compared to multi-parity sows by about 10-15%.
However, the aim is to provide the nutrients required for the litter's growth to maximize weaning weight while limiting weight loss to 10%.

BFT loss must not exceed 3 to 4 mm, i.e. 20%, and muscle loss (protein) must not exceed 10%.

Beyond a BFT loss of 2 mm during lactation, each additional millimeter reduces the subsequent litter size by 0.2 piglet (Huard 2010). The solution is to maximize the feed intake to minimize losses and maximize lactation.

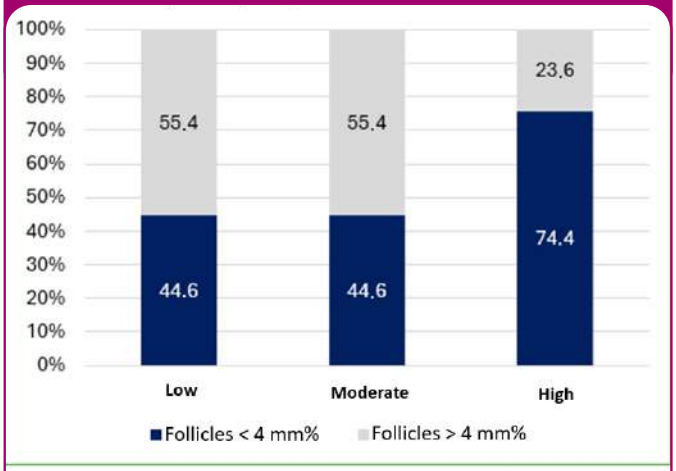
3. NURSING SOW DIET
LACTATION DIET

Effects of the sow's fat reserve during weaning on embryonic survival rate during the subsequent cycle
N.C Whitley and Coll., JAS 2002



Feeding ad libitum is recommended between farrowing and weaning. On the day following farrowing, the sow can be fed its pre-parturition diet, then the diet should be increased by at least 500 g daily.

Effects of protein body losses during lactation on oocyte quality during the previous cycle



Cumulative losses at 20 days
Body protein, parturition weight %
Low 5.1 ± 1.42/ moderate 6.1 ±1.49/ high 12.3 ± 1.32

Although AXIOM sows can increase their daily feed intake by up to 700-800 g, a number of factors related to rearing and housing conditions come into play. Delayed or discontinued (if the intake is increased too quickly) feed intake increase will be difficult to catch up subsequently.

To achieve good lactation, we have drawn up a feeding curve based on our livestock's average ingestion capacity. This curve must be adjusted for each animal based on housing, environmental conditions and employees. It meets the requirements of sows with 14 weaned piglets.

Day in lactation	Average daily feed intake (sow) (10MJ/Kg)	Average daily feed intake (gilt) (10MJ/Kg)
-1	3.2	2.9
0	2	2
1	3	2.8
2	3.5	3
3	4	3.5
4	4.5	4
5	5	4.5
6	5.5	4.9
7	6	5.4
8	6.5	5.9
9	7	6.4
10	7.5	6.7
11+	Ad libitum	Ad libitum

3. NURSING SOW DIET
LACTATION DIET

A maximum feed supply of around 7 Kg for gilts is optimum.
For sows, the maximum supply should be at least 8 Kg and can reach up to 10 to 11 Kg.
The average lactation diet values are given in the appendix. The table shows sow intake per weaned piglets and according to the lactation period *(source Dourmad et all Inra 2005)*.

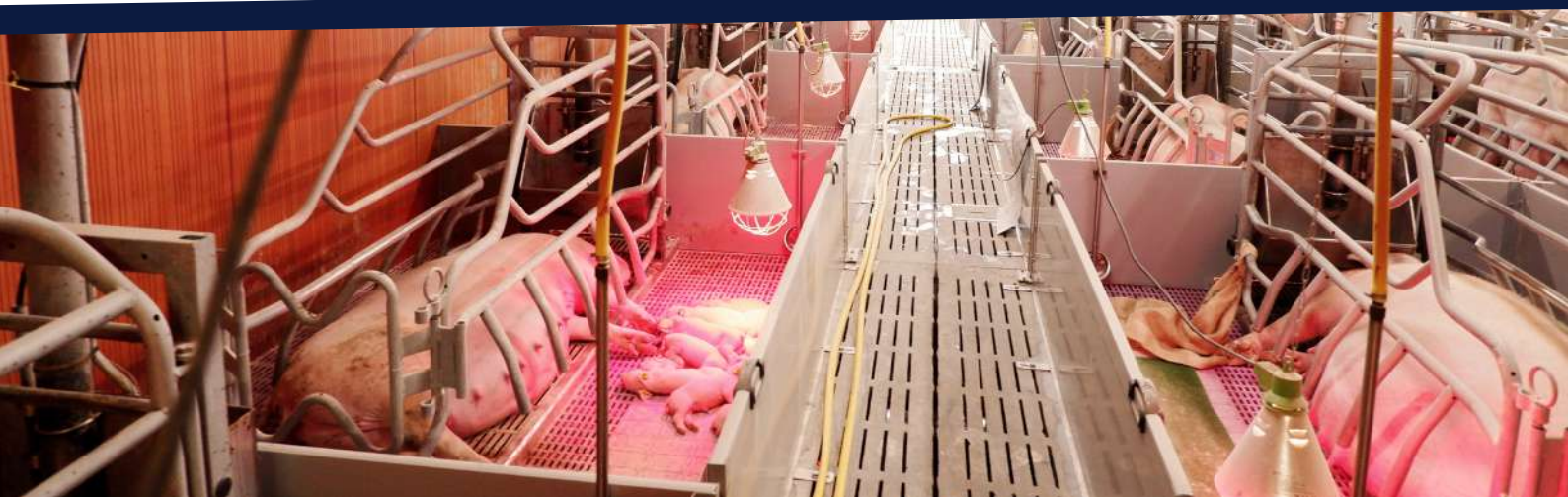
Criteria	21 days			28 days		
Number of weaned piglets	**13**	**14**	**15**	**13**	**14**	**15**
Average daily feed intake (Kg)	5.7	6.1	6.3	6.5	6.9	7.2
Daily energy intake/net energy (Mj)	57	61	34	65	69	72
Daily energy intake/metabolizable energy (Mj)	77	82	86	88	93	97
Daily digestible lysine intake (g)	54	58	60	62	66	68

> Lactating Sow Intake Optimization Strategies

To optimize feed intake, keep the temperature as low as possible and provide the piglets with a good nest = good environment for the sow and piglets.

Animal	Thermoneutral Zone	Farrowing Unit Temperature At 30°C	Farrowing Unit Temperature At 18°C
Sow	16-20°C	▸ Postpartum Dysgalactia Syndrome ▸ Loss of appetite = nutritional deficiency, fat and muscle loss	Ideal temperature
Piglet	30-32°C (week 1) 28-30°C (weeks 2,3,4)	Ideal temperature (Piglet growth drops as the sow produces less milk)	▸ Poor colostrum ingestion ▸ The colostrum intake is not enough to cover thermoregulation requirements ▸ Neonatal scours
Recommended air speed for a piglet: 0.1 m/s			

- Sows should not be fat during farrowing = better feed intake during lactation
- Feed at least 3 meals a day, during the coolest hours of the day, and remove any feed waste on a daily basis.
- Supply good quality (physico-chemical and microbiological) water ad libitum: see Appendices.
- Check mycotoxin levels: see Appendices.



3. NURSING SOW DIET
FOCUS ON DIET AND HEAT STRESS

> Focus on Diet and Heat Stress

The thermal environment in the farrowing unit significantly affects the sow's eating behavior. A higher ambient temperature leads to hyperthermia and increased respiratory rate.

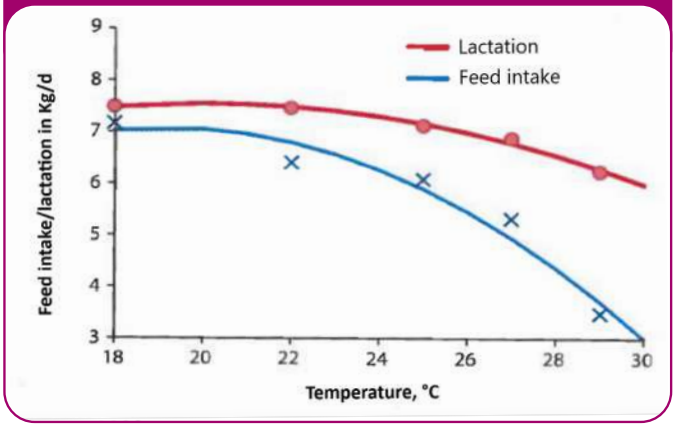
Above 22°C (71-72°F), each degree induces **a drop in voluntary feed intake by 190g/d**, leading to a drop in lactation.

Lactation is negatively affected and the sow draws on its body reserves, leading to reduced suckling piglet growth.

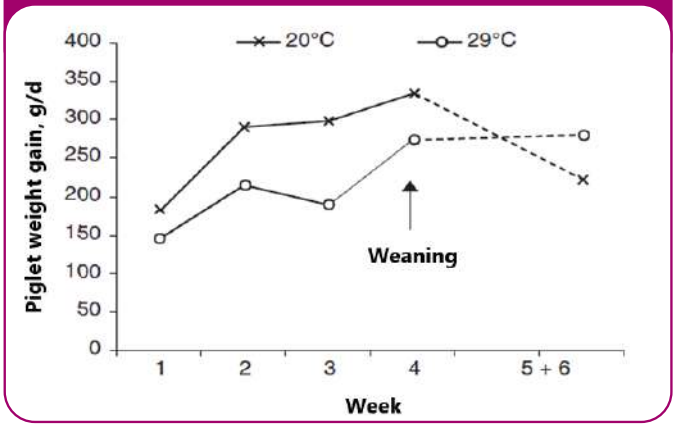
Furthermore, **the sows' reproductive performance post weaning are affected**, with a higher infertility rate, smaller subsequent litter sizes and a longer weaning-estrus interval.

It was also shown that **heat stress can directly affect follicular recruitment**, generating disruptions to the insulin signaling pathway, which plays a key role in ovary physiology.

Impact of temperature on daily feed intake and lactation
Quiniou, 2000



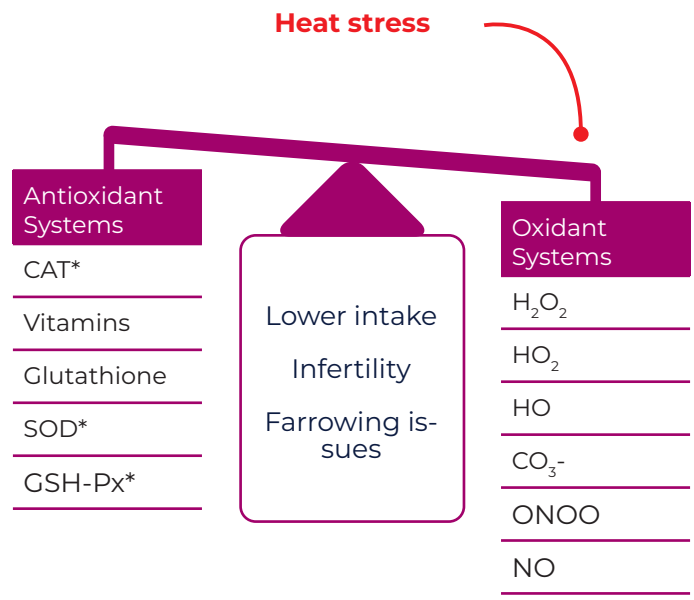
Impact of temperature on piglet weight gain over time



3. NURSING SOW DIET
FOCUS ON DIET AND HEAT STRESS

Heat inside the building (heat stress) causes the animals to hyperventilate to release body heat, as pigs do not perspire.
This leads to higher CO2 output through breathing and lower CO2 concentration in the blood: the blood pH increases, the sow is in respiratory alcalosis.

Furthermore, **heat stress** leads to **oxidative stress** (Yan Zhao and coll., Asian-Australas J Anim Sci 2020) in sows, affecting their health and impairing their reproductive performance.



Impact of heat stress on sow health and reproductive performance

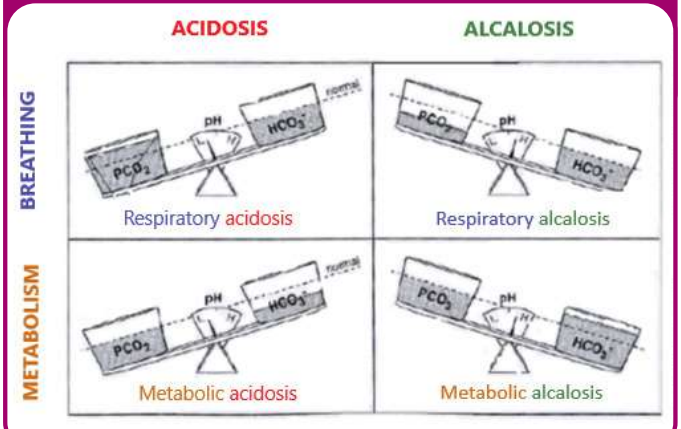
Qihui Li and Coll, Animal Nutrition 2022

CAT: Catalase
SOD: Superoxide-dismutase
GSH-Px: Gluthatione Peroxidase

As a result, during warm periods, AXIOM recommends adjusting the feed formulation.

1. **Reduce metabolic heat production:** use net energy sources as **fat** rather than as starch: 1 to 1.5% fat increase.
2. **Reduce the feed's protein content** and use pure amino acids: 0.5 to 1% protein content decrease.
3. **Compensate respiratory alcalosis** with metabolic acidosis: **the increase in electrolyte balance** (EB, in Meq/Kg) during warm periods induces metabolic acidosis. Using sodium bicarbonate will help, as the EB must be at least 200 Meq/Kg. The intake of 5 Kg/Tonne of sodium bicarbonate increases EB by +60 Meq/Kg. Increased EB also improves feed digestibility.

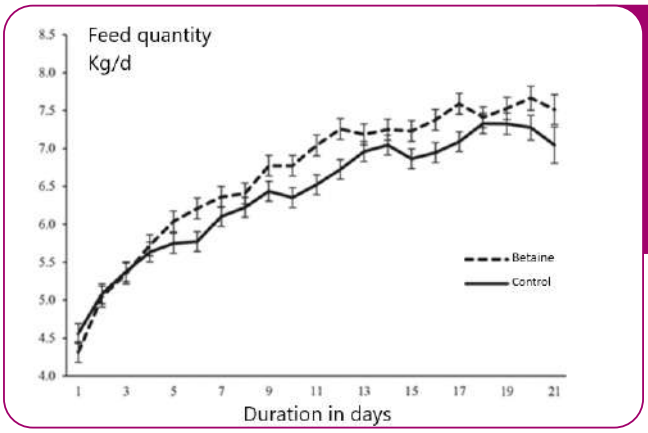
3. Respiratory Alcalosis Compensation



EB, meq/Kg		-50	100	250	400
Ileal digestibility %	Nitrogen	68.9	72.8	**75.4**	76.1
	Energy	63.3	68.4	**69.6**	72.3
	Lysine	79.4	82.2	**83.6**	83.6
	Threonine	66.9	70.3	**72.3**	72.4

Qihui Li and Coll., Animal Nutrition 2022

4. **Fight oxidative stress** by heightening the feed's antioxidant effect: increased antioxidant vitamins such as vitamin E (150-200 mg/Kg), use of vitamin C (100-150 mg/Kg). Using organic selenium (0.1-0.15 mg/Kg) also improves the antioxidant status. A number of plant extracts and polyphenols are available on the market, some of which can be useful.
5. **AXIOM teams recommend using a hepatoprotector** during the lactation period: 750 mg/Kg Choline. In hot weather conditions, adding 2kg/T of Betaine feed improves the feed intake of lactating sows.



Effect of adding Betaine on the feed intake of lactating sows in hot weather conditions

F. A. Cabezón et al, The Professional Animal Scientist 32 (2016)

APPENDIX #1
WATER

> Water

Water intake is crucial for sows before and after lactation. On average, the water intake should be 5 liters per 1 Kg of feed. Water intake, in conjunction with good feed intake, promotes good milk production and reduces weight loss. Water intake may increase by 50% in hot conditions. Regularly flushing (1 to 4 times daily) the water lines improves fresh water intake.

The sows' water supply system should be checked every time prior to the sows' entrance (3 to 5 liters/minute at 1 bar).

Day in lactation (d)	Water intake (L/sow/d)	Day in lactation (d)	Water intake (L/sow/d)
-3	16	2	23
-2	22	3	27
-1	24	10	30
Farrowing	18	15	32
1	22	20+	40

> Water Quality Requirements

There is not enough focus on water quality testing on pig farms, which has a major impact on the sows' health (uro-genital infection) and the feed intake level.
AXIOM recommends testing the drinking water quality at least twice yearly and cleaning the lines at least once yearly. Water treatment is also essential (disinfection, acidification, etc.) The water line can be flushed between batches or every day in the farrowing unit and in the nursery, especially after weaning, to optimize fresh water supply.

Drinking water criteria for sows: should be drinkable for humans.

Water Physico-Chemical Criteria		
Criterion	Recommended Limit Value	Possible Actions
pH at 20°C	5.5 to 6.5	Acidification
Total water hardness TH (°F)	10 to 25	Neutralization if TH < 10 Softener if TH > 30
Conductivity (micro siemens/cm)	200-1000 at 25°C (mineralization deficiency risk if < 333, gilts PC)	Addition of calcium chlorides
Organic matter, Potassium permanganate oxidizability (mgO2/L)	< 2	Line filtration and cleaning
Iron (mg/L)	< 0.02	Iron removal with oxidation then filtration
Manganese (mg/L)	< 0.05	Manganese removal with oxidation then filtration
Nitrates (mg/L)	< 50	Denitration
Nitrites (mg/L)	< 0.1	Denitrification
NH4 (mg/L)	< 1	
Chlorides (mg/L)	< 250	
Sulfates (mg/L)	< 150	
Sodium (mg/L)	< 400	

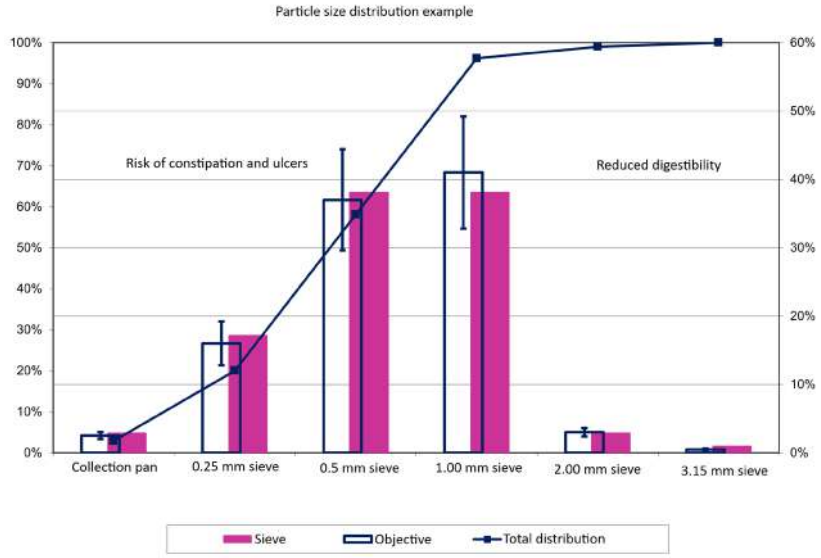
APPENDIX #1
WATER

Water Microbiological Quality Criteria		
Criterion	Recommended Limit Value	Possible Actions
Total germs per mL at 22°C for 72 h	<100	
Total germs per mL at 37°C for 24 h	<10	If only the microbiological deviation criterion is retained, suspected contamination at the time of sample collection
Total coliforms per 100 mL at 37°C for 24 h	0	If only the microbiological criterion deviates (<5 germs/100 mL), suspected contamination at the time of sample collection Runoff-related contamination signs from a contaminated source
Thermotolerant coliforms (including E. coli) per 100 mL at 44°C for 24 h	0	Fecal contamination Bacterial infection risk
Enterococci (group D fecal streptococci) per 100 mL at 37°C for 48 h	0	Fecal contamination Bacterial infection risk
Sulfate reducing anaerobic bacteria (bacteria and spores) per 100 mL at 37°C for 48 h	0	Former fecal water contamination or poor water line maintenance (biofilm)
Salmonella in 5 liters	0	

APPENDIX #2
FEED QUALITY

> Particle Size Target - Grinding Fineness

Feed particle size should be tested to prevent constipation and sustain good digestibility in the farrowing unit. Minimizing particles below 0.2 mm is essential. 70% of particles should have a diameter between 0.4 and 1.1 mm.



> Feed Health Quality

Besides nutritional balance considerations, focus should be placed on raw material quality control.

The control plan aims to check the main nutrients in the raw materials to take into account any deviation in the feed formulation. Thus, depending on processed raw material volumes, their source, AXIOM recommends humidity, ash, protein, starch, crude cellulose testing for all raw materials, according to a set sampling plan.

Testing the manufactured or purchased feed once a month will help identify any discrepancy between expected and measured values. A key control criterion is the fungal quality control of raw materials and feeds as mycotoxins are endocrine disruptors that have multiple effects on sows: low feed intake, return to estrus, lower immunity, litter size drop, carry-over into the milk, etc.

Bear in mind that mycotoxins can also be found in straw bedding, which is consumed by straw-reared animals on a daily basis: though the raw materials may contain little contamination, the straw could be contaminated.

With the effects of climate change and weather conditions, the risk of raw material contamination is heightened. Moreover, the regulatory limit values are reviewed on a regular basis as low concentration toxicity is better known. Finally, when analyzing the main mycotoxins, many so-called emerging mycotoxins are gradually being documented for their harmful effects on reproductive performance (e.g., beauvericins, enniatins). Recent studies have shown a negative interaction between mycotoxin contamination and bone health.

APPENDIX #2
FEED QUALITY

Finally, by affecting gut lining permeability, mycotoxins promote the transfer of endotoxins into the blood stream, which can lead to a number of inflammatory responses (necrosis, delayed lactation onset, impaired performance, etc.) The effects of mycotoxins are often additive, and even at a low contamination level, the addition of several mycotoxins can have harmful effects. A number of surveys are published every year by solution developers, and the risks can be assessed according to geographical areas.

Important: there is no quick fix for eliminating the mycotoxin hazard! The first step is to conduct a risk assessment, ensure safe raw material storage, using antifungal agents if necessary, disposing of any contaminated raw material or reducing its use in the diet formula.

Toxin	Limit Value
Diacetoxyscirpenol (DAS)	< 2 ppm
Toxin T-2	< 1 ppm
Zearelenone (ZEN)	1 to 3 ppm (young gilt diets)
Ochratoxin A	< 0.2 ppm (kidney lesions) / < 2 ppm (weight gain drop)
Ergot (Alkaloids)	4 to 6 ppm
Vomitoxin (Deoxynivalenol, DON)	< 1 ppm (growing pigs) / 0 ppm (lactating or gestating sows)
Aflatoxin	< 0.02 ppm

APPENDIX #3
NUTRITIONAL REQUIREMENTS
GROWING AND FINISHING REPLACEMENT GILTS

		Growth 30-70 Kg			Finishing 70-115 Kg			90-125 Kg		
Energy	**Unit**	%	MIN	MAX	%	MIN	MAX	%	MIN	MAX
Net Energy	MJ/Kg		9.7	-		9.5	-		9.4	-
ME Energy Value (Netherlands) Energy Value (Denmark)	MJ/Kg EV NE		13.5 1.10 1.09	-		13.2 1.08 1.07	-		13.1 1.07 1.06	-
Net Energy	Kcal/Kg		2,320			2,270			2,250	
Fats	%		-	-		-	-		-	-
LysDP/NE ratio			0.082			0.078			0.068	

Protein		%	MIN	MAX	%	MIN	MAX	%	MIN	MAX
Crude Protein	%		-	16.5		-	15.5		-	15.5
SiD Lysine	%		0.80	-		0.74	-		0.64	-
SiD M+C	%	58%	0.46	-	58%	0.43	-	58%	0.37	-
SiD M	%	30%	0.24	-	29%	0.21	-	29%	0.19	-
SiD Threo	%	60%	0.48	-	64%	0.47	-	63%	0.40	-
SiD Trp	%	18%	0.14	-	17%	0.13	-	18%	0.12	-
SiD Val	%	66%	0.52	-	68%	0.50	-	66%	0.42	-
SiD Ileu	%	50%	0.40	-	50%	0.37	-	50%	0.32	-
SiD Leu	%	100%	0.80	-	100%	0.74	-	100%	0.64	-
SiD His	%	32%	0.25	-	32%	0.24	-	32%	0.20	-

Minerals		%	MIN	MAX	%	MIN	MAX	%	MIN	MAX
STTD P	%		0.34	-		0.29	-		0.28	-
Dig P	%		0.28	-		0.25	-		0.24	-
Na	%		0.20	0.25		0.20	0.25		0.20	0.25
STTD Ca	%		0.70	0.72		0.72	0.78		0.75	0.80
STTD Ca / STTD P			2.06	2.12		2.50	2.70		2.70	2.90
Total Calcium (analytical)	%		0.80	0.90		0.80	0.90		0.80	0.90
EB	Meq/Kg		180	-		180	-		200	-

Fiber		%	MIN	MAX	%	MIN	MAX	%	MIN	MAX
ADL	%		-	1.7		-	1.7		-	1.8
Crude Fiber	g/Kg		40	-		40	-		55	-

APPENDIX #4
NUTRITIONAL REQUIREMENTS DURING GESTATION

		Gestation			Part 1		Part 2		
Energy	**Unit**	%	MIN	MAX	MIN	MAX	%	MIN	MAX
Net Energy	MJ/Kg		9.2	-	9.2	-		9.4	-
ME Energy Value (Netherlands) Energy Value (Denmark)	MJ/Kg EV NE		12.8 1.05 1.03	-	12.8 1.05 1.03	-		13.1 1.07 1.06	-
Net Energy	Kcal/Kg		2,200		2,200			2,250	
Fats	%		-	-	-	-		2	-
LysDP/NE ratio			0.060		0.050			0.070	

Protein		%	MIN	MAX	MIN	MAX	%	MIN	MAX
Crude Protein	%		-	14	-	14		-	14
SiD Lysine	%		0.55	-	0.46	-		0.66	-
SiD M+C	%	62%	0.34	-	0.29	-	62%	0.41	-
SiD M	%	30%	0.17	-	0.14	-	30%	0.20	-
SiD Threo	%	68%	0.38	-	0.31	-	73%	0.48	-
SiD Trp	%	17%	0.09	-	0.08	-	17%	0.11	-
SiD Val	%		-	-	-	-		-	-

Minerals		%	MIN	MAX	MIN	MAX	%	MIN	MAX
STTD P	%		0.26	-	0.27	-		0.29	-
Dig P	%		0.21	-	0.22	-		0.24	-
Na	%		0.20	0.28	0.20	0.28		0.20	0.28
STTD Ca	%		0.65	0.72	0.65	0.72		0.65	0.72
STTD Ca / STTD P			2.50	2.80	1.70	2.70		1.70	2.50
Total Calcium (analytical)	%		-	0.90	-	0.95		-	0.90
EB	Meq/Kg		190	-	190	-		220	-

Fiber		%	MIN	MAX	MIN	MAX	%	MIN	MAX
NDF	%		19	-	19	-		19	-
Crude Fiber	g/Kg		-	-	-	-		-	-

APPENDIX #5
NUTRITIONAL REQUIREMENTS DURING LACTATION

		Lactation			Lactation - Heat stress		Farrowing	
Energy	**Unit**	%	MIN	MAX	MIN	MAX	MIN	MAX
Net Energy	MJ/Kg		9.8	-	10.3	-	9.3	-
ME Energy Value (Netherlands) Energy Value (Denmark)	MJ/Kg EV NE		13.6 1.11 1.10	-	14.3 1.17 1.16	-	12.9 1.0, 6 1.05	-
Net Energy	Kcal/Kg		2,350		2,450		2,220	
Fats	%		3.5	-	5.0	-	3.5	-
LysDP/NE ratio			0.090		0.092		0.078	

Protein		%	MIN	MAX	MIN	MAX	MIN	MAX
Crude Protein	%		-	17	-	16	-	13.5
SiD Lysine	%		0.88	-	0.95	-	0.73	-
SiD M+C	%	65%	0.43	-	0.62	-	0.47	-
SiD M	%	28%	0.21	-	0.27	-	0.20	-
SiD Threo	%	74%	0.46	-	0.70	-	0.54	-
SiD Trp	%	18%	0.13	-	0.17	-	0.13	-
SiD Val	%	75%	0.49	-	0.71	-	0.54	-

Minerals		%	MIN	MAX	MIN	MAX	MIN	MAX
STTD P	%		0.36	-	0.38	-	0.32	-
Dig P	%		0.32	-	0.34	-	0.30	-
Na	%		0.25	0.30	0.25	0.30	0.20	0.25
STTD Ca	%		0.60	0.70	0.60	0.70	0.35	0.42
STTD Ca / STTD P			1.70	1.94	1.60	1.84	1.710	1.30
Total Calcium (analytical)	%		-	0.90	-	0.90	-	0.55
EB	Meq/Kg		190	-	220	-	-	170

Fiber		%	MIN	MAX	MIN	MAX	MIN	MAX
NDF	%		16	-	14	16	20	-
Crude Fiber	g/Kg		-	-	-	-	-	-

APPENDIX #6
AXIOM MICRONUTRIENT REQUIREMENTS

Vitamins	Sow	Stage 1 weaner	Stage 2 starter (<30 Kg)	Replacement gilts
Vitamin A	15,000	15,000	12,000	10,000
Vitamin D	2,000	2,000	2,000	2,000
Vitamin E	100	150	80	100
Vitamin B1	2.5	2.5	1.5	2
Vitamin K3	3.5	3	3	2
Vitamin C		200		
Vitamin B2 riboflavin	5	8	5	5
Vitamin B5 pantothenic acid	30	20	12	25
Vitamin B6 pyridoxine	3.5	5	4	3.5
Vitamin B9 folic acid	5	1	0.5	3.5
Vitamin B12	0.03	0.03	0.03	0.03
Vitamin B3 PP, niacin	25	20	15	20
Biotin	0.3	0.2	0.1	0.3
Choline Chloride	500	500	250	500
HyD (25 OHD3)*				
Cu (mg)	10	150	100	10
Fe (mg)	120	180	120	120
Zn (mg)	100	100	100	100
Mn (mg)	75	70	60	75
I (mg)	1.5	2.5	1.5	1.5
Mg (%)	0.3	0.3	0.25	0.3
Se (mg)**	0.3	0.4	0.3	0.3
Na (%)	0.2	0.25	0.2	0.2
Cl (%)	0.2	0.25	0.2	0.2

* Vitamin 25(OH) D3 is a form of vitamin D that presents better bioavailability for sows, allowing for higher vitamin D plasma levels than with conventional supply forms.
Excess vitamin D deficiency can lead to foot and limb weakness in gilts and sows, and impair their immune system. AXIOM recommends checking gilt and sow vitamin D status in order to adopt a suitable vitamin D supply form and concentration (note that there are different regulations regarding authorized maximum levels).

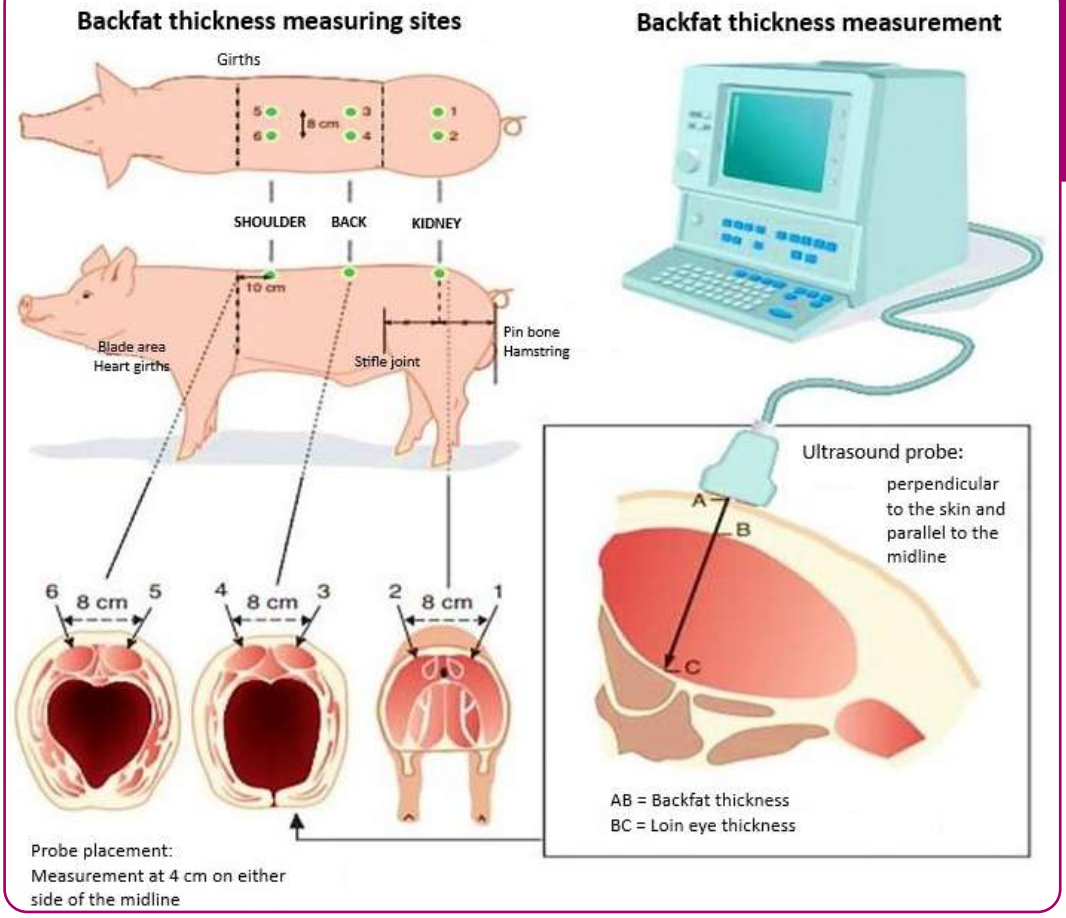
APPENDIX #7
RAW MATERIAL INCORPORATION LIMITS

		Gestation		Lactation		Lactation under heat stress		Farrowing	
Raw materials	**Unit**	min	max	min	max	min	max	min	max
Cereals and by-products									
Barley	g/Kg	200	400	150	350	100	350	250	500
Rolled oats	g/Kg		50		80		100		150
Wheat	g/Kg		450		450		450		450
Wheat bran + wheat middlings + food grade gluten	g/Kg		100		100		150		175
Wheat gluten meal (80% CP)	g/Kg		75		100		125		125
Wheat DDGS	g/Kg		100		100		125		125
Corn	g/Kg		400		400		500		200
Corn gluten meal (60% CP)	g/Kg		50		100		125		125
Corn gluten based feeds	g/Kg		50		50		75		75
Corn DDGS	g/Kg		100		100		125		125
Triticale	g/Kg		150		200		200		200
Rye	g/Kg		80		100		150		200
Biscuit meal	g/Kg		100		150		100		150
Sugar beet pulp	g/Kg	40	50	20	50		50	50	80
Ground flaxseed/meal	g/Kg		30		30		50		50
Copra meal	g/Kg		30		30		50		50
Alfalfa	g/Kg		20		20		30		30
Citrus pulp	g/Kg		20		20		20		30
Molasses	g/Kg		30		30		40		50
Plant-based Proteins									
Sunflower meal (low protein and high protein content)	g/Kg		50		80		80		10
Hipro soybean meal >48% CP	g/Kg								
Lopro soybean meal <48% CP	g/Kg								
Extruded whole soybean	g/Kg								
Soybean hulls	g/Kg		10		20		20		40
Peas	g/Kg		100		80		80		50
Rapeseed extract (00 grade)	g/Kg		50		50		50		50
Palm kernel meal	g/Kg		30		30		30		30
Animal protein									
Fish meal 70%	g/Kg								
Oils and Fats									
Fish oil	g/Kg		2				2		2
Soybean oil	g/Kg		2				2		2
Sunflower oil	g/Kg		3				3		3
Corn germ oil	g/Kg		3				3		3
Coconut oil	g/Kg		2				2		2
Palm oil	g/Kg		3				3		3
Rapeseed oil	g/Kg		3				3		3
Animal fat > 5% free fatty acids (FFA)	g/Kg		5		5		5		5
Lard	g/Kg								

APPENDIX #8
BACKFAT THICKNESS MEASUREMENTS AND LINE-SPECIFIC OBJECTIVES

> Measurements

BFT can be measured using either a Renco lean-meter or an ultrasound. The measurement is done at the same measuring point, point P2, where the last rib and points 3-4 are located on the diagram below (backbone).



Ultrasound Placement for BFT Measurement

Renco Lean-Meter for BFT Measurement

The main difference between the two devices resides in the probe, and therefore, in the measurement quality and accuracy. The ultrasound probe is slenderer and more accurate. Generally speaking, an ultrasound measurement is considered to be greater than a Renco measurement by 2 mm.

If no measurement tools are available, you may find it useful to refer to the Body condition score below, which is less objective than BFT measurements.

APPENDIX #8
BACKFAT THICKNESS MEASUREMENTS AND LINE-SPECIFIC OBJECTIVES

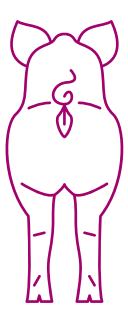
> Line-specific Objectives

Purebred objectives vary depending on the type of farm: breeding or multiplier. For breeding farms, whose objectives are to measure optimum growth, including for gilts, and as the animals have a limited career (maximum parity 4 or 5) for a quick generation replacement, the weight objectives are greater while BFT objectives are lower. For multiplier or internal replacement farms, the nutrition management is very similar to the management of F1, and therefore, the objectives will be almost identical to F1.

Large White	Breeding	Multiplier/internal replacement
Age at 1st AI	255-265 days	255 days
Weight at 1st AI	155-170 Kg	150-165 Kg
BFT at 1st AI	12-13 mm	13-14 mm
Weight at 1st farrowing	250-265 Kg (including litter)	240-260 Kg (including litter)
BFT at 1st farrowing (+1mm if 28d in lactation)	15-17 mm (Gilt) 18 mm (Sow)	16-18 mm

Landrace	Breeding	Multiplier/internal replacement
Age at 1st AI	255-265 days	255 days
Weight at 1st AI	155-170 Kg	150-165 Kg
BFT at 1st AI	12-13 mm	13-14 mm
Weight at 1st farrowing	250-265 Kg (including litter)	240-260 Kg (including litter)
BFT at 1st farrowing (+1mm if 28d in lactation)	15-17 mm (Gilt) 18 mm (Sow)	16-18 mm

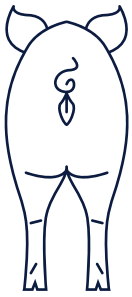
> Body Condition Score (BCS)



< 10 mm
BCS 1

Emaciated
Visible hip bones and backbone.

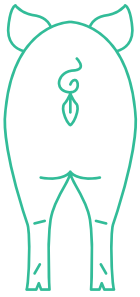
Skip a cycle. Cull.



10-13 mm
BCS 2

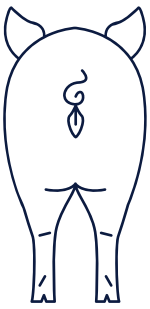
Thin
Moderately visible hip bones and backbone.

Skip a cycle if necessary.



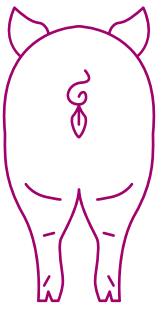
14-18 mm
BCS 3

Ideal
Hip bones and backline can be felt when applying slight pressure.



19-23 mm
BCS 4

Fat
Hip bones and backline can be felt when applying strong pressure.



> 23 mm
BCS 5

Very fat
Hip bones and backbone cannot be felt.

Consult your nutritionist for a minimum limit value.

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