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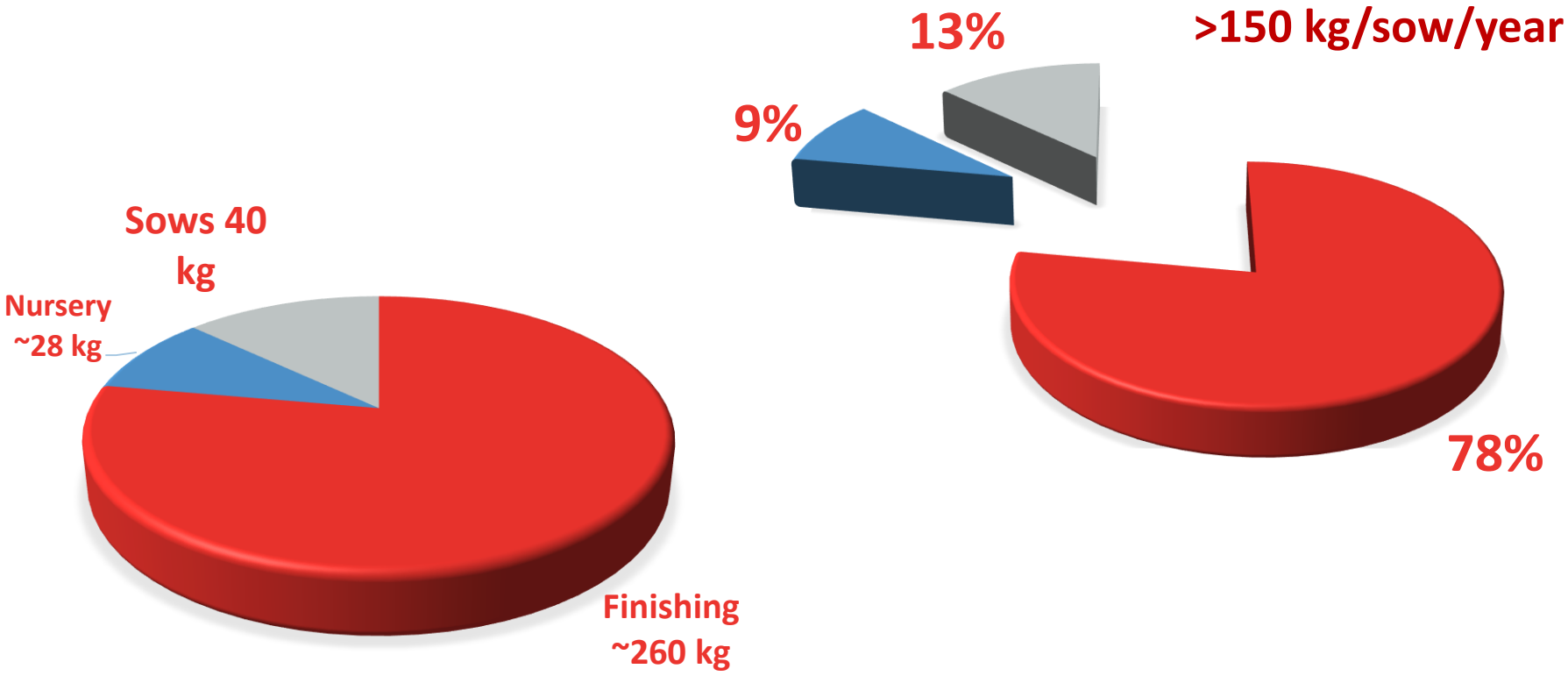
Nutrition & Reproduction
Technical Services

Nutrition and feeding recomendations for modern sows

1st European Nutrition Webinar
May 26th, 2020

PIC Global Nutrition

Why are we discussing Camborough efficiency?



Why are we discussing Camborough efficiency?

Target 135 to 160 kg body weight at first breeding

- Less consumption of gilt developer diet (or diet fed prior to AI).
- Positive impact on sow longevity and retention rate.

No bump feeding at d 90 of gestation to transfer

- Base feeding of gilts and sows during gestation on their body condition score.
- Bump feeding has minimal effect on piglet birth weight.
- Bump feeding can result in a fat herd and, consequently, in a higher stillborn rate, lower lactation feed intake, and lower retention rate.

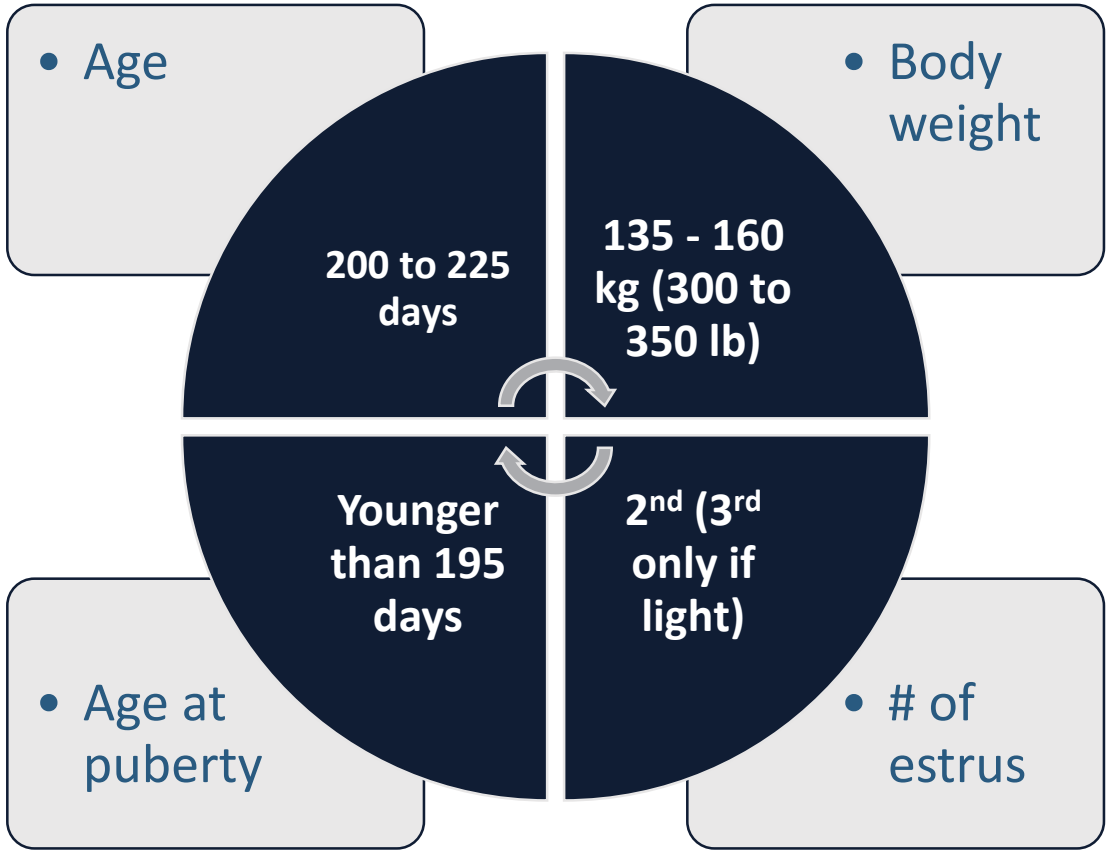
Breeding thinner herd

- Heavy gilts (>160 kg at first AI) have higher maintenance requirements.
- Heavy gilts are likely heavier during gestation across parities. (+23 kg feed/sow/year).
- Heavy gilts are known to have shorter productive lifetimes.

Nutrition and feeding during gilt development

Nutrition and feeding during gilt development

Target at first breeding
4 key elements



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Nutrition and feeding during gilt development

Growth rate and breeding weight

Significant impact on sow lifetime performance

Gilt breeding weight

Weight targets for replacement gilts

Too light – Do not breed	<135 kg (<300 lb)
Eligible to breed	135-160 kg (300-350lb)
Too heavy	>160 kg (>350lb)

Average Daily Gain from birth to 1st breeding		
Age, days	225	200
Weight, kg (lb)	135 (300)	160 (350)
ADG, g (lb)	600 (1.32)	800 (1.76)

Avoid stress around breeding:

- Gilts should start gaining weight with minimal stress 15 days before breeding.

Nutrition and feeding during gilt development

Goals for feeding replacement gilts

Meeting nutrient demands for:

- Adequate growth
- Adequate reproductive tract development
- Adequate bone development
- A sound foot and leg structure

Nutrition and feeding replacement gilts

Updated STTD Phosphorus requirements, %

	Body weight, kg				
	23-41	41-59	59-82	82-104	104-129
Terminal Gilts					
PIC2016	0.33	0.30	0.28	0.26	0.24
PIC2020	0.40	0.37	0.33	0.29	0.25
Barrows					
PIC2016	0.33	0.30	0.27	0.25	0.24
PIC2020	0.37	0.34	0.31	0.28	0.24
Replacement Gilts					
PIC2016	0.35	0.35	0.35	0.35	0.35
PIC2020	0.42	0.38	0.34	0.30	0.26

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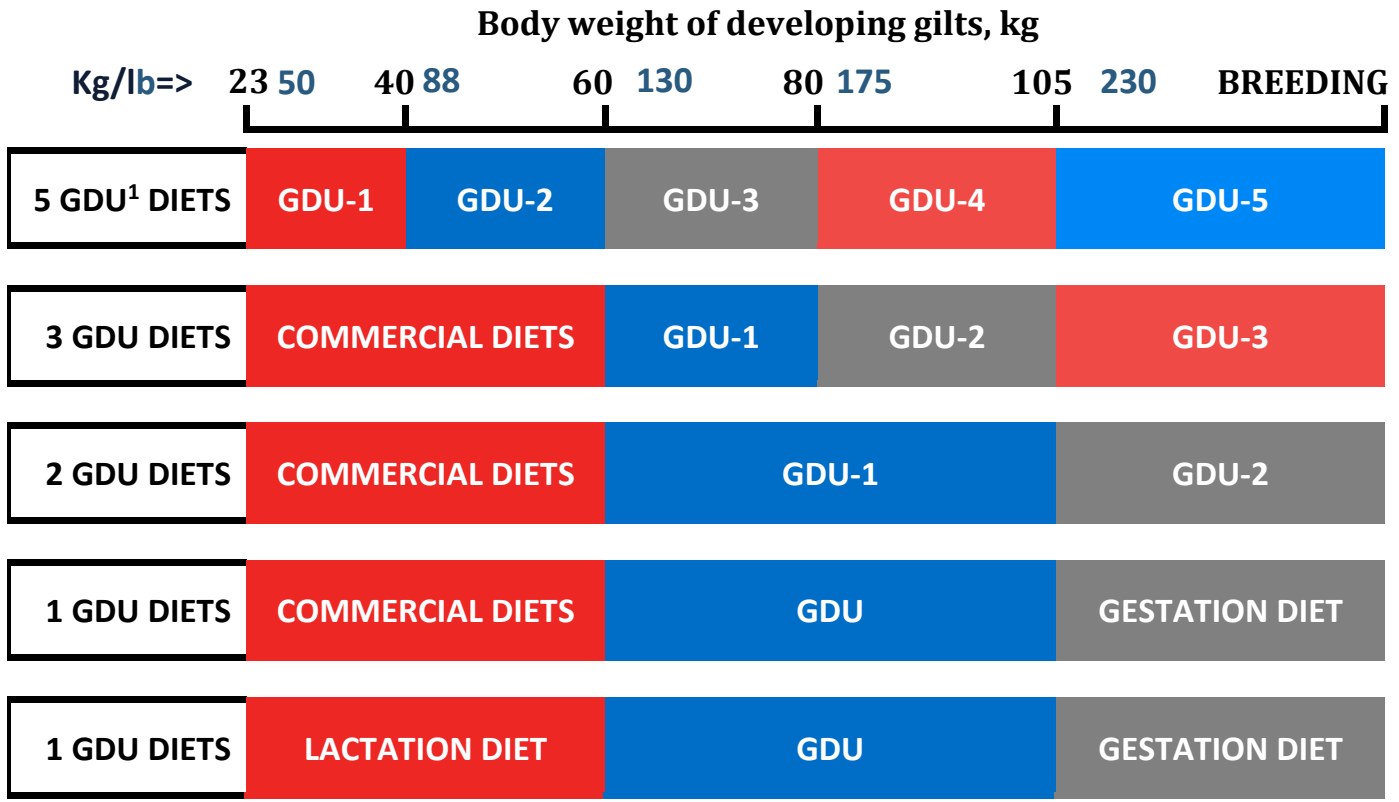
STTD: Standardized Total Tract Digestible

Nutrition and feeding during gilt development

How many diets to build a reasonable phase feeding for gilt development?



[1]GDU: gilt development unit.

Nutrition and feeding during gilt development

Summary

- Provide ad libitum feed access from birth to first breeding
- Lysine/Energy ratio – Use ~97% commercial gilt concentrations for maximum performance
- Vitamins/Trace minerals – Details in the PIC 2020 Nutrition Manual
- Calcium and Phosphorus – Higher concentrations than commercial gilts
- Measure gilt weight to ensure adequate weight at breeding (scale, tape, image…)

Weight targets for replacement gilts

Too light – Do not breed	<135 kg (<300 lb)
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Nutrition and feeding during gestation

Nutrition and feeding during gestation
Early Gestation

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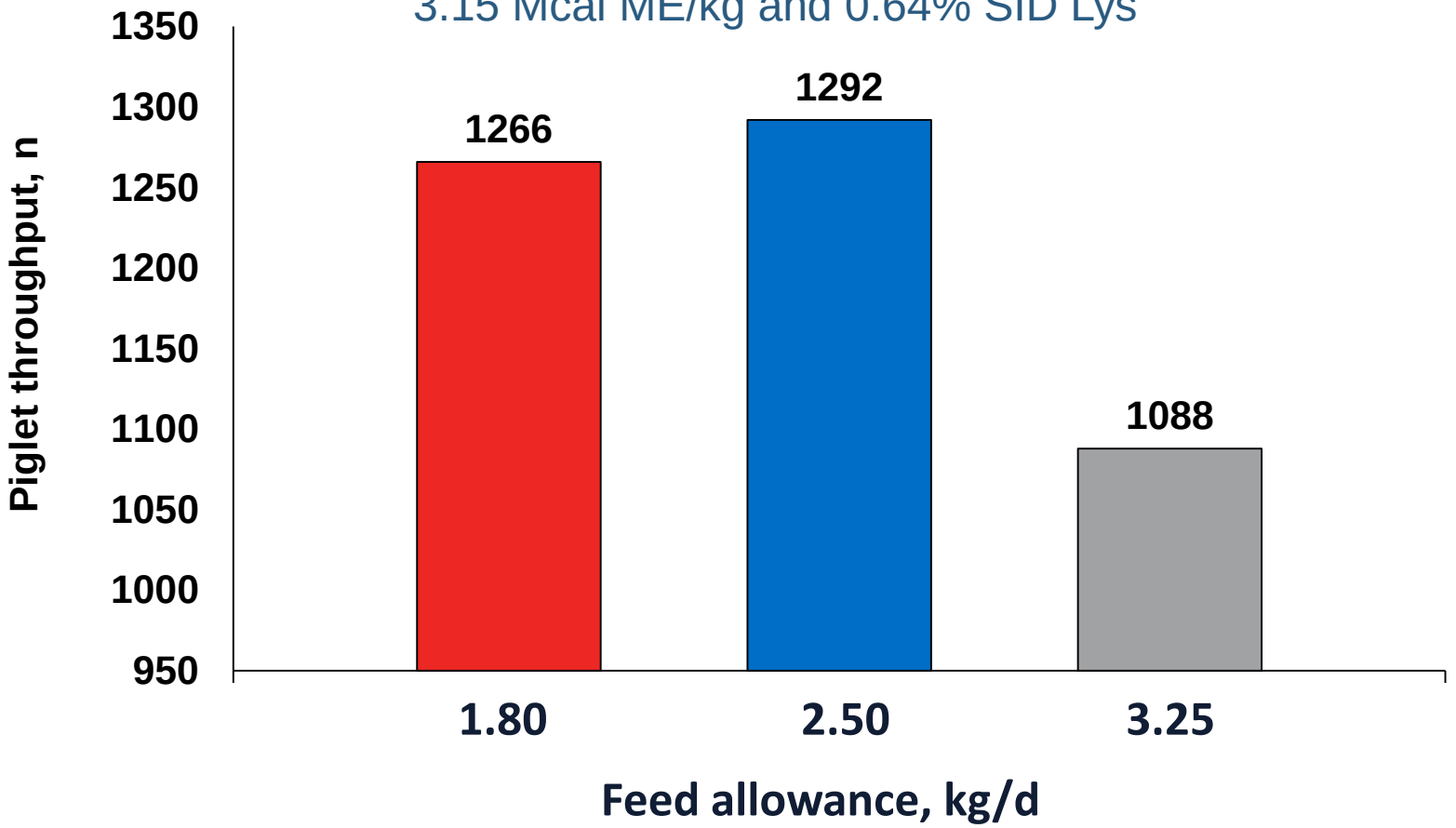
Piglet throughput reduced when combined gilts and sows

Treatments performed from day 6 to day 30 of gestation

3.15 Mcal ME/kg and 0.64% SID Lys



Linear, $P < 0.001$
Quadratic, $P = 0.008$
n = 361 sows

Born alive index =
FR,% x BA x 100

Represent born alive from 100 sows bred

Mallmann, 2019, Unpublished data

Nutrition and feeding during gestation

Early Gestation

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Descriptive summary of different early gestation feeding levels on embryo survivability and hormone secretion of gilts and sows

REFERENCE	SAMPLE SIZE	STAGE	GESTATION DAYS	WEIGHT AT BREEDING, kg	ME_m, Mcal/d	DIETARY ME, Mcal/kg	FEEDING LEVEL, kg/d		% OF ME_m		RESPONSE CRITERIA		
							CON.	TRT.	CON.	TRT.	EMBRYO SURVIVABILITY	PLASMA PROGESTERONE	TOTAL BORN
Jindal et al., 1996	48	Gilt	1 – 15	116	3.52	2.71	1.9	2.6	146%	200%	-22%	-57%	-
Athorn et al., 2013	18	Gilt	0 – 10	126	3.76	2.89	1.5	2.8	115%	215%	19%	-	-
Athorn et al., 2013	19	Gilt	0 – 10	126	3.76	2.89	1.5	2.8	115%	215%	-	26%	-
Langendijk et al., 2015	21	Gilt	10 – 11	103	3.22	2.87	0.0	2.5	0%	223%	-	-8%	24%
Virolainen et al., 2005	12	Sow	1 – 35	252	6.32	2.83	2.0	4.0	89%	179%	-35%	-25%	-
Hoving, 2012	37	Sow	3 – 35	170	4.71	3.11	2.5	3.3	165%	215%	2%	ns	
Mallmann et al, 2020	244	Sow	6 – 30	197	5.26	3.15	1.8	2.5	108%	150%	-	-	0%
Mallmann et al, 2020	239	Sow	6 – 30	197	5.26	3.15	1.8	3.2	108%	192%	-	-	-8%
Weighted Average	-		-	**184**	**4.98**	**3.08**	**1.7**	**2.8**	**107%**	**178%**	**-9%**	**-22%**	**-1%**

PIC Base Level (Gilt/Sow)	**150/200**	**4.18/5.32**	**3.23**	**1.8**	**141%/111%**
PIC Thin Level (Sow)	**190**	**5.12**	**3.23**	**2.5**	**157%**

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Nutrition and feeding during gestation
Early Gestation

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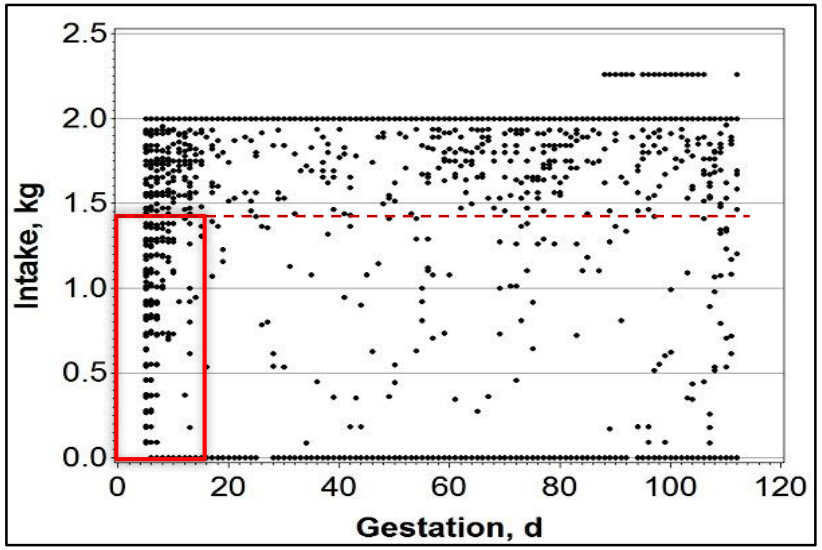
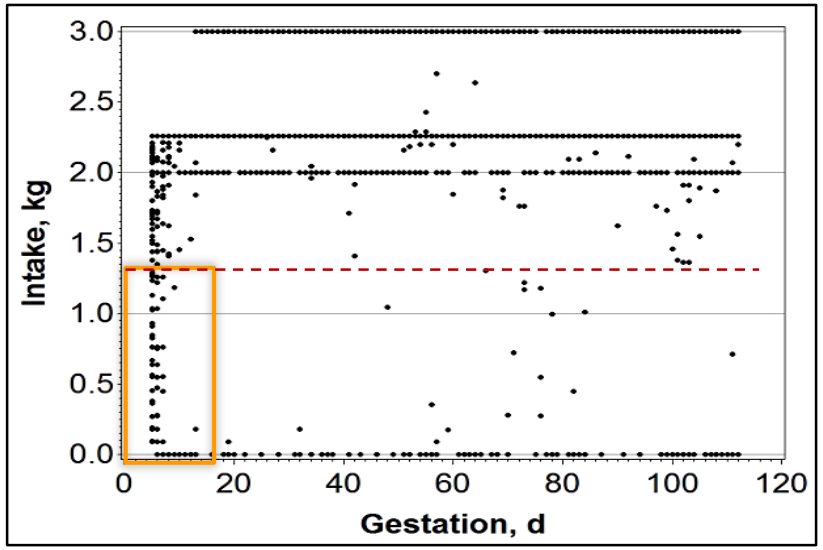
Group-housed **gilts** and **sows** fed via electronic feeding system struggle to consume their full feed allowance during early gestation.

Parity 1 and 2+ sows begin to consume their allowance much faster than gilts.

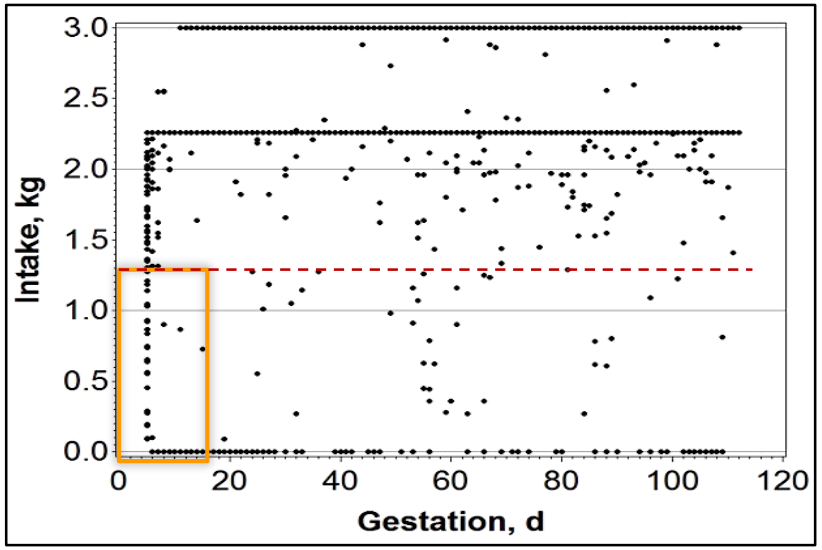
Intake records: *n* = 74,114 (PIC 1050, PIC®)



Gilts



Parity 1 sows



Parity 2+ sows

Average gilt and sow weight = 165 kg

MEm = 4.604 Mcal ME/kg which is equivalent to 1.43 kg/d

Thomas et al., 2016

Nutrition and feeding during gestation

Summary – Early Gestation

- Evidence suggests feeding below base level during the first days after breeding will lead to reduced embryo survival

- Excessive feed intake (>10 Mcal of ME/day) has negative impact in total born overall parties.

Nutrition and feeding during gestation
Late Gestation

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Descriptive summary of bump-feeding experiments for PIC sows

REFERENCE	START, DAY OF GESTATION	LITTERS PER TREATMENT	TOTAL BORN	CONTROL,		INCREASED FEED INTAKE,		CHANGES DUET TO EXTRA FEED	
				Mcal ME/d	g SID Lys/d	Mcal ME/d	g SID Lys/d	BW GAIN per kg OF EXTRA DAILY FEED, kg	PIGLET BIRTH CHANGE, g
Shelton et al. 2009	90	32	12.4	**7.9**	**11.9**	**11.4**	**19.9**	4.9	-109
Soto et al. 2011	100	51	12.9	**7.9**	**11.2**	**13.9**	**19.5**	NR	-69
Gonçalves et al. 2015	90	181	15.1	**5.9**	**10.7**	**8.9**	**10.7**	9.0	47
Gonçalves et al. 2015	90	181	15.3	**5.9**	**20.0**	**8.9**	**20.0**	10.8	19
Greiner et al. 2016	95	128	14.7	**5.9**	**9.0**	**8.8**	**14.0**	7.1	-40
Mallmann et al., 2018	90	221	15.4	**5.9**	**11.7**	**7.2**	**14.3**	9.0	-4
Average	---	---	14.3	6.6	12.4	9.9 (50%)	16.4 (32%)	**8.9**	**-1.3**
Standard deviation	---	---	1.3	1.0	3.9	2.4	3.9	1.6	44.2

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Nutrition and feeding during gestation
Late Gestation

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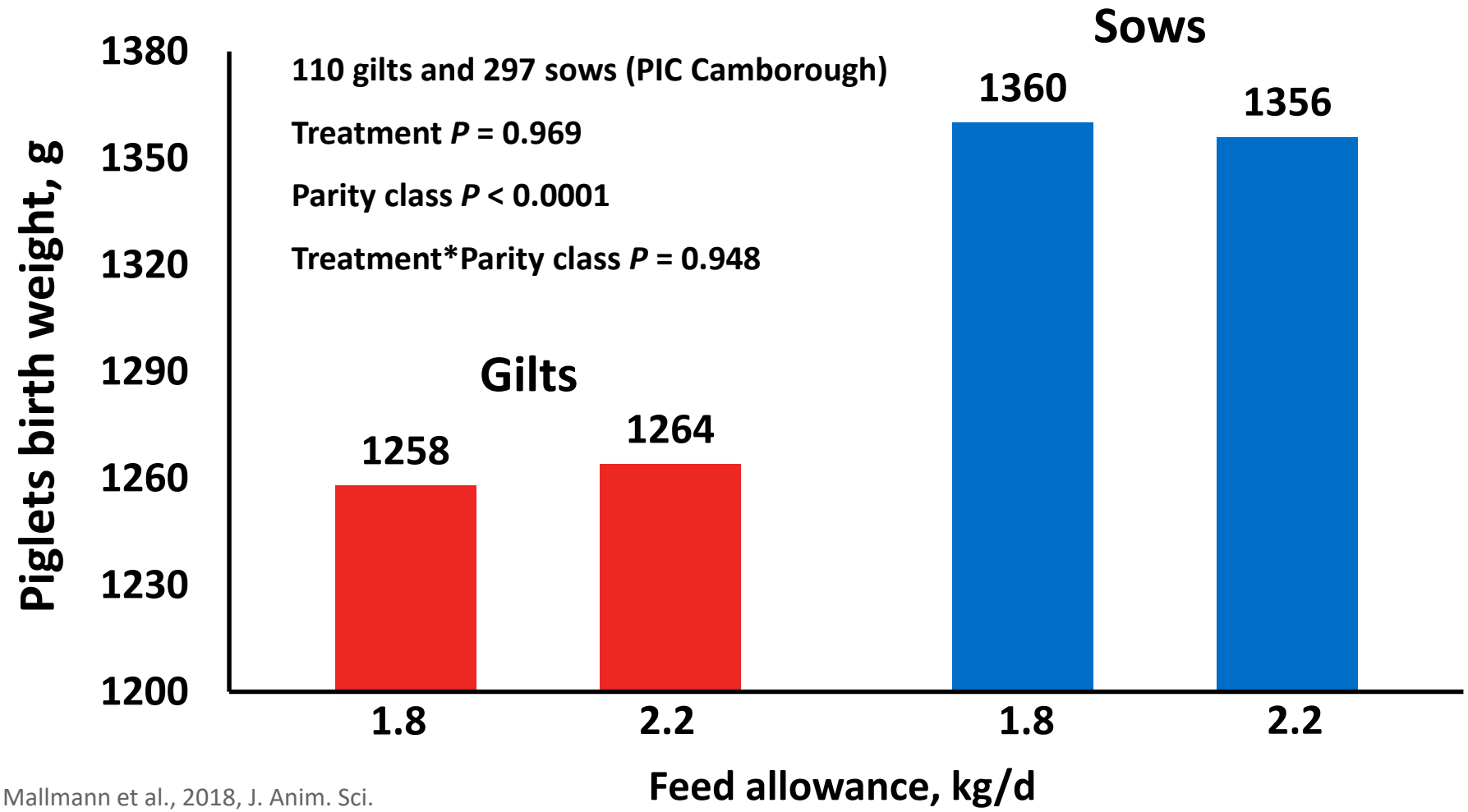
Bump feeding from d 90 of gestation
didn't improve piglet birth weight for PIC gilts or sows



Mallmann et al., 2018, J. Anim. Sci.

Nutrition and feeding during gestation
Late Gestation

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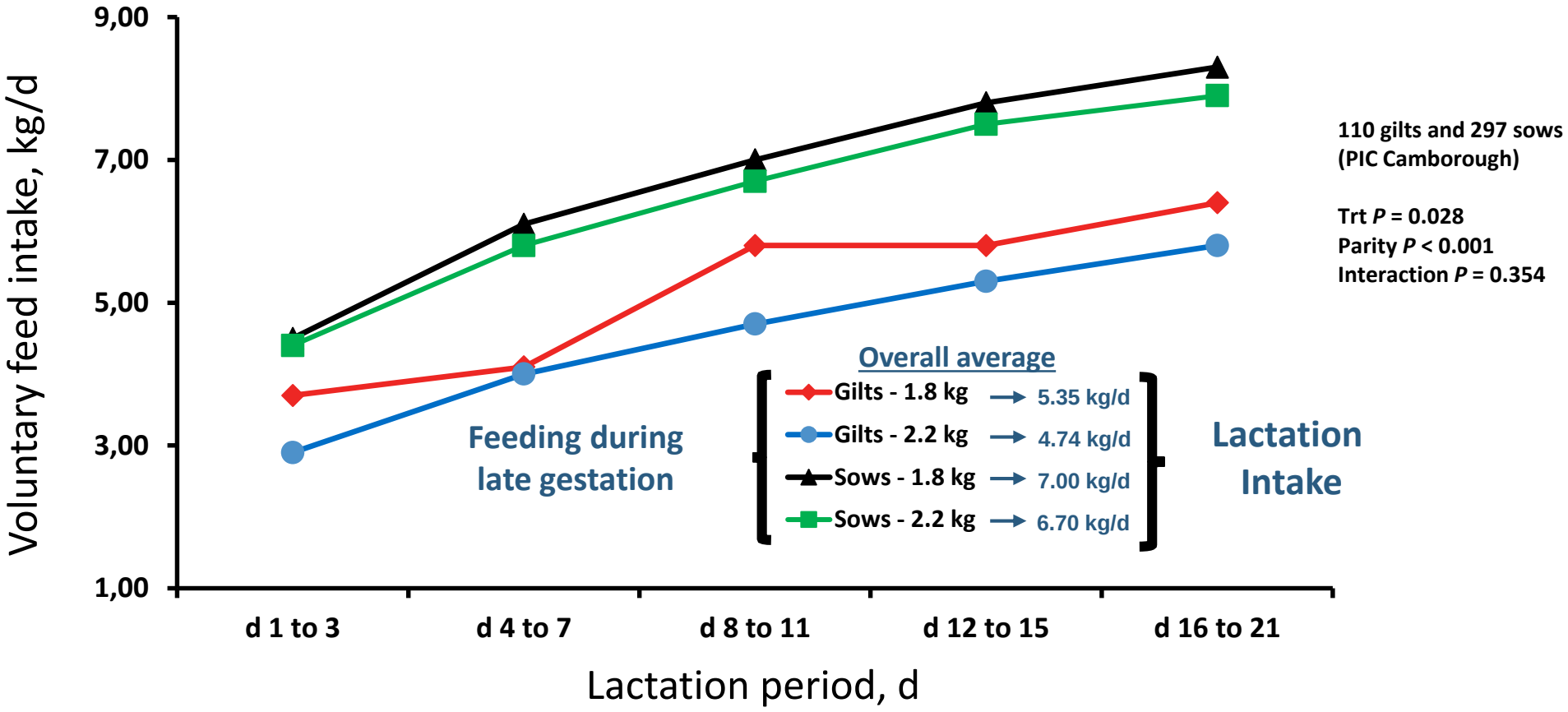
Bump feeding from d 90 of gestation
may compromise lactation voluntary feed intake



110 gilts and 297 sows (PIC Camborough)

Trt *P* = 0.028
Parity *P* < 0.001
Interaction *P* = 0.354

Mallmann et al. 2018, J. Anim. Sci.

Nutrition and feeding during gestation

Late Gestation

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Descriptive summary of bump-feeding experiments for PIC gilts

REFERENCE	START DAY OF GESTATION	LITTERS PER TREATMENT	TOTAL BORN	CONTROL		INCREASED FEED INTAKE		CHANGES DUET TO EXTRA FEED	
				Mcal ME/d	g SID Lys/d	Mcal ME/d	g SID Lys/d	BW GAIN per kg OF EXTRA DAILY FEED, kg	PIGLET BIRTH CHANGE, g
Shelton et al. 2009	90	21	14.3	**6.8**	**11.9**	**9.8**	**17.1**	6.6	86
Soto et al. 2011	100	24	12.5	**7.0**	**9.8**	**12.9**	**18.2**	NR	126
Gonçalves et al. 2015	90	371	14.2	**5.9**	**10.7**	**8.9**	**10.7**	5.6	24
Gonçalves et al. 2015	90	371	14.2	**5.9**	**20.0**	**8.9**	**20.0**	9.1	28
Greiner et al. 2016	100	65	13.4	**5.9**	**9.0**	**8.8**	**14.0**	NR	-120
Ampaire 2017	90	17	13.4	**7.2**	**12.3**	**8.6**	**14.5**	24	-10
Mallmann et al., 2018	90	50	14.4	**5.9**	**11.7**	**7.2**	**14.3**	6.5	6
Mallmann et al., 2019	90	243	14.1	**5.9**	**11.5**	**7.6**	**14.7**	6.4	26
Mallmann et al., 2019	90	242	14.3	**5.9**	**11.5**	**9.2**	**17.9**	8.8	-1
Mallmann et al., 2019	90	246	14.3	**5.9**	**11.5**	**10.9**	**21.1**	7.9	-11
Average	---	---	13.9	6.2	12.0	9.3 (49%)	16.3 (36%)	**7.7**	**12.0**
Standard deviation	---	---	0.6	0.5	3.0	1.6	3.2	2.4	36.1

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Nutrition and feeding during gestation

Late Gestation

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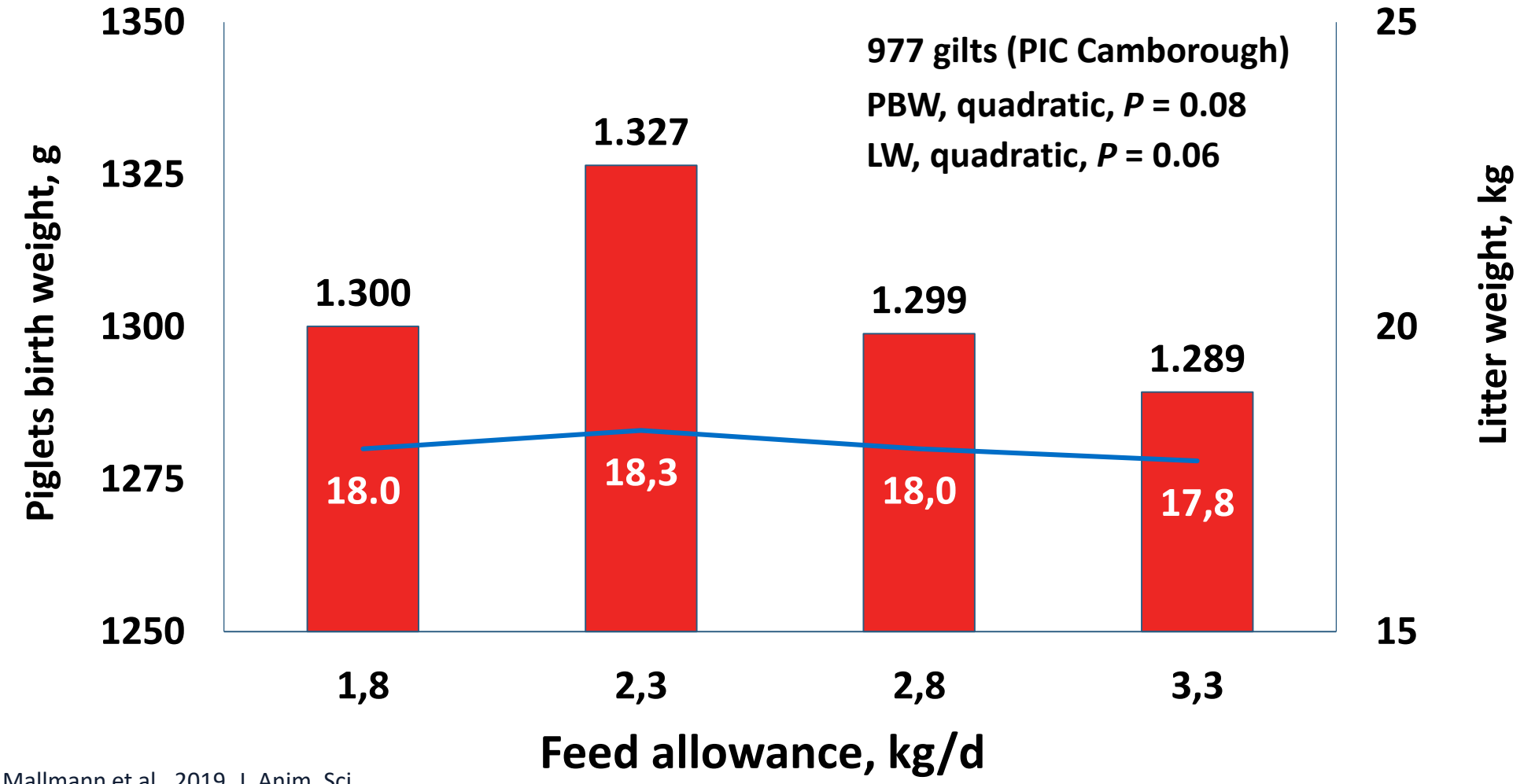
Bump feeding from d 90 of gestation

Piglets birth weight, and litter weight of PIC gilts



Mallmann et al., 2019, J. Anim. Sci.

Nutrition and feeding during gestation
Late Gestation

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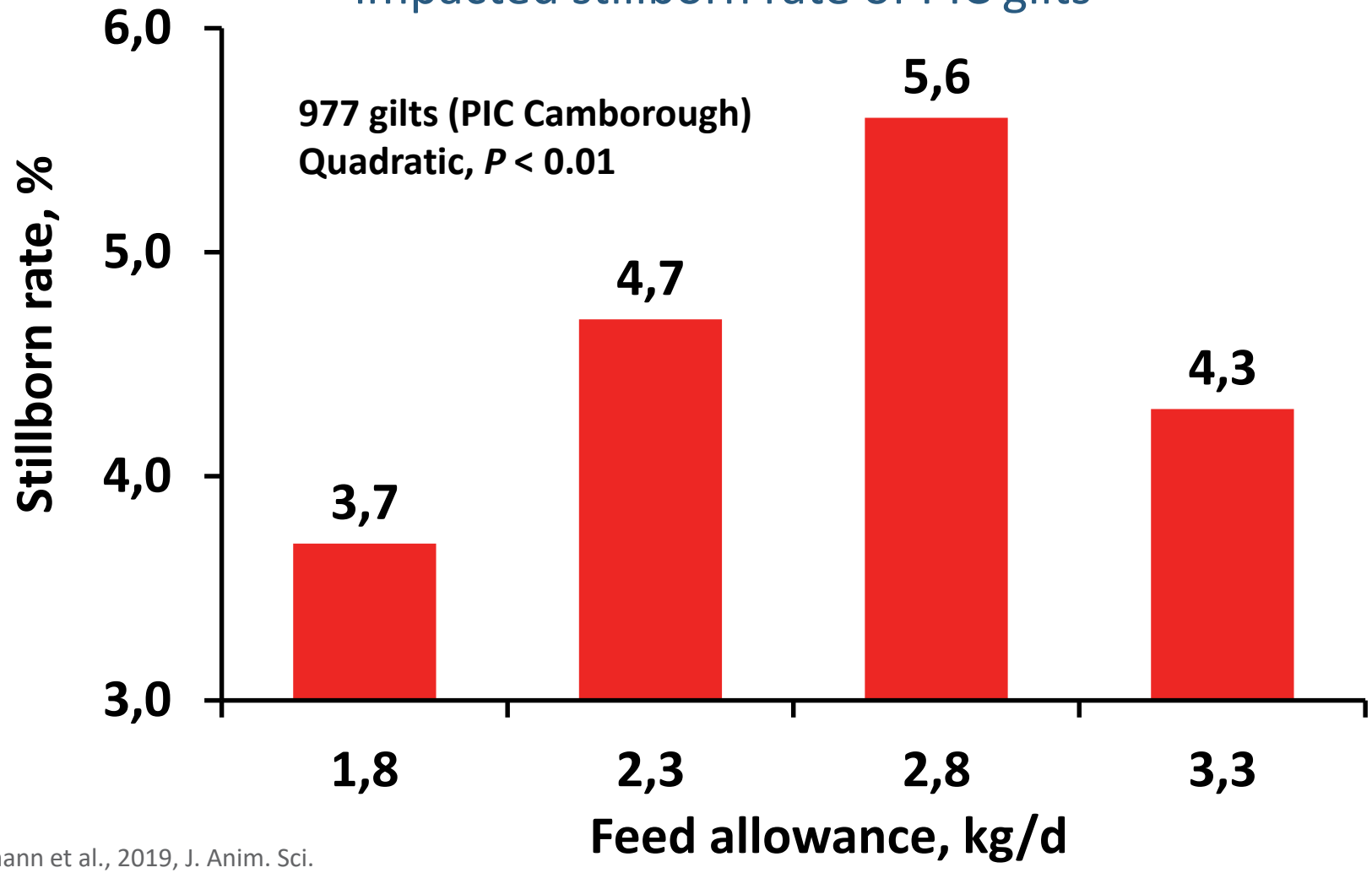
Bump feeding from d 90 of gestation
impacted stillborn rate of PIC gilts



Mallmann et al., 2019, J. Anim. Sci.

Nutrition and feeding during gestation

Late Gestation

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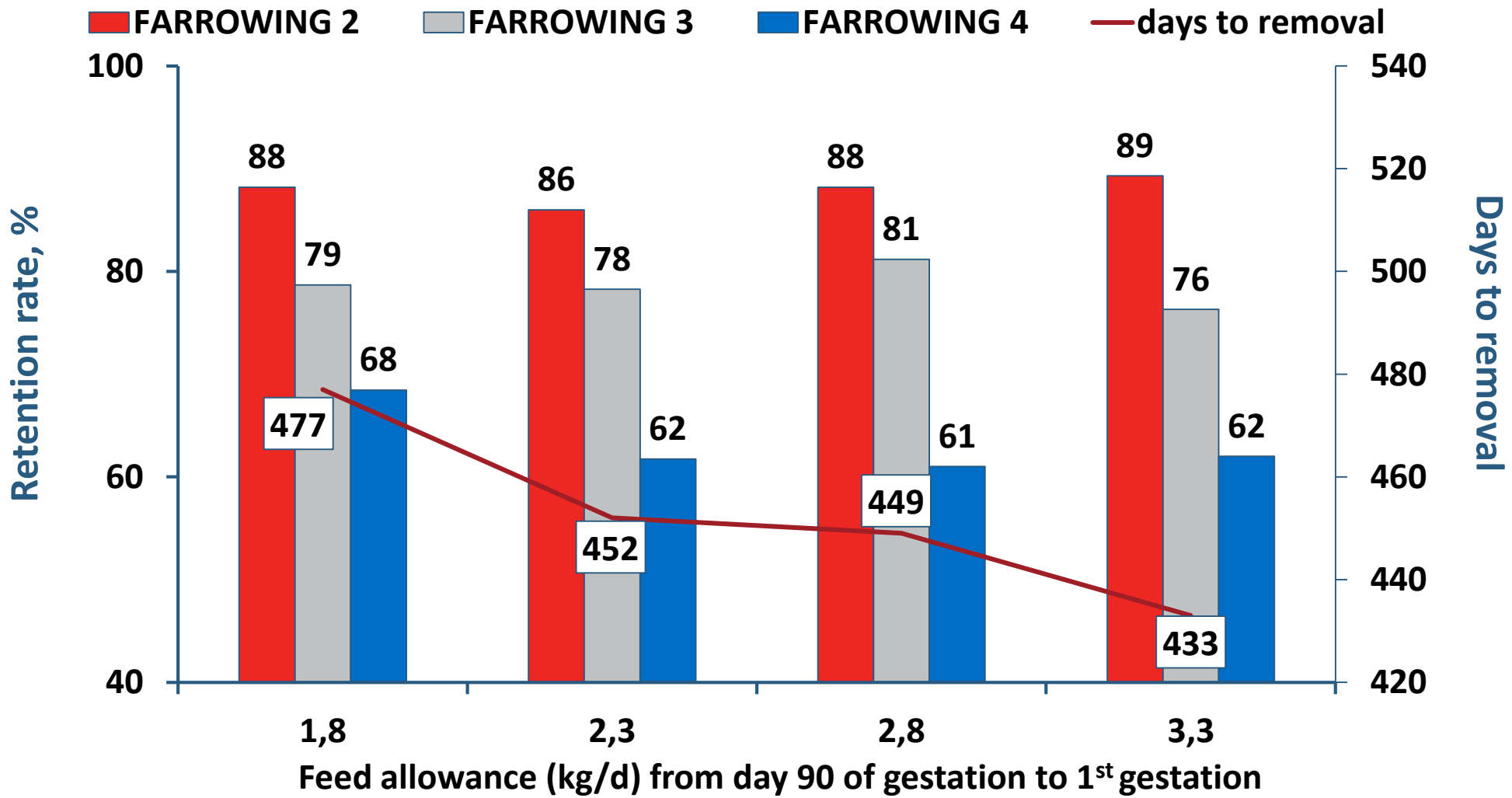
Long term impacts of pump feeding during the 1st gestation



Mallmann 2019, Unpublished data

Nutrition and feeding during gestation

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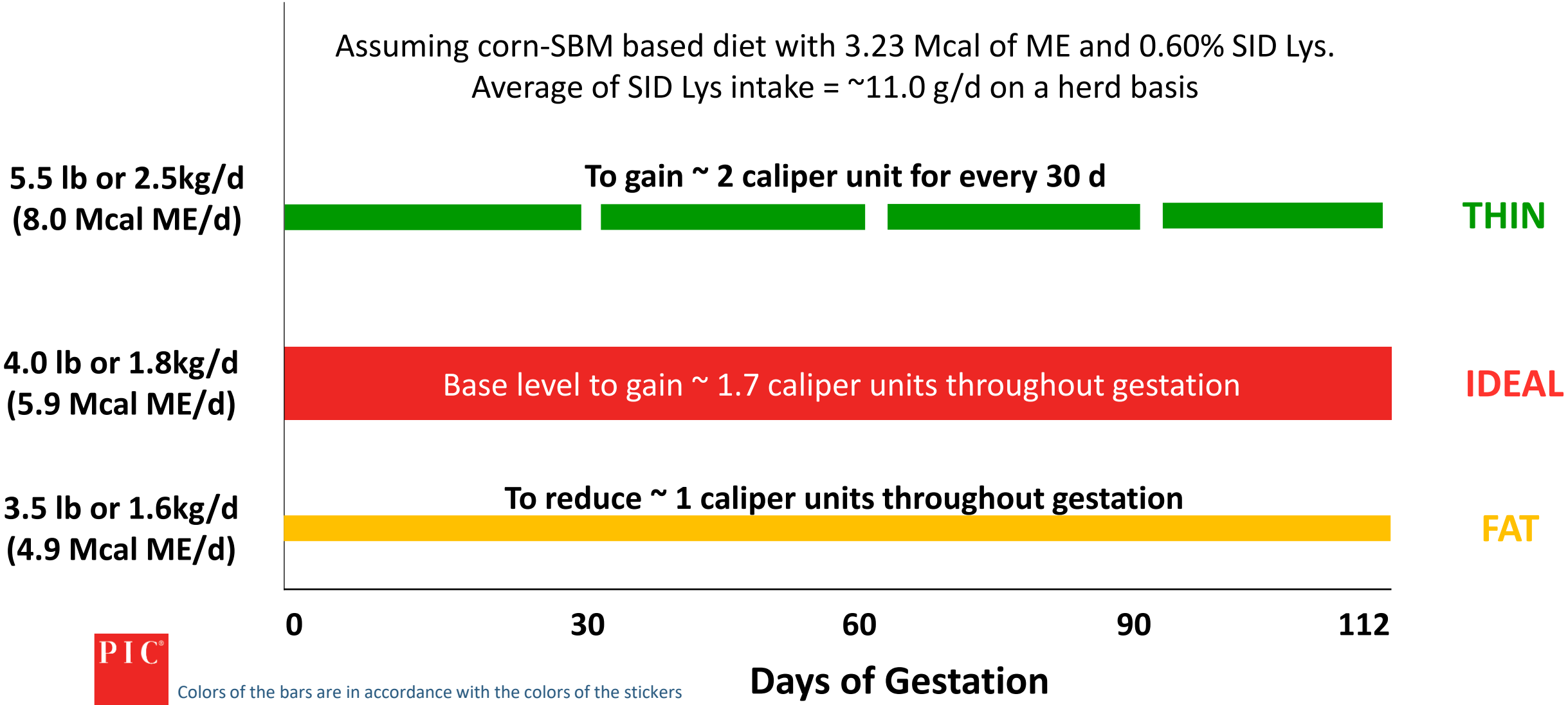
PIC 2020 – Gilts and Sows



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Colors of the bars are in accordance with the colors of the stickers in the sow caliper

Nutrition and feeding during gestation

Summary – Late gestation

- Bump feeding results in:
  - Little improvement of birth weight in piglets from gilts
  - No improvement of birth weight in piglets from sows
  - Higher percentage of stillborns in gilts and sows
  - Decreased lactation feed intake
  - Tendency to fewer days in the herd
- Stop bump feeding for both gilts and sows
- Current recommendation:
  - 11.0 g/d minimum of SID lysine for gilts and sows during gestation

Nutrition and feeding during peripartum

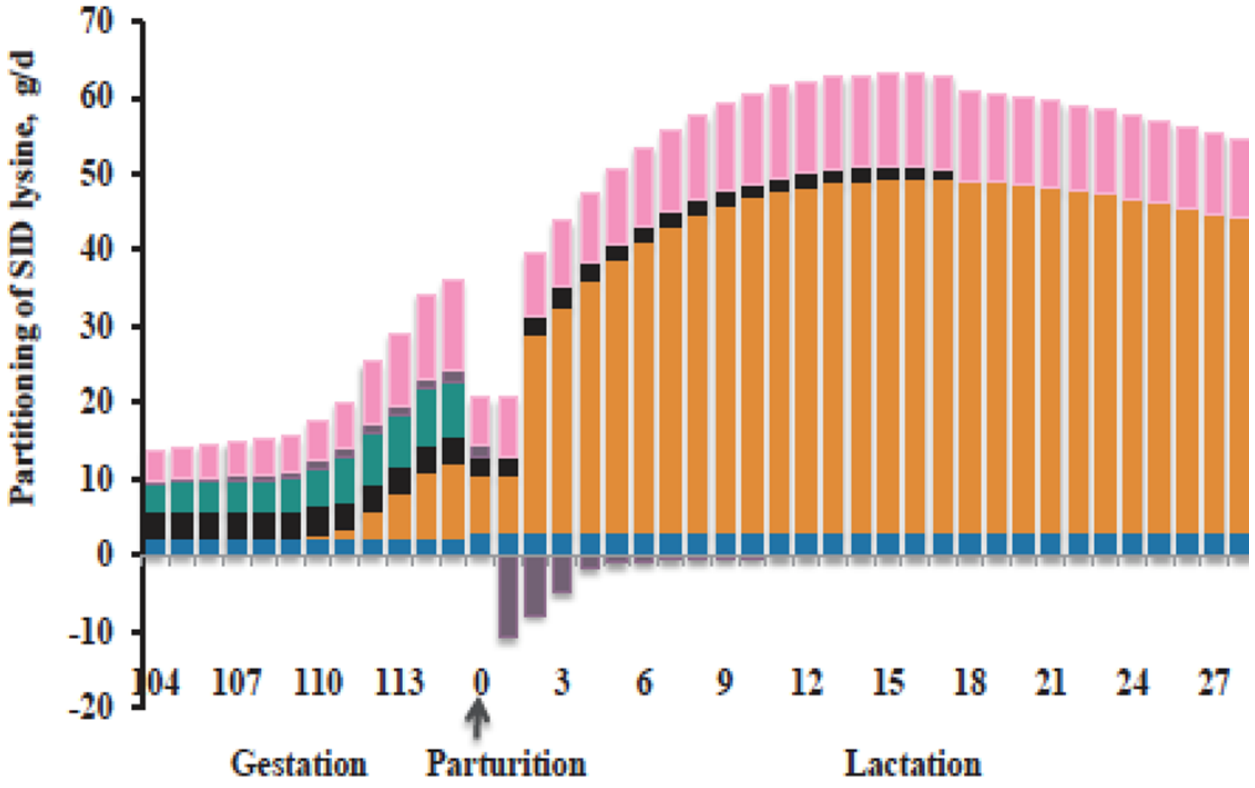
Nutrition and feeding during peripartum

Last 12 days prior to farrowing:

- ME requirement increases 61%
- SID Lys requirement increases 149%

Requirements to support:

- Fetal growth
- Mammary growth
- Colostrum production
- Maintenance
- Uterine components



Feyera and Theil, 2017

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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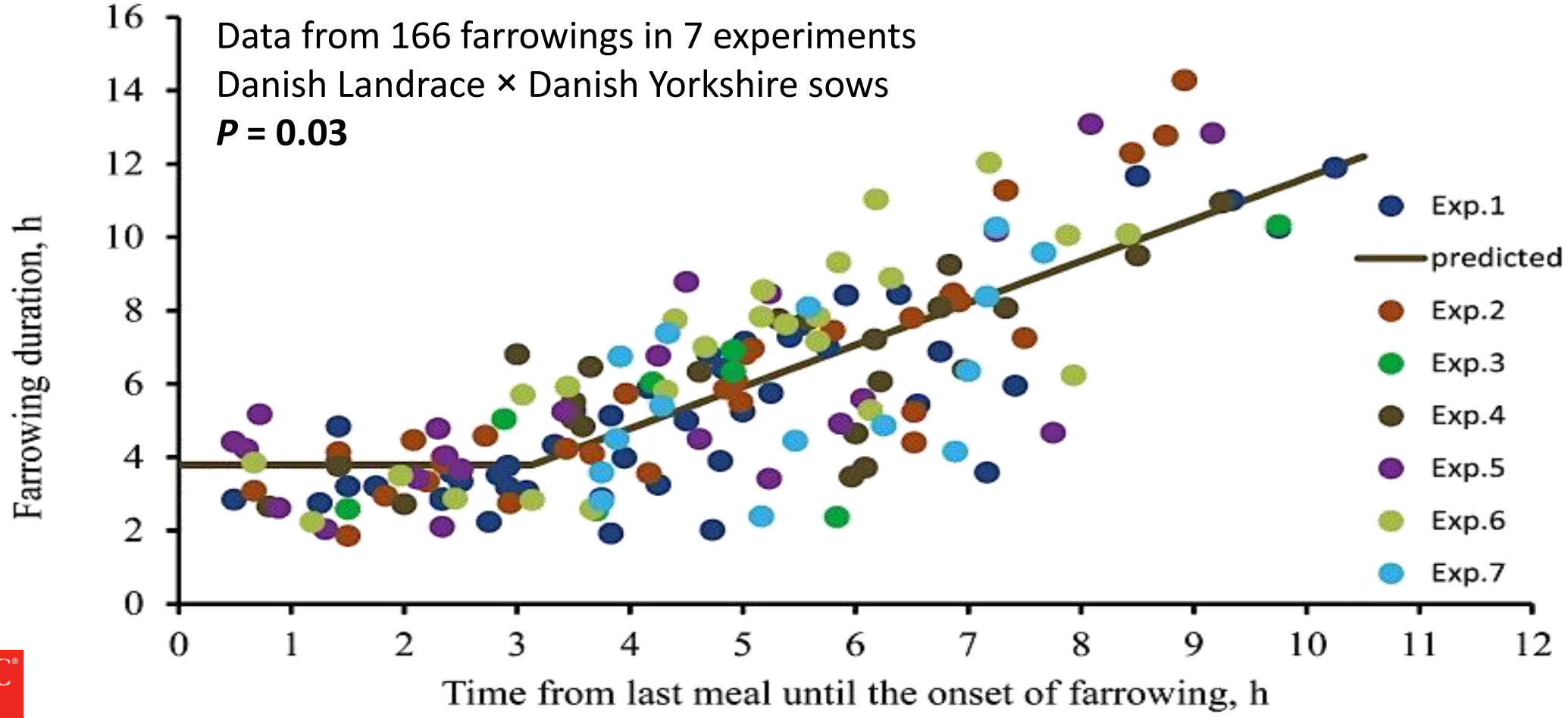
Farrowing duration is reduced if sows have access to feed at least 3 h before farrowing

Data from 166 farrowings in 7 experiments
Danish Landrace × Danish Yorkshire sows
***P* = 0.03**



Feyera et al., 2018. J Anim Sci

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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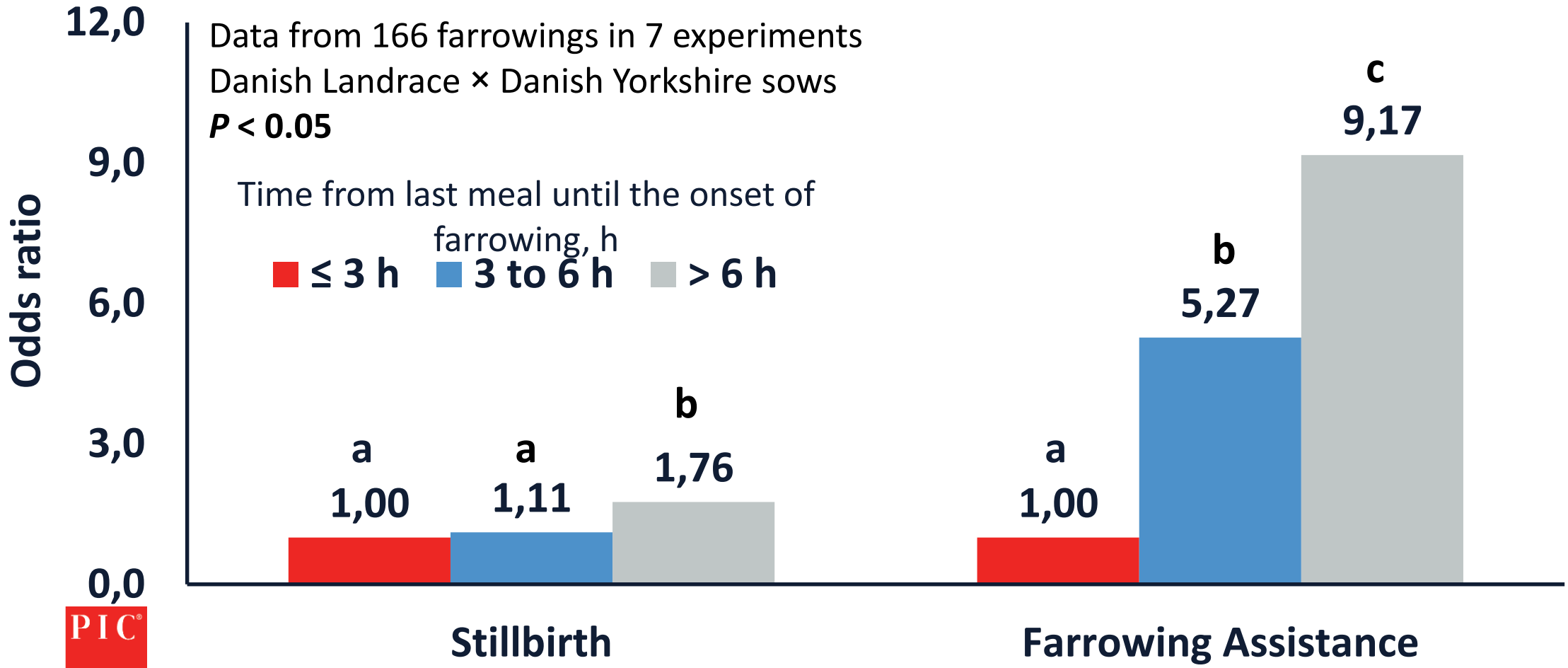
Probability of stillbirth and farrowing assistance is increased if sows have access to feed longer than 6 h before farrowing



Feyera et al., 2018, J. Anim. Sci.

Nutrition and feeding during peripartum

Amount of feed prior to farrowing

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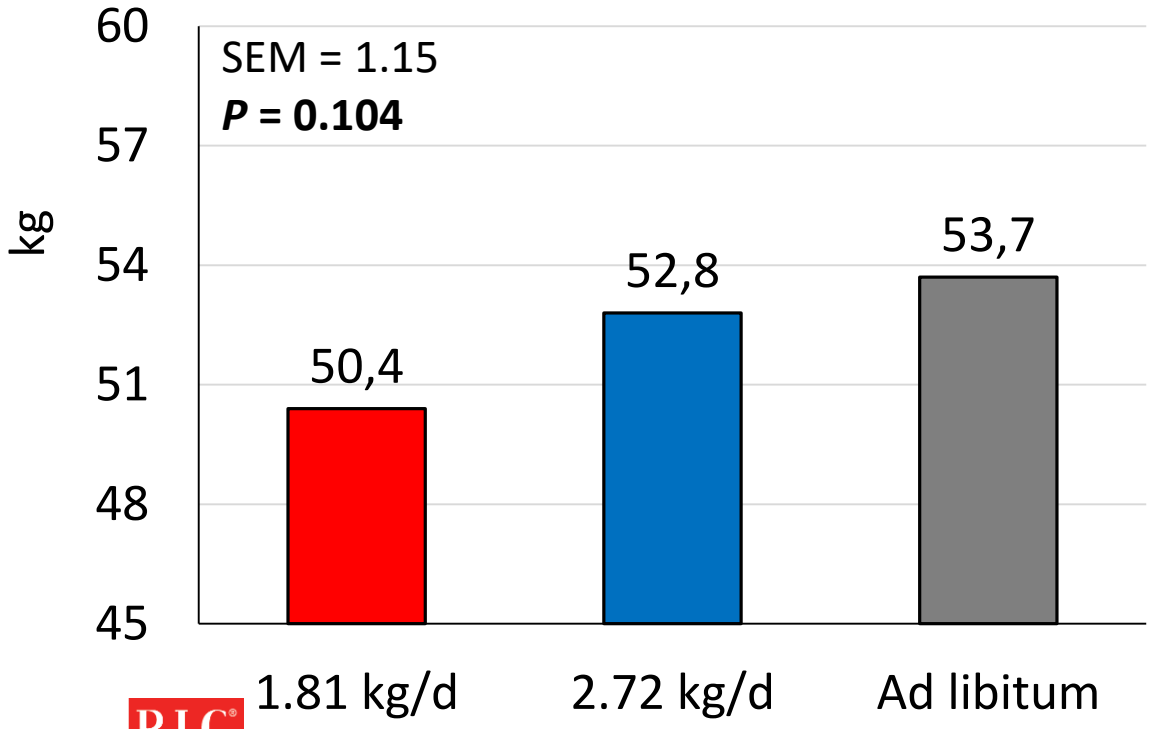
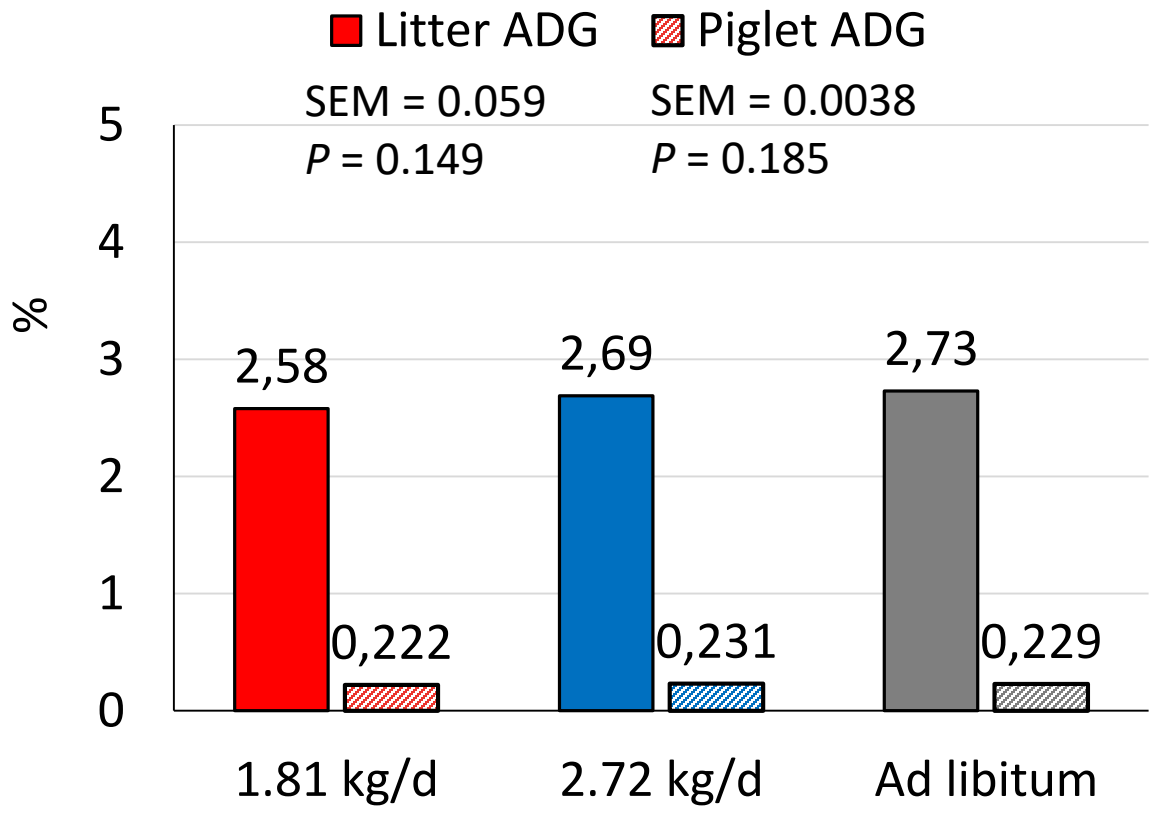
Effects of increasing the feeding amount in the pre-farrow period

Treatment started on d 112 of gestation and sows were fed twice a day

Litter weight gain, cross-foster-to-wean



Litter and piglet average daily gain



Silva et al., 2020, yet-to-be published

n = 278 PIC Camborough sows

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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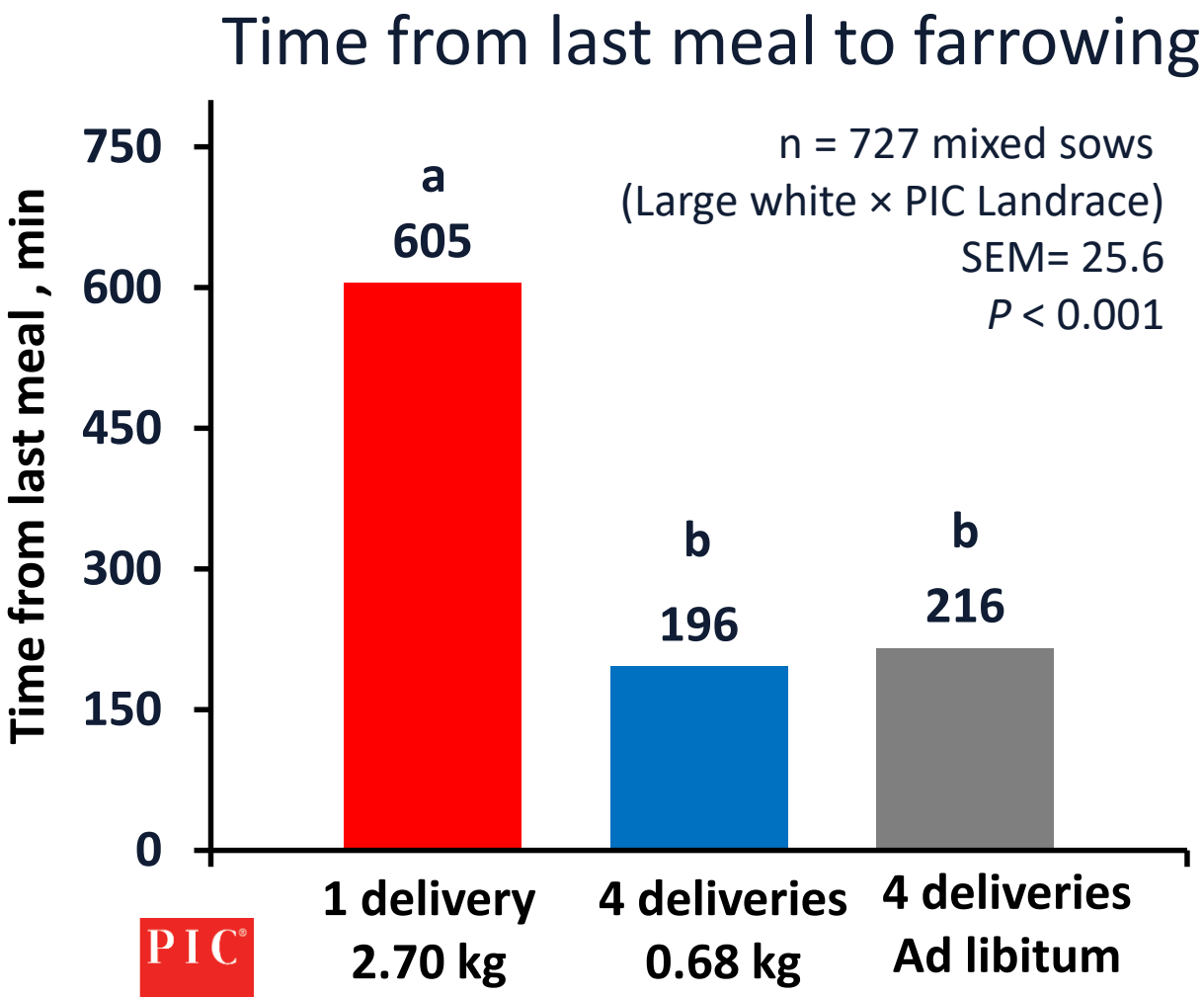
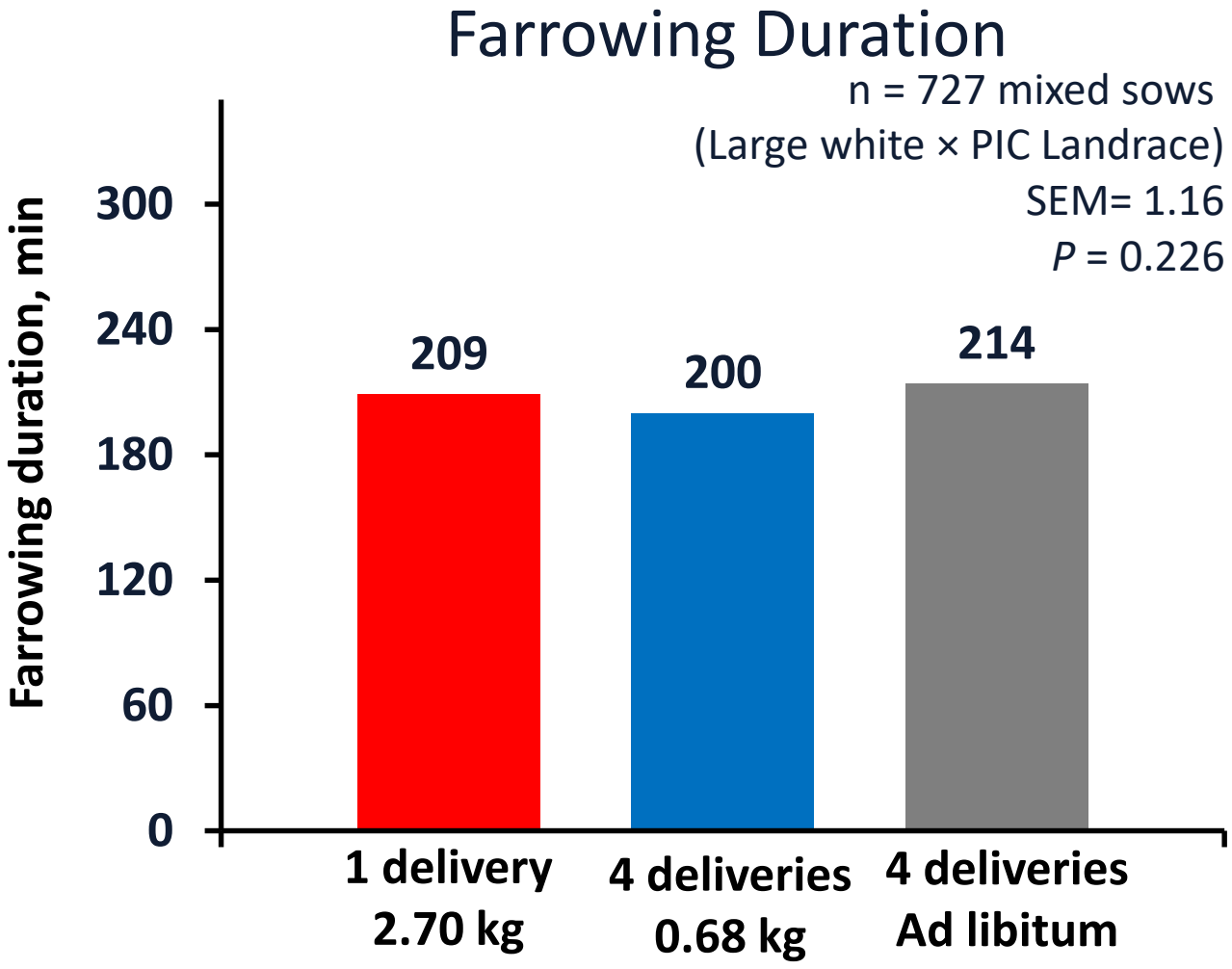
Effects of timing and amount of feed offered pre-farrow





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Gourley et al., 2020

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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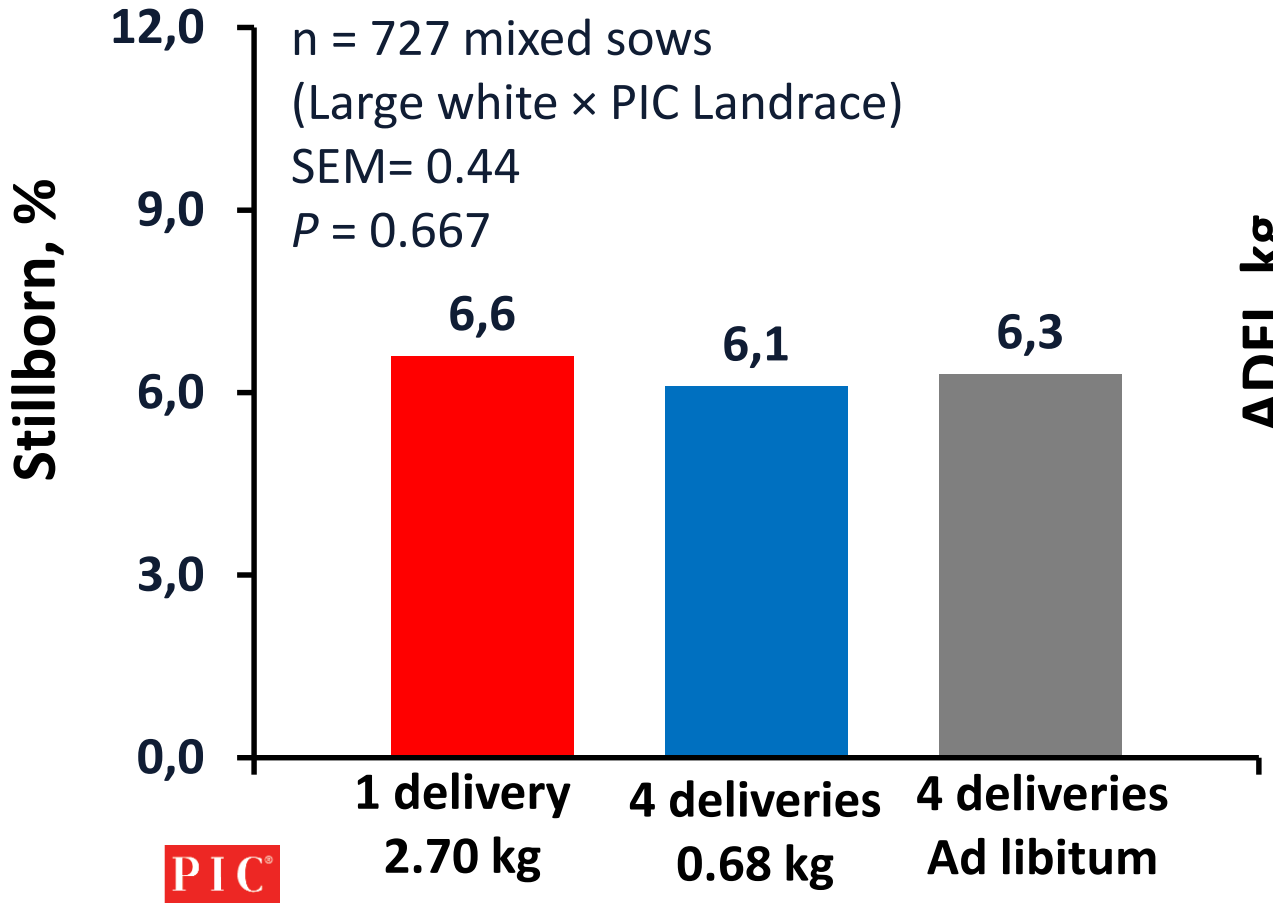
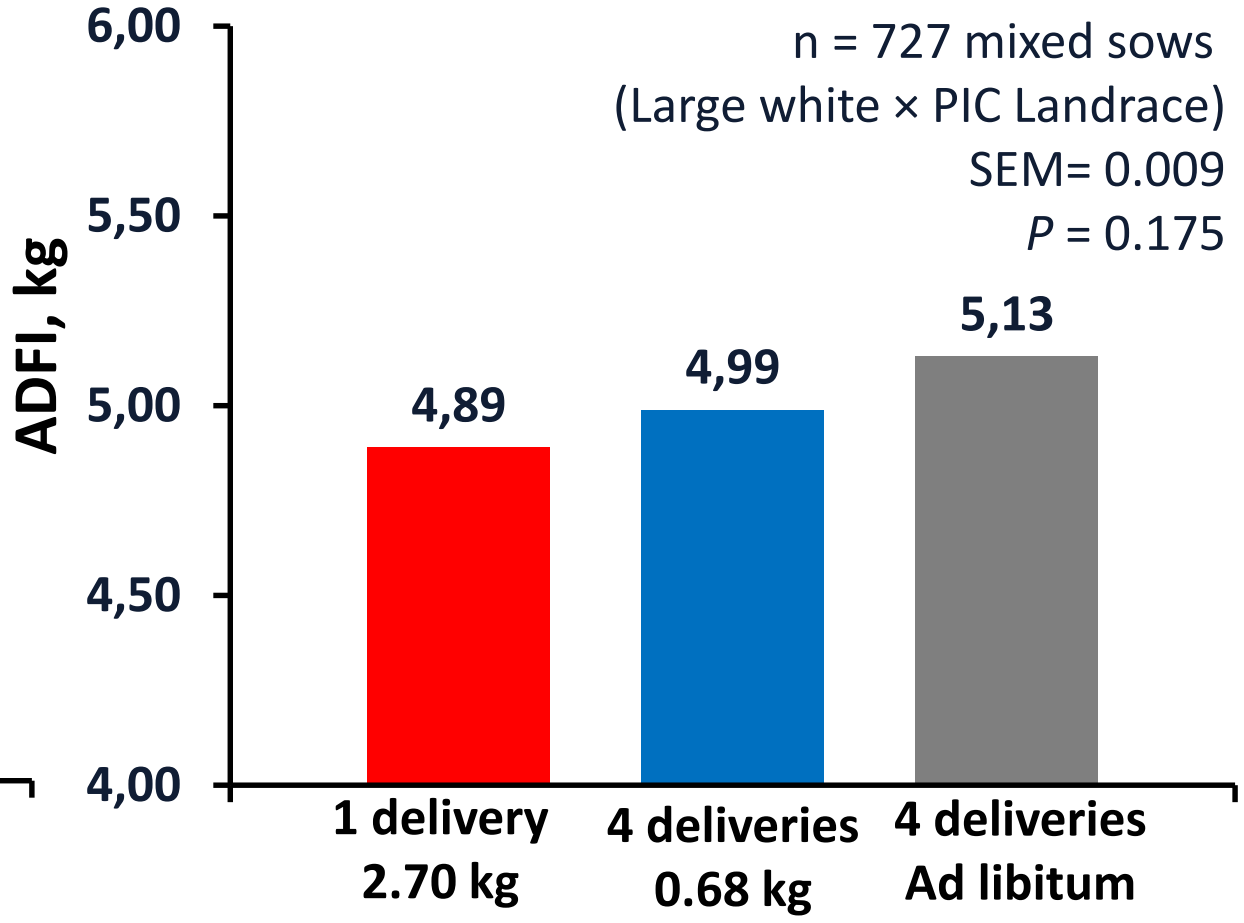
Effects of timing and amount of feed offered pre-farrow

Stillborn rate



Sow lactation ADFI



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Gourley et al., 2020

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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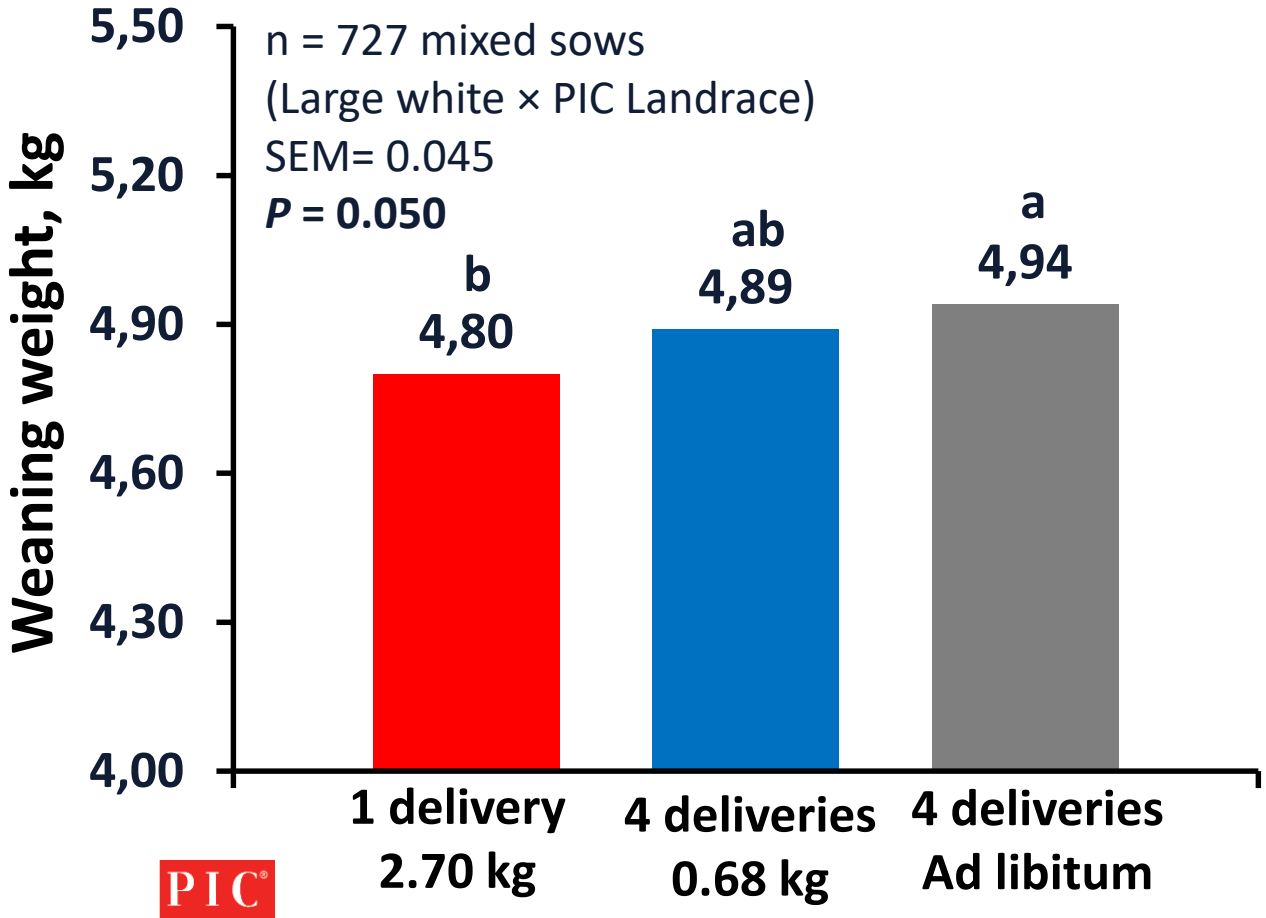
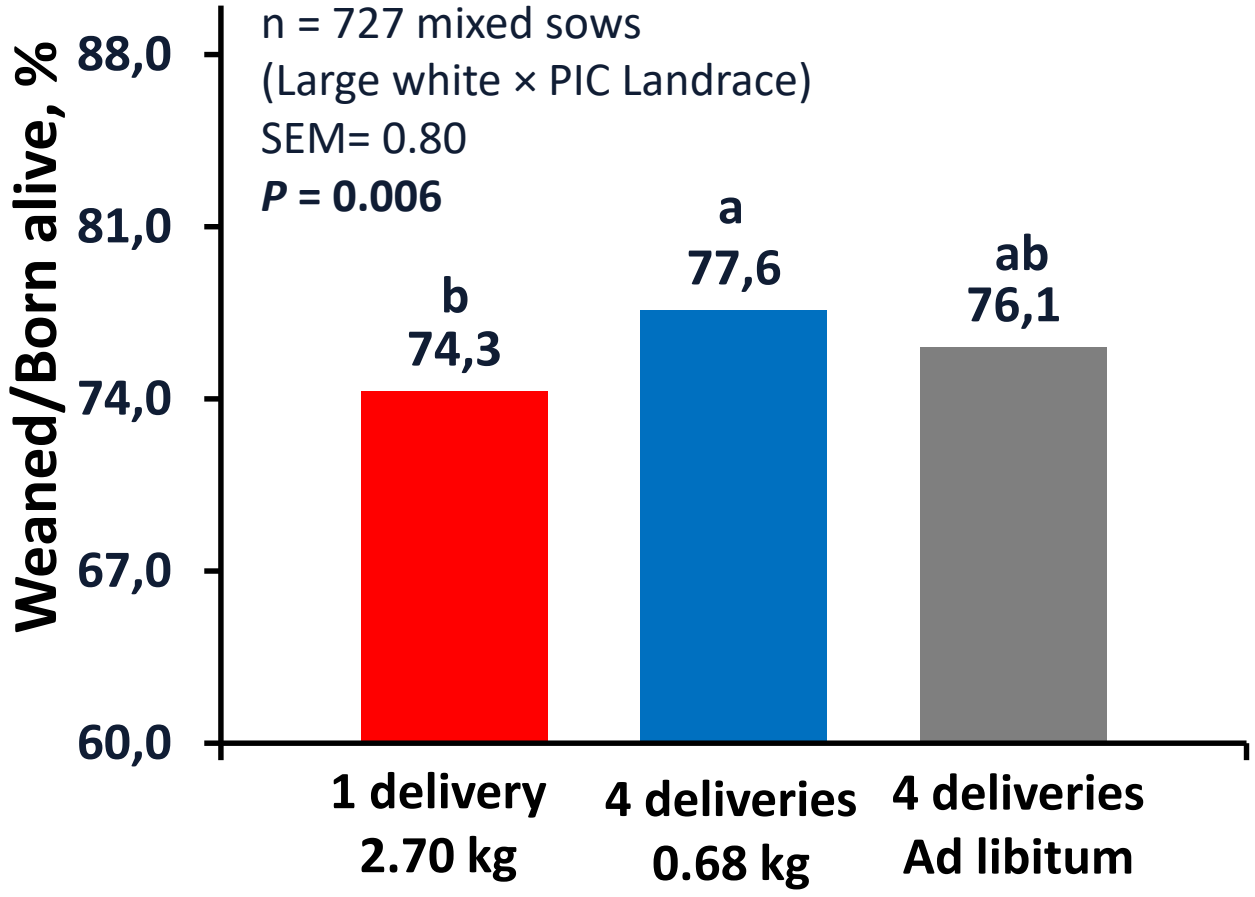
Effects of timing and amount of feed offered pre-farrow

Piglet weaning weight



Piglet survival to weaning



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Gourley et al., 2020

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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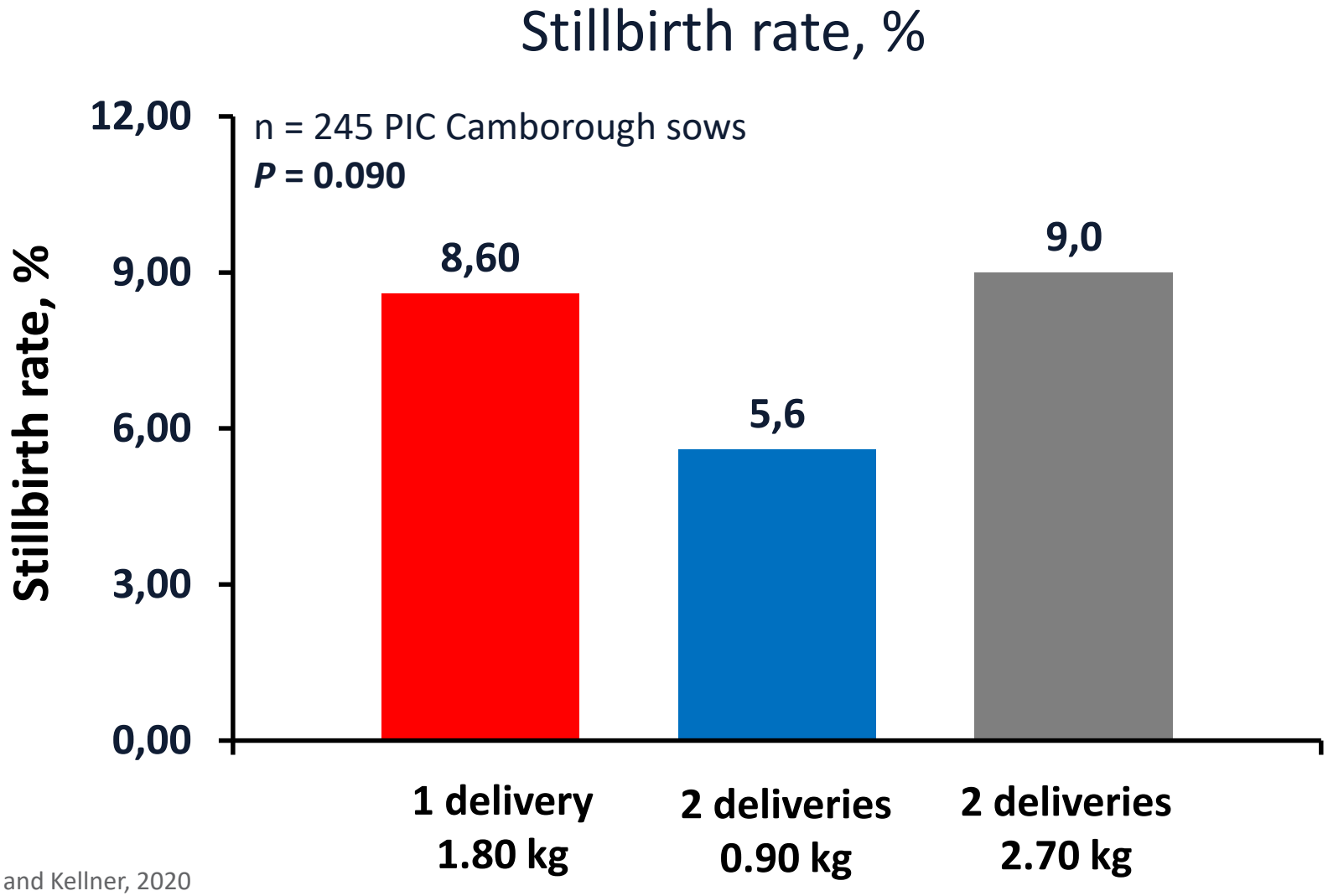
Effects of amount and frequency of feeding offered pre-farrow



Miller and Kellner, 2020

Nutrition and feeding during peripartum

Timing of feed prior to farrowing

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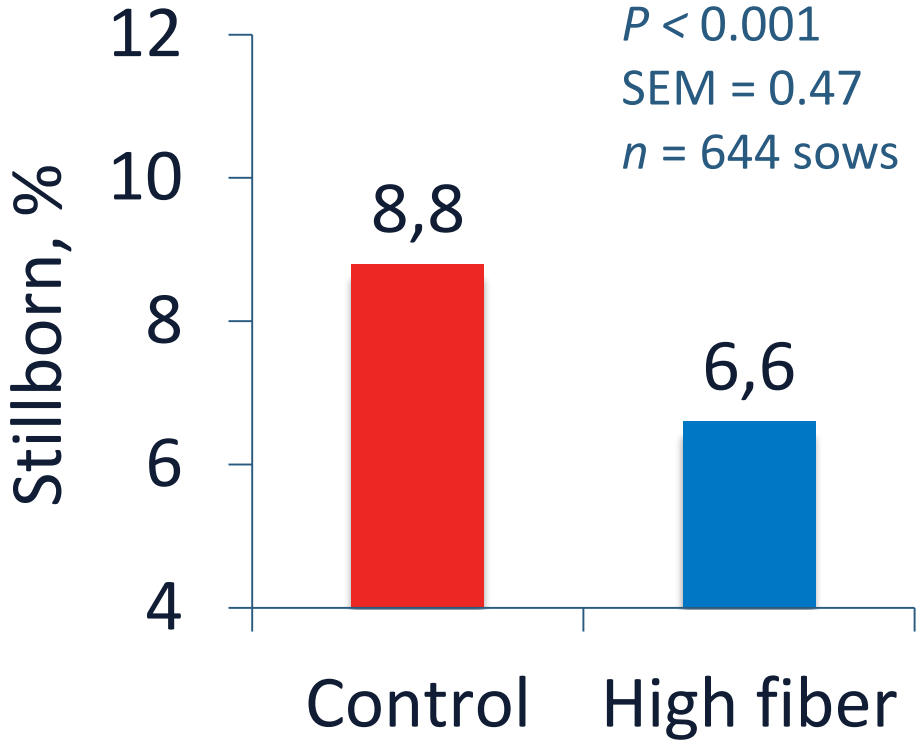
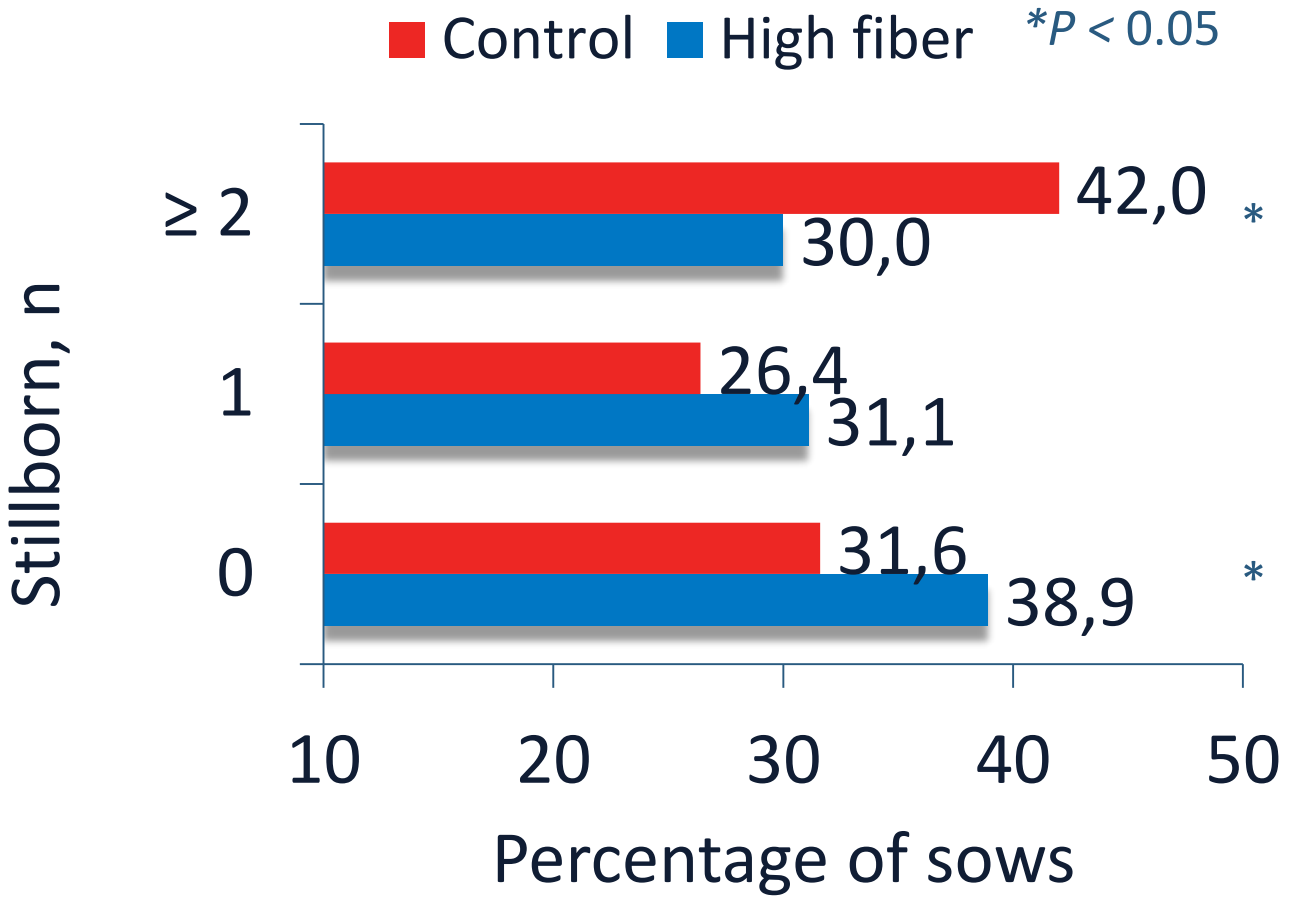
Fiber level on peripartum reduced stillborn rate





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Feyera et al., 2017. J Anim Sci

Nutrition and feeding during peripartum

Summary

Continue feeding the same feed amount as sows were previously fed in gestation.

- Most farms feed lactation diet prior to farrowing during this period.

Increase the frequency of feeding after sows are loaded in the farrowing crates:

- Some evidence suggests reduced stillbirth rate when farrowing assistance is limited.
  - Example: giving the sow half her feed first thing in the morning and half her feed before you leave.
- One study has shown improved pre-weaning livability.

If self-feeders are used, special attention is needed to identify non-eaters, mainly gilts.

Fiber may reduce stillborns but more research is needed.

Nutrition and feeding during lactation

Nutrition and feeding during lactation

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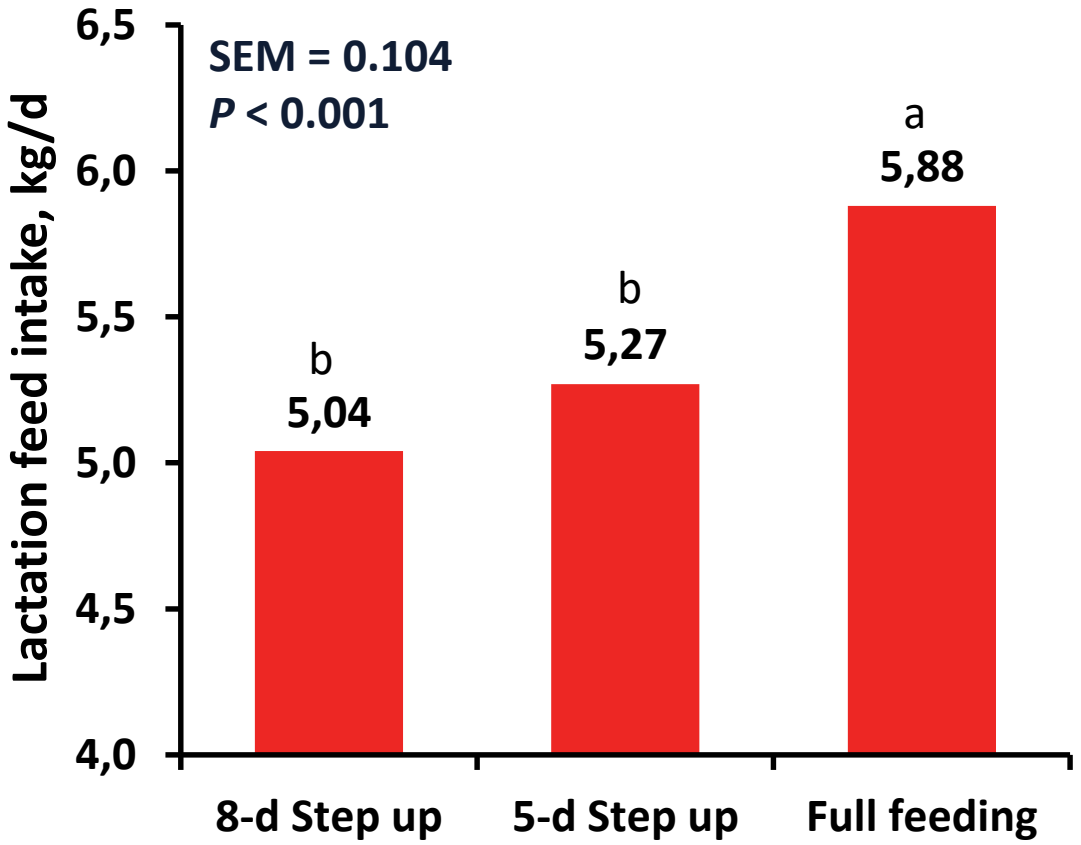
Lactation feeding regime influenced lactation feed intake of PIC P1 sows

Days of lactation	Lactation feeding regiome, kg/d		
	8-d Step up	5-d Step up	Full feeding
0	1.8	1.8	Full
1	1.8	2.7	Full
2	2.7	3.6	Full
3	2.7	4.6	Full
4	3.6	5.5	Full
5	3.6	Full	Full
6	4.6	Full	Full
7	4.6	Full	Full
8 to 19	Full	Full	Full



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PIC/United Animal Health, internal research

Nutrition and feeding during lactation

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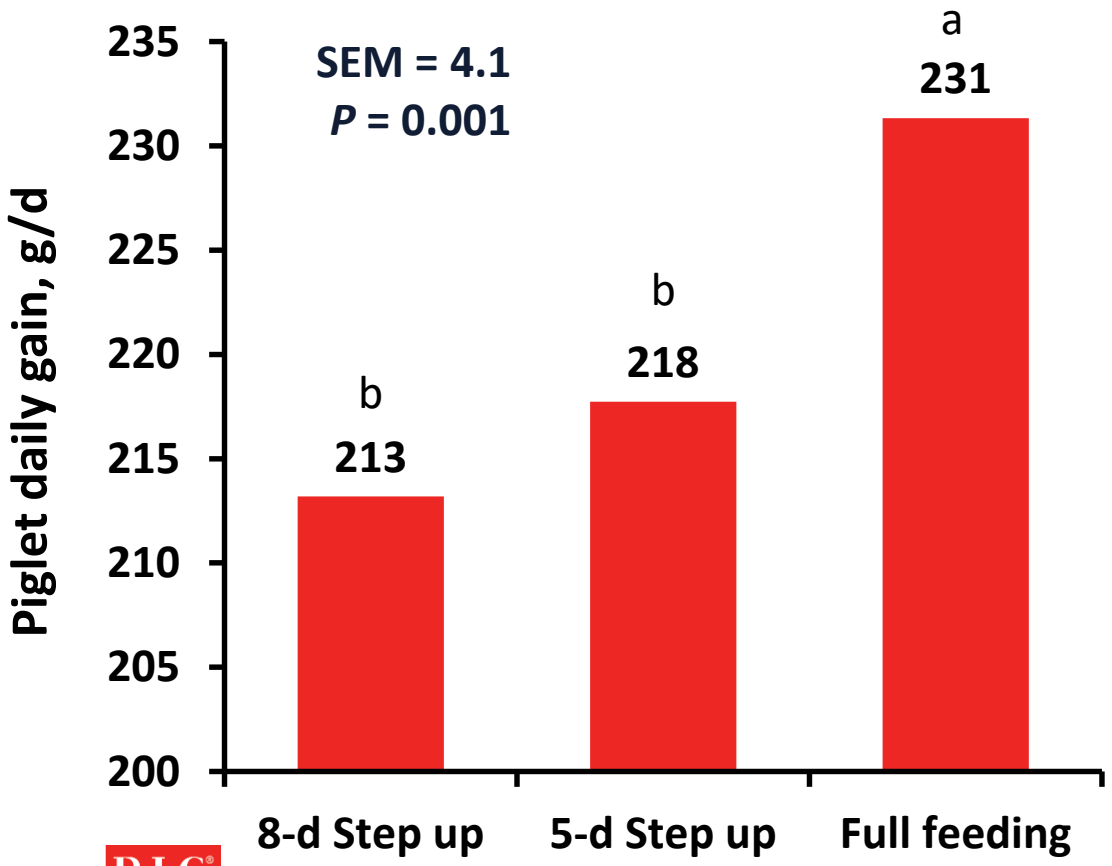
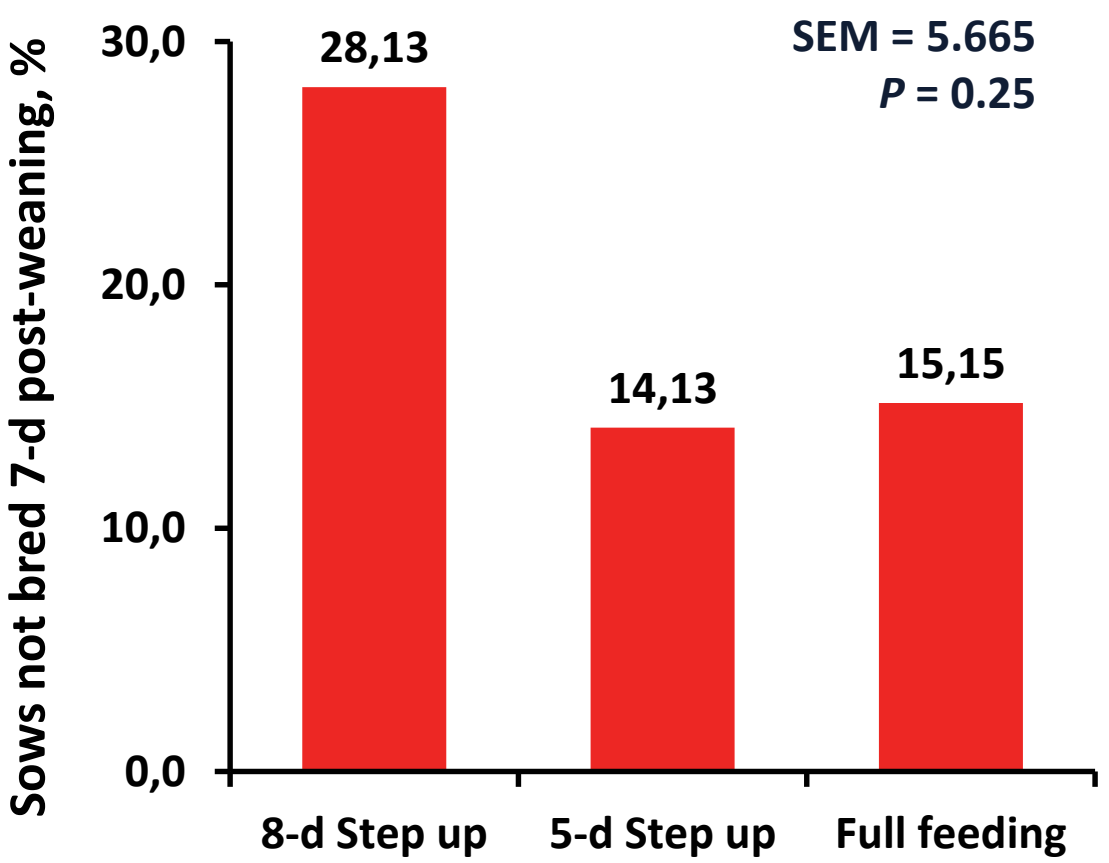
Lactation feeding regime influenced P1 sows and piglet performance





PIC/United Animal Health, internal research

Nutrition during lactation

Summary

- Follow the nutritional recommendations
  - Gilts and sows require ~63 g of SID Lysine/d;
  - The optimal SID Thr:Lys is no less than 64%;
  - The optimal SID Val:Lys is no less than 64%

Feeding during lactation

Summary

- Provide ad libitum feed access during the entire lactation period
    - Gilts are expected to have 15 to 20% less feed intake compared to sows
- Manage the environment to maximize feed intake
- Know the average lactation feed intake
- Ensure adequate water access
    - Many times gilts have difficulty adjusting to lactation drinkers
- Adequate amino acids adjusted for feed intake and litter size
- Limit fiber inclusion

Camborough, if well managed from gilt development to gestation, will wean well, have high productivity, and maximize lifetime productivity

Nutrition and feeding during wean-to-estrus interval

Nutrition and feeding during wean-to-estrus interval

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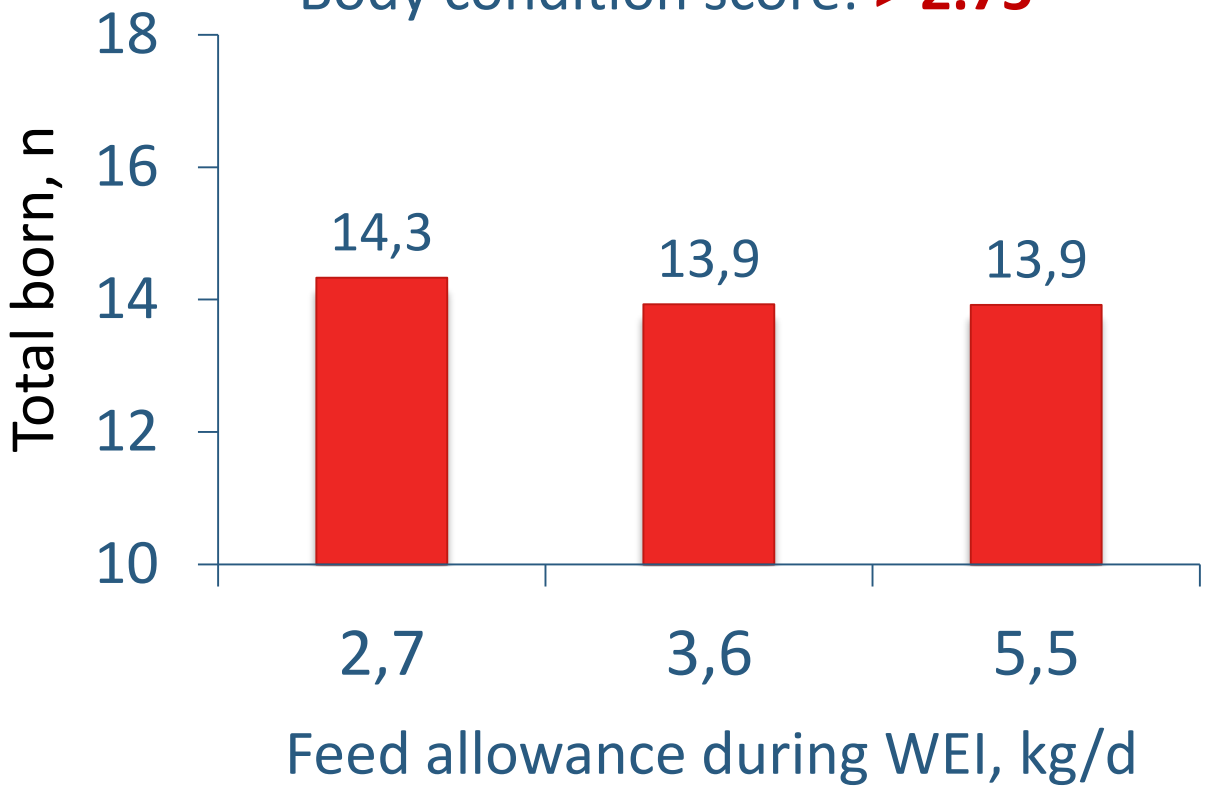
Goal of nutrition in WEI: Subsequent reproduction

Sows in good body condition do not benefit from high feed allowance during WEI

Body condition score: **> 2.75**



P > 0.10
SEM = NR
n = 638 sows
(PIC 1050/C22/C29)

Graham et al., 2015

Nutrition and feeding during wean-to-estrus interval

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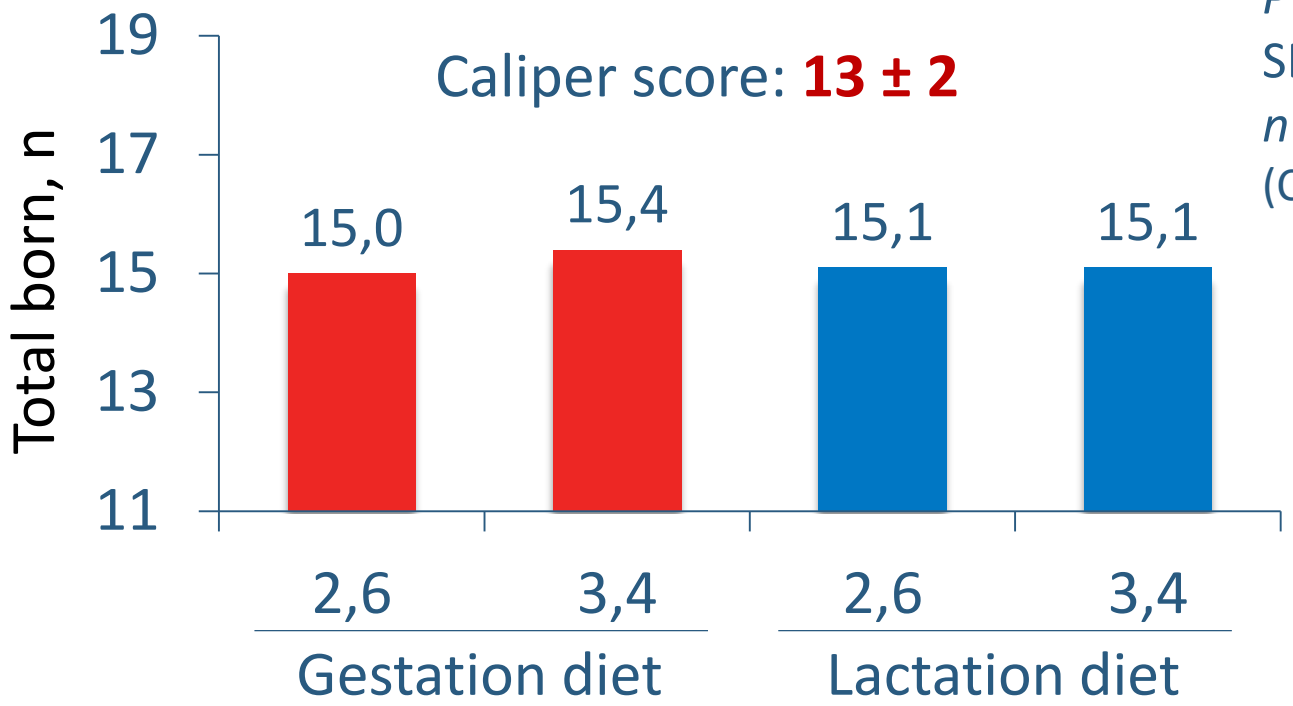
Goal of nutrition in WEI: Subsequent reproduction

Sows in good body condition do not benefit from feeding lactation diet during WEI



P > 0.10
SEM = 0.36
n = 542 sows
(Camborough, PIC®)

Almeida et al., 2018

Nutrition and feeding during wean-to-estrus interval

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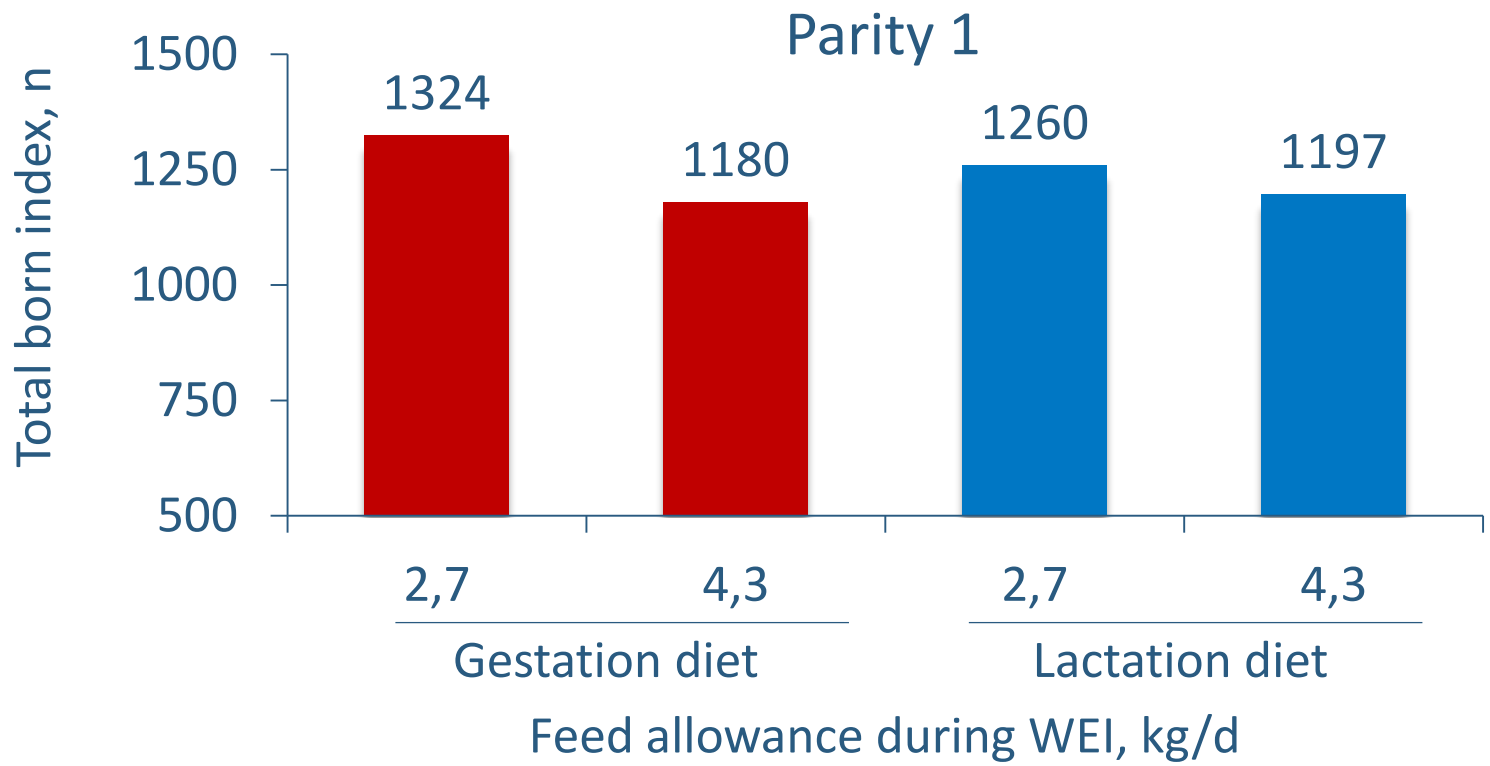
Goal of nutrition in WEI: Subsequent reproduction

Impact of feeding type and level in the wean to service interval (WSI), total born and farrowing rate for sows in different parities



$P > 0.10$
n = 1060 sows
(Camborough, PIC®)

Born alive index =
FR,% x BA x 100

Represent born alive from 100 sows bred

Gianluppi et al., 2019

Nutrition and feeding during wean-to-estrus interval

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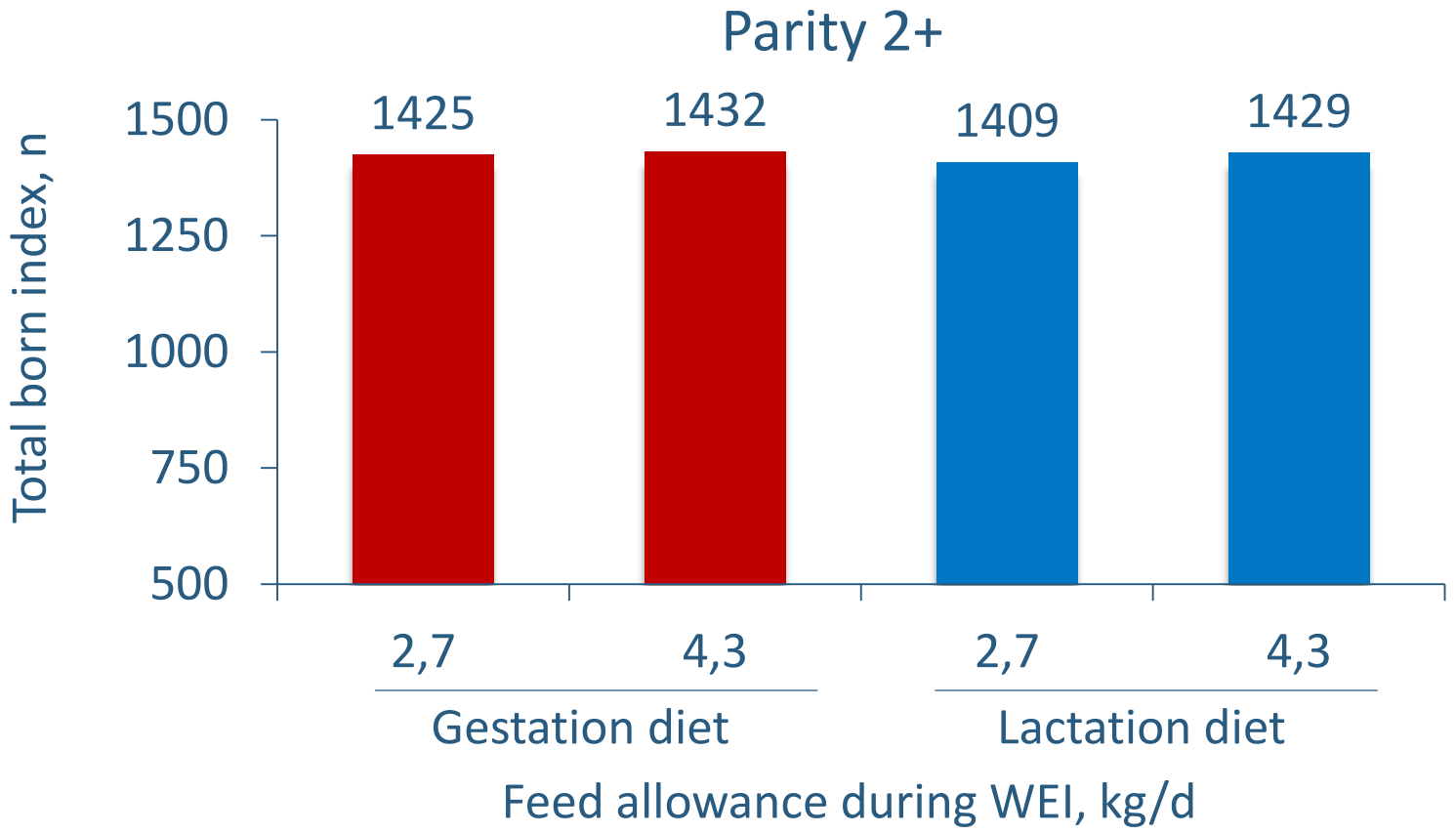
Goal of nutrition in WEI: Subsequent reproduction

Impact of feeding type and level in the wean to service interval (WSI), total born and farrowing rate for sows in different parities



P > 0.10
n = 1060 sows
(Camborough, PIC®)

Born alive index = FR,% x BA x 100

Represent born alive from 100 sows bred

Gianluppi et al., 2019

Nutrition and feeding during wean-to-estrus interval

- Can not fix prior insults:
  - Short lactation length
  - Excessive lactation weight loss (protein loss)
- Energy/feed requirement is not extreme
- Reproduction can shut off and is difficult to turn back on
  - Do not skip a meal (think about the practical implications)!

Nutrition and feeding during wean-to-estrus interval

Summary

- Feeding 6 lb (2.7kg) per day gestation diet is adequate to maximize subsequent reproduction
- Provide feed ad libitum only for thin animals
- Group sows by body condition
- Ensure feed is fresh and minimize wastage

Body condition management

Body condition management

Project: to investigate the association between caliper measurements and reproductive performance

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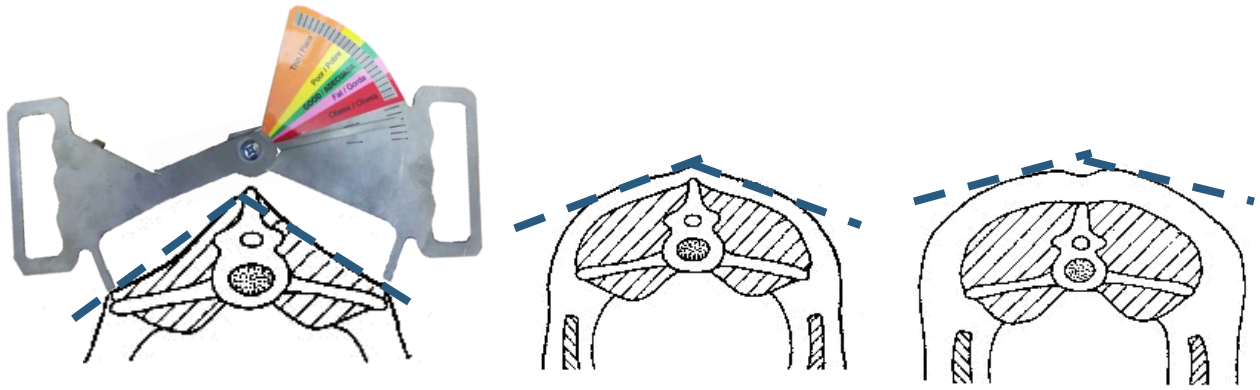
Thin	Fat	Ideal
 	 	 
“Perfect world”		
<5%	<5%	>90%
“Real world”		
None at farrowing	None at weaning	As much as possible

Feeding The Pregnant Sow: The Sow Caliper

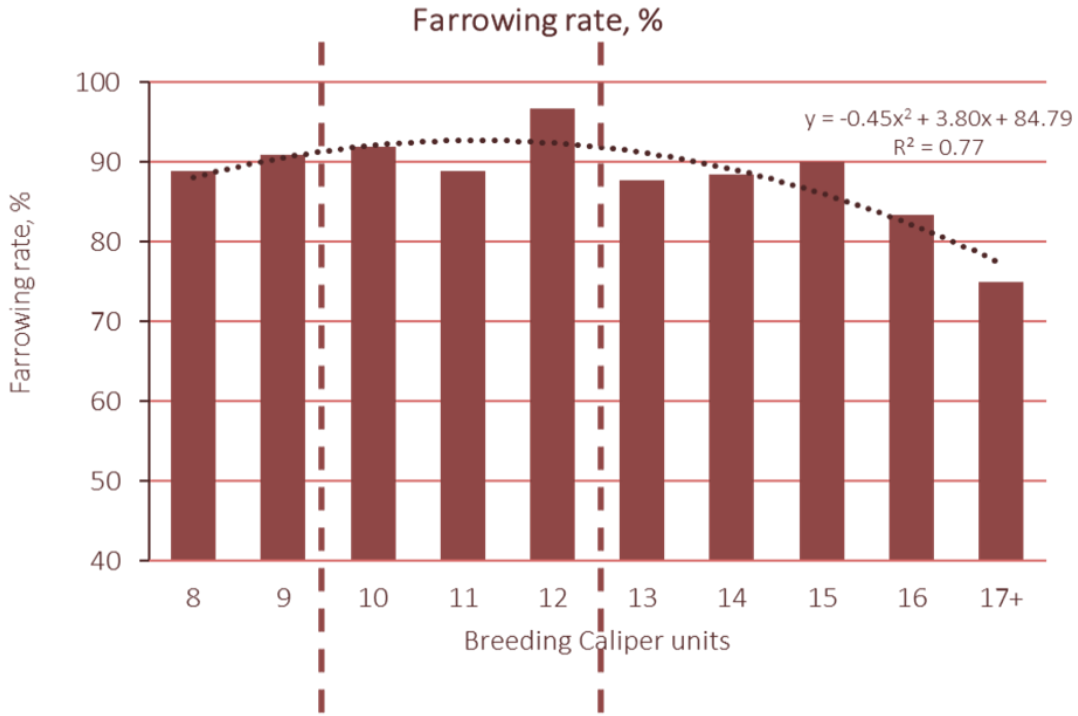
- Developed by Knauer and Baitinger (2015) – North Carolina State University
- It quantifies the angularity of a top-line of the sow
- Based on the findings by Edmonson et al. (1989) that proposed that as an animal's back looses fat and muscle it becomes more angular.
- **Replace the subjective Visual Scoring**

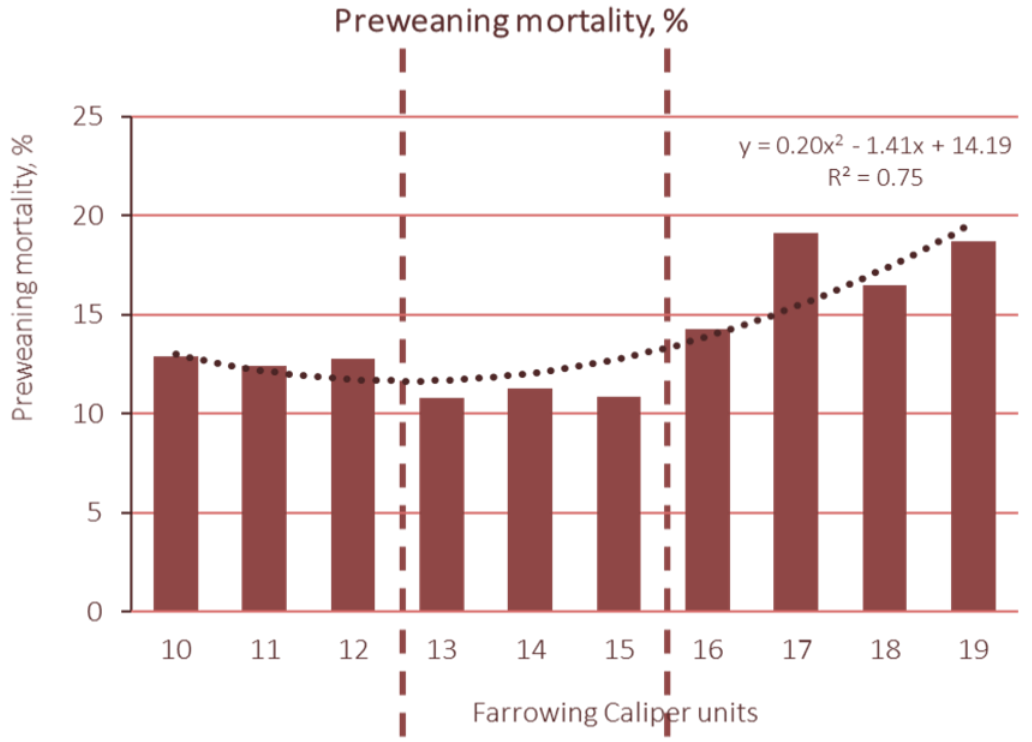


BCS 1 BCS 3 BCS 5

Body condition management

Project: Investigate association between caliper measurements and reproductive performance





PIC

Rosero et al., 2019, Allen D. Leman Swine Conference

Body condition management

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Evaluation of the NRC (2012) model in estimating standard maintenance metabolizable energy requirement of PIC sows during mid-gestation

- Caliper score change per day = 0.1350 × (Daily ME intake, % of ME_m) – 0.1332
- With the assumptions
  - ME of gestation diet is 3.05 Mcal/kg
  - Average sow herd weight is 220 kg

% of MEm	ME allowance, Mcal/d	Feed allowance, kg/d	Caliper score change during gestation (d 7-112)
80%	4.57	1.50	-2.67
90%	5.14	1.69	-1.24
100%	5.71	1.87	0.19
110%	6.28	2.06	1.62

Feeding level merely met maintenance ME requirement would not impair sow body condition.

PIC

Knauer et al., 2020

Body condition management

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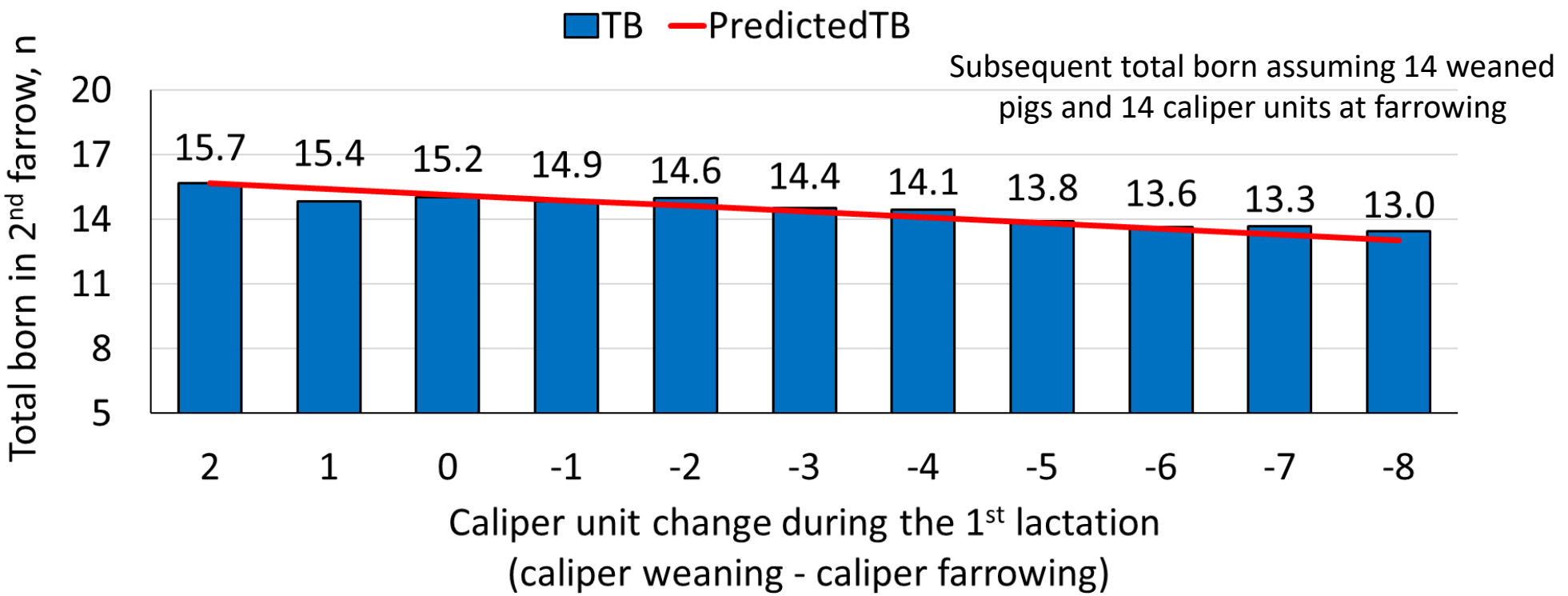
Project: Investigate association between caliper measurements and reproductive performance

For every unit of caliper lost during 1st lactation, subsequent TB was reduced by 0.27



TB, n = 14.51888 + (-0.26649 × CaliperChange1stLactation) + (0.12564 × Caliper1stFarrow) + (-0.0929 × WeanedPigs1stLactation)
Data from 4500 sows measured from parity 1 to 6
In collaboration with Technical Services of UVESA Spain

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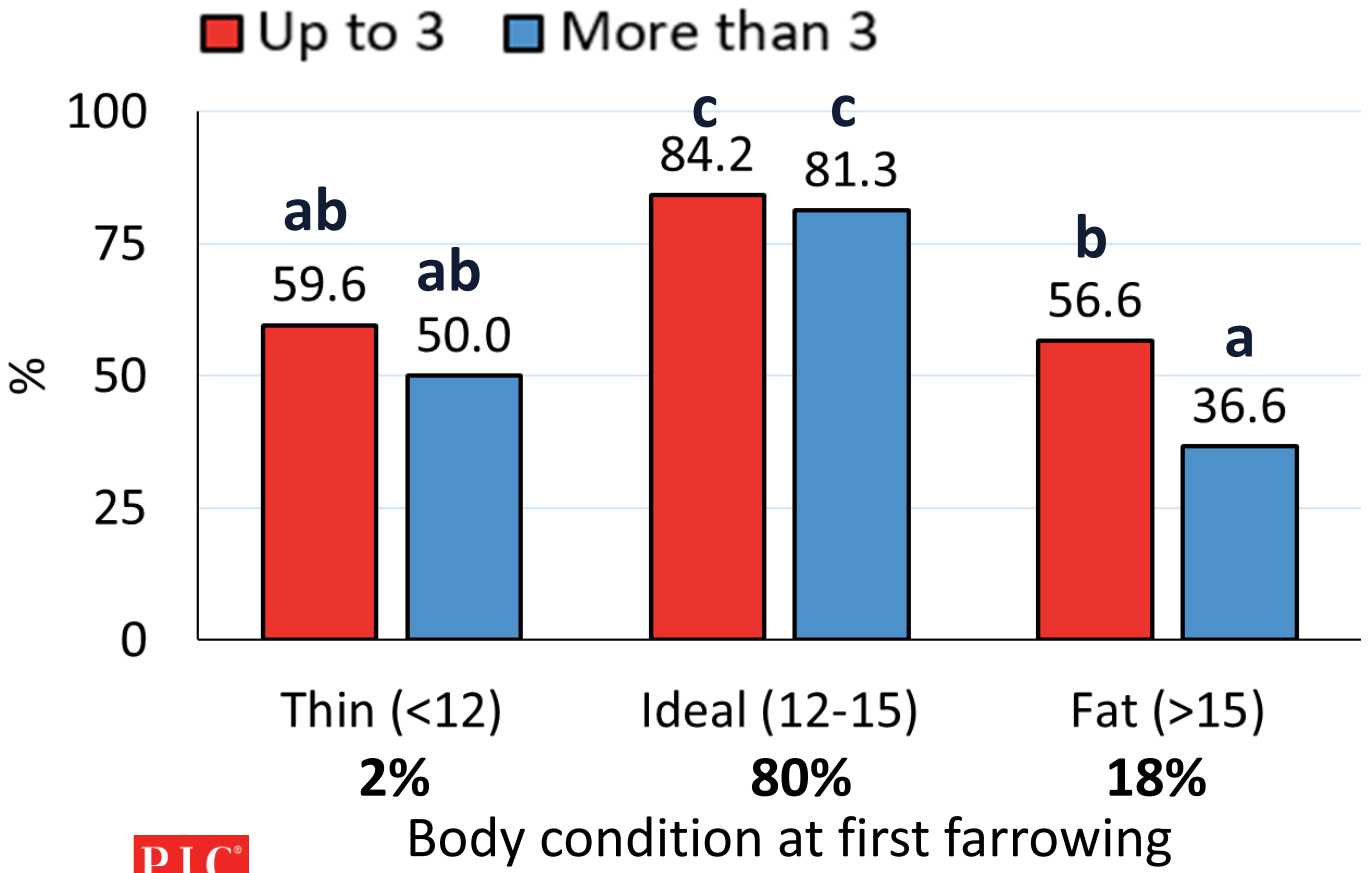
Body condition management

Project: Investigate association between caliper measurements and reproductive performance – retention up to 3rd parity

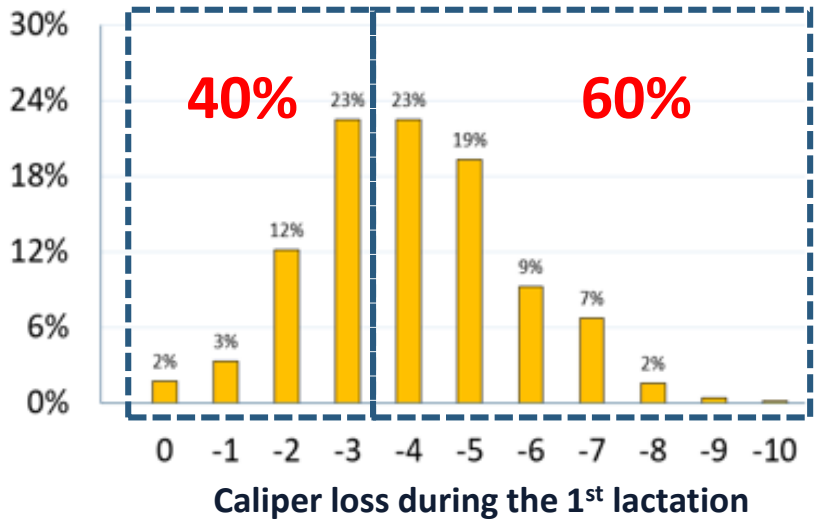
Caliper unit loss in first lactation



BCSFarrow × CaliperLoss, P = 0.063

BCSFarrow, P < 0.001

CaliperLoss, P < 0.001



Data from 4500 sows measured from parity 1 to 6
In collaboration with Technical Services of UVESA Spain

Body condition management

Summary

- Body condition of sows is predicting the subsequent reproductive performance
- Minimize thin sows at farrowing, fat sows at weaning, and maximize ideal sows at farrowing as much as possible
- Body condition of sows should be used as a guidelines for gestation feeding

Camborough efficiency -
Dynamic sow feeding tool
“under construction”

Camborough efficiency – Dynamic sow feeding tool

Summary

- Available with the PIC 2020 Nutrition Manual
- Accessible by computer or smartphone
- First part will be data input: Simple questions and user friendly
- Second part will provide 3 outputs:
    - Feeding management recommendations
    - Diet nutrient specifications
    - Economic and performance opportunity estimates
- Targeted for production managers, technical service advisors, and nutritionists

Dynamic feeding program for PIC Camborough

Click here to Start a Tour

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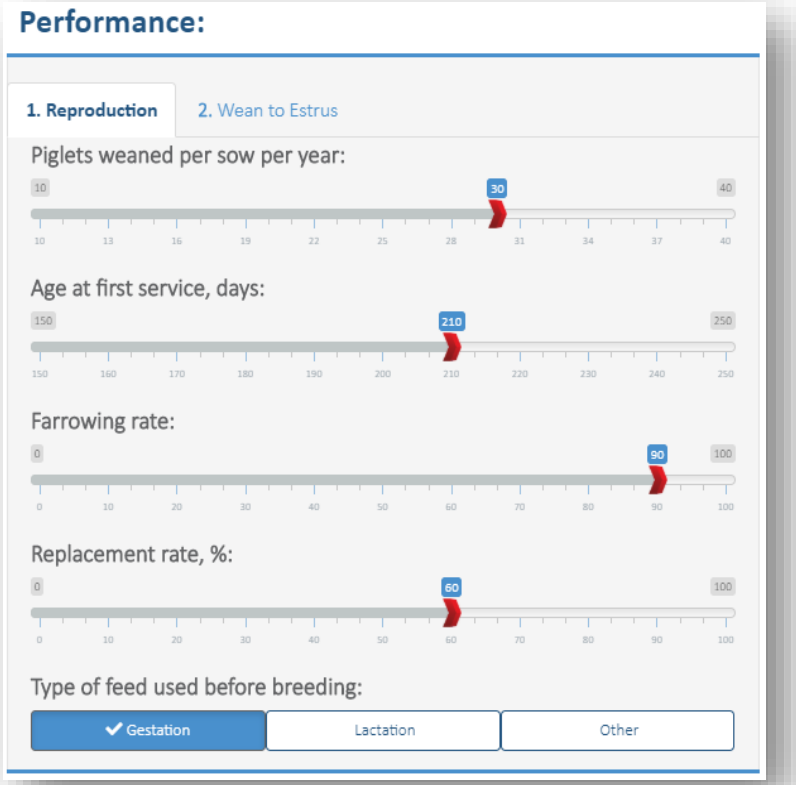
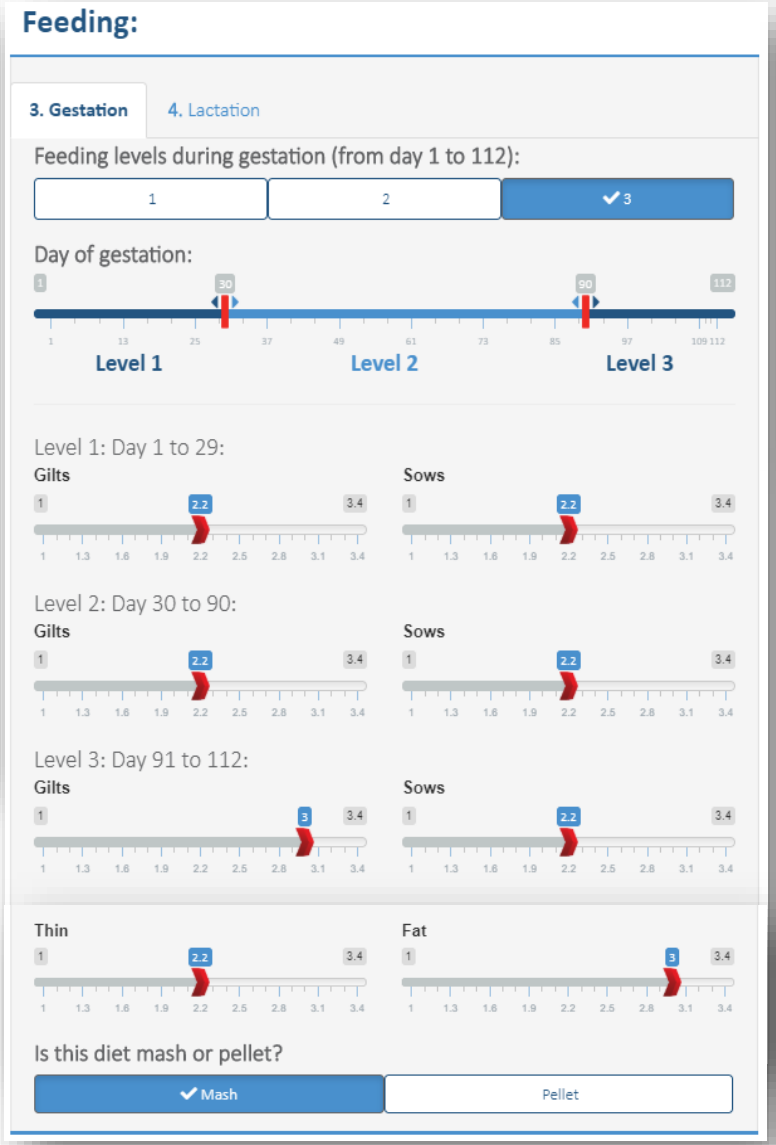
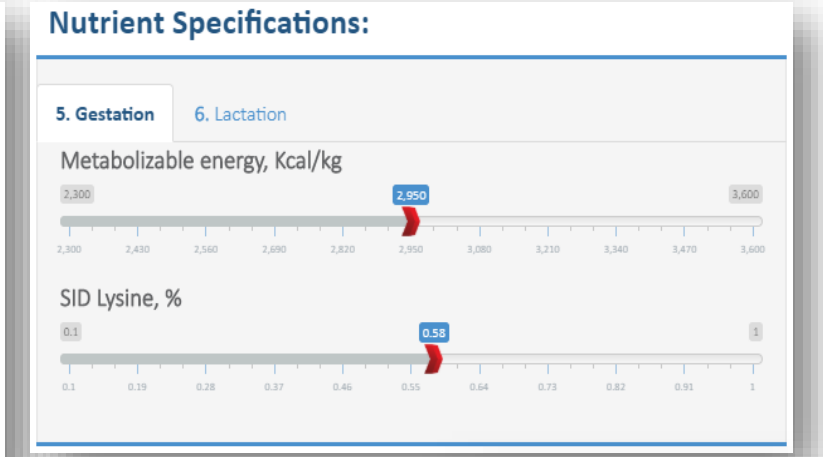
Performance:



Feeding:



Nutrient Specifications:



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Data Inputs

Dynamic feeding program for PIC Camborough

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Feeding Program | Nutrient Specifications | **Economics & Performance Opportunities**

Total feed per sow per year	PIC		Customer A	
Gestation (kg/sow)	59%	642	62%	778
Total Lactation (kg/sow)	41%	446	38%	485
Amount feed per sow per year*	1088		1262	

Customer A uses +175 kg/sow/year compared to PIC recommendations, there is an opportunity to Customer A in follow PIC Recomendations: **$30.8 /sow/year**

Customer A can improve their piglets weaned per sow per year using the PIC recommendations: **2.2**

* Including returning sows and replacement gilts from 150 days of age up to 1st service.

** Assuming the caliper score at breeding is 11.5 units.

*** Assuming the caliper score loss during lactation is 2 units.

**** Assuming 100 bred sows and 12 born alive piglets.

Outputs

Thank you!