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# Effect of body development from first insemination to first weaning on performance and culling until the third farrowing of Landrace x Large White swine females

[*Efeito do desenvolvimento corporal desde a primeira inseminação até o primeiro desmame no desempenho e descarte até o terceiro parto de fêmeas suínas Landrace x Large White*]

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## ABSTRACT

The aim of this study was to verify the association of sow body weight development until the 1st weaning with reproductive performance, piglet production and culling rate until the 3rd farrowing in 196 primiparous sows using logistic regression models. Each 10kg increase in weight gain in the 1st pregnancy (OR= 0.63), weight at 1st farrowing (OR= 0.70), weight at the 1st weaning (OR= 0.73) or weight gain from the 1st artificial insemination (AI) to the 1st weaning (OR= 0.67) decreased the percentage of primiparous sows with long weaning-to-oestrus interval - WOI (>5 days). An increasing lactation length and an increase in the number of weaned piglets were responsible for respectively decreasing (OR= 0.77-0.80, per day of lactation) and increasing (OR= 1.52-1.59, per piglet weaned) the percentage of sows with long WOI. Sows with <159.5kg at weaning had higher odds of non-farrowing (NFR) compared to sows with >170kg (OR= 4.73). Sows with <17.5kg of gain from the 1st AI to the 1st weaning had higher odds (OR= 4.88) of NFR than sows gaining >30kg. Each additional lactation day decreased the NFR (OR= 0.74). Females weighing <139kg at the 1st AI had higher percentages of small numbers of total born in the second parity (STB2, OR= 2.00) and over three parities (OR= 3.28) compared to those weighing ≥139kg. Sows with weight gain <25kg at the 1st pregnancy had higher odds of STB2 (OR= 3.01) compared to sows gaining >35kg. Each 10kg of increase in weight at the 1st weaning or in weight gain from the 1st AI to the 1st weaning decreased the total culling rate (OR= 0.71 and 0.73, respectively) and culling for reproductive reasons (OR= 0.57 and 0.61, respectively). The culling rate until the 3rd farrowing was also increased in sows with a smaller first litter size. The results show that not only reaching a minimum weight at the 1st AI but also having an adequate body weight gain until the 1st weaning is important for the reproductive performance, productivity and retention of Landrace x Large White Danbred sows in the herd.

Keywords*:* Sows, body weight, litter size, reproductive performance, retention rate

## RESUMO

*O objetivo do estudo foi verificar, com modelos de regressão logística, a associação entre características de desenvolvimento corporal até o 1º desmame com o desempenho reprodutivo, produção de leitões e taxa de remoção até o 3º parto de 196 fêmeas suínas primíparas. Houve redução nas chances de as fêmeas terem intervalo desmame-estro (IDE) longo (>5 dias) a cada 10kg de aumento no ganho de peso na 1ª gestação – GPG1 (razão de chance – RC = 0,63), peso no 1º parto – PP1 (RC= 0,70), peso no 1º desmame – PD1 (RC= 0,73) ou ganho de peso da 1ª inseminação artificial (IA) ao 1º desmame – GPIAD1 (RC= 0,67). O percentual de porcas com IDE longo reduziu com o aumento da duração da lactação (RC= 0,77-0,80, por dia de lactação) e aumentou com o aumento no número de leitões desmamados (RC= 1,52-1,59, por leitão desmamado). Porcas com <159,5kg ao desmame tiveram maior chance de não parir (NP) em comparação a porcas com >170 kg (RC= 4,73). Porcas com <17,5kg de GPIAD1 tiveram maior chance (RC= 4,88) de NP do que porcas ganhando >30kg. O aumento da duração da lactação reduziu a chance de NP (RC= 0,74, para cada dia). Fêmeas com <139kg na 1ª IA tiveram maior chance de terem leitegada pequena no segundo parto - LPSP (RC= 2,00) ou ao longo de 3 partos (RC= 3,28), em comparação às fêmeas com ≥139kg. Fêmeas com*

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*GPG1 <25kg tiveram maior chance de LPSP (RC= 3,01) do que fêmeas com >35kg. Houve diminuição na taxa geral de descarte (RC= 0,71 e 0,73, respectivamente) e descarte por causas reprodutivas (RC= 0,57 e 0,61, respectivamente) para cada 10kg de aumento no PD1 e GPIAD1. A taxa de descarte até o 3º parto também aumentou nas porcas com menor leitegada no primeiro parto. Os resultados mostram que, além de atingir um peso mínimo na 1ª IA, o ganho de peso entre a 1ª IA e o primeiro desmame é importante para o desempenho reprodutivo, produtividade e retenção de fêmeas Danbred Landrace x Large White no rebanho.*

*Palavras-chave: porcas, peso corporal, tamanho da leitegada, desempenho reprodutivo, taxa de retenção*

## INTRODUCTION

Sow lifetime productivity is important to herd profitability. However, the premature culling of gilts and young sows results in more sows producing only 30 to 40 piglets per lifetime against the potential for 60 or more (Lucia *et al*., 2000; Engblom *et al*., 2007).

The high productivity of herds is influenced by a correct parity distribution, which starts with the management of replacement gilt, and female development up to the first pregnancy and lactation (Anil *et al*., 2006; Amaral Filha *et al*., 2010; Hoving *et al*., 2010; Schenkel *et al*., 2010). The age of first oestrus, body weight and average daily gain of gilts influence their subsequent reproductive performance (Roongsitthichai *et al*., 2013). The importance of a target weight of gilts at the 1st mating and the 1st farrowing has been reported by several authors (Clowes *et al*., 2003; Young *et al*., 2004; Kummer *et al*., 2006; Roongsitthichai *et al*., 2013).

The third or greater oestrus is recommended for the insemination of Landrace x Large White (Danbred) gilts, provided that they are older than 230d and weigh at least 138kg (Danbred, 2012). The third oestrus was also suggested to be the optimal to mate gilts, as it resulted in more piglets produced throughout their lifetime (Cottney *et al*., 2012). Although it has been observed that under commercial conditions some gilts reach the recommended breeding weight at an earlier age, little information is available taking into account body development in the first cycle of production, the weight target at 1st farrowing and weaning, and their consequences on the lifetime performance and retention in the herd in Danbred females. The aim of this study was to verify the association of sow body weight development from first AI until first weaning with the reproductive performance, piglet production and culling rate until 3rd farrowing in Landrace x Large White Danbred sows.

## MATERIALS AND METHODS

The study was performed with 196 pregnant Landrace (75%) x Large White (25%) gilts (DB90® - Danbred line) in a gilt development unit (GDU) and in a sow farm, both located in the Midwest of Santa Catarina state, Brazil. Puberty stimulation started when gilts were 159.2 ± 0.41 days of age. Gilts were inseminated on the second or third post pubertal oestrus, when they achieved the target weight (≥135kg). They were mated on average at 210.3±11.6 days of age and 140.4±6.6kg. At approximately 37 days of pregnancy, 10 to 12 pregnant gilts per week were moved to a sow farm (1000 heads capacity). Their performance was followed until they reached the 3rd farrowing.

In GDU, gilts were penned in groups, with each one containing 12 gilts and a space allowance of 1.5m$^2$ per female. Gilts were fed 2.6kg/day until two weeks before insemination with a standard corn soybean gestation diet (3204kcal ME/kg, 14.2% CP and 0.64% lysine). Two weeks before AI, gilts were housed in crates (0.55 x 2.2m) where they were fed 3.5kg/day of the gestation diet. After AI gilts were automatically fed a gestation diet twice a day with the following schedule: between 0 and 5 days of gestation (day 0 = day of first AI) females received 1.8kg/day; from 6 to 85 days of gestation, 1.8, 2 or 2.2kg/day was provided according to the body condition score of the sows (Young *et al*., 2004), and from 86 to 110 days they received 2.6 to 2.8kg/day. After being transferred to farrowing crates, all sows were fed a corn soybean lactation diet (3412kcal ME/kg, 18.6% CP and 0.99% lysine) twice a day, with a gradual decrease in the amount provided, from 4 days before (2.8kg) up to the predicted farrowing date (1kg). After farrowing, sows were fed with increasing amounts of feed, from 1kg on the first day up to 4kg on third day. From the third day onwards they were fed *ad libitum*. After weaning, until they were bred, sows received 3kg of the

lactation diet, divided into three portions per day. Water supply was always provided *ad libitum.* Culling reasons were recorded and locomotor disorders, diseases (mastitis, MMA syndrome), small number of born piglets and reproductive failures were included. Reproductive failures included anoestrus after weaning, vulvar discharge, return to oestrus, abortion, and failure to farrow after positive pregnancy detection.

All statistical analyses were performed using the Statistical Analysis System software, version 9.1.3 (Statistical…, 2005). Descriptive statistics were generated by the UNIVARIATE procedure.

Logistic regression models, using the LOGISTIC procedure, were run to evaluate the effect of sow characteristics until first weaning on their reproductive performance and culling rate until third farrowing. Backward elimination was used to determine which factors could be excluded from each model based on a likelihood ratio Chi-square statistic corresponding to P= 5% at each step. Six binary outcome dependent variables were studied: long weaning-to-oestrus interval (LWOI; yes= >5 days or no= ≤5 days); non-farrowing (yes/no); small number of total born piglets in second parity (STB2; yes= <11 piglets or no= ≥11 piglets); small number of total born piglets over three parities (STB3P; yes= <34 piglets or no= ≥34 piglets); total culling (yes/no), and culling by reproductive reasons (yes/no). Due to the low number of sows culled by locomotor (3 sows) or productive (3 sows) reasons, these culling reasons were not separately analysed. Litter size and WOI were investigated as binary outcome variables by separating sows in two classes so that approximately one quarter of them had the occurrence of the event being studied: 21.2%, 27.1% and 28.4% of sows with LWOI, STB2 and STB3P, respectively. Only sows that farrowed without interruptions (return to oestrus, abortion or failure to farrow) were considered in the analysis of sows with STB2 or STB3P.

The following explanatory variables were tested: age at 1st AI; weight at 1st AI; oestrus at breeding (second or third oestrus); weight gain during 1st pregnancy; weight at 1st farrowing; weight loss during 1st lactation; weight at 1st weaning; weight gain from 1st AI to 1st weaning; total number of piglets born in the 1st parity; number of piglets weaned in the 1st parity, and lactation length in the 1st parity. Explanatory variables were first analysed as continuous variables and when they were not significant they were introduced in the model as categorical variables. The following categories were created: age at 1st AI (≤210 or >210 d); weight at 1st AI (<139 and ≥139kg); weight gain in the 1st pregnancy (<25; 25-35 and >35kg); weight at the 1st farrowing (<163.5; 163.5-175 and >175kg); weight at 1st weaning (<159.5; 159.5-170 and >170kg); relative weight loss in the 1st lactation (<0.5%; 0.5-7.4% and >7.4%); weight gain from 1st AI to 1st weaning (< 17.5; 17.5-30 and >30kg); lactation length in the 1st parity (<19; 19-20 and >20 days); number of piglets weaned in the 1st parity (10, 11 and >11 piglets), and total number of piglets born in the 1st parity (<12, 12-13 and >13 piglets). The categories concerning these variables were established to have approximately 50% (two classes) or 33% (three classes) of sows in each class. The frequency distributions of sows for each dependent variable within explanatory categorical independent variables were obtained with the FREQ procedure.

Before running the logistic regression models, the possible colinearity among the variables was examined by correlation analysis with the CORR procedure. To avoid colinearity problems, independent variables with a Pearson correlation coefficient >0.40 were not simultaneously included in the multivariable models. From 10 independent variables, five were correlated with a correlation coefficient >0.40 and were tested separately. Thus, for each one of the dependent variables, five multivariable models were run (Table 1). Six independent variables were present in all models (age at 1st AI, weight at 1st AI, oestrus at breeding, total number of piglets born in 1st parity, lactation length in 1st parity, and number of piglets weaned in 1st lactation), and one additional variable was added to the other six, in each tested model (weight gain during 1st pregnancy, weight at 1st farrowing, weight at 1st weaning, weight loss during 1st lactation or weight gain from 1st AI to 1st weaning). In all models the effects of the interaction between age and weight at 1st AI could also be investigated.

Table 1. Variables tested in multivariable logistic regression to investigate their effect on long weaning-to-oestrus interval, non-farrowing rate, small total number of born piglets in the second parity or over three parities, and on culling rate from 1st to 3rd farrowing

| Independent variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| Age at 1st AI | X | X | X | X | X |
| Weight at 1st AI | X | X | X | X | X |
| Oestrus at breeding | X | X | X | X | X |
| Number of piglets in 1st farrowing | X | X | X | X | X |
| Lactation length in 1st parity | X | X | X | X | X |
| Weaned piglets in 1st lactation | X | X | X | X | X |
| Weight gain in 1st pregnancy | X | | | | |
| Weight at 1st farrowing | | X | | | |
| Weight at 1st weaning | | | X | | |
| Weight loss in 1st lactation | | | | X | |
| Weight gain 1st AI to 1st weaning | | | | | X |

When variables were not significant as continuous they were tested as categorical.

## RESULTS

Sows weighed 170.8 ± 16.0 and 163.7 ± 16.2kg at 1st farrowing and 1st weaning, respectively, and gained 23.3 ± 16.2 kg from1st AI to 1st weaning. The number of total born piglets in the 1st, 2nd and 3rd farrowing were 12.5 ± 2.8, 11.8 ± 2.9 and 12.2 ± 3.1, respectively. The first lactation lasted on average 19.9 ± 2.2 days and sows had 11.2 ± 1.0 weaned piglets. The 1st and 2nd weaning-to-oestrus intervals were of 5.7 ± 5.4 and 4.6 ± 2.2 days, respectively.

Factors associated with long WOI or non-farrowing are shown at Table 2. Each 10kg of increase in weight gain in 1st pregnancy, weight at 1st farrowing, weight at weaning, and weight gain from 1st AI to 1st weaning reduced the risk for long WOI. An increase in the number of weaned piglets was responsible for increasing the percentage of sows with long WOI. An increasing lactation length decreased the occurrence of long WOI and non-farrowing. Sows with <159.5 kg at weaning had higher odds of non-farrowing compared to sows with >170kg. Sows with <17.5kg of gain from 1st AI to 1st weaning had higher odds of non-farrowing than sows gaining >30kg.

Table 2. Results of logistic regression analysis for variables associated with long weaning-to-oestrus interval (> 5 days) and non-farrowing after the first weaning

| Variables | Category | n | % Sows | Odds ratio | 95% CI | P-value |
|---|---|---|---|---|---|---|
| **Long weaning-to-oestrus interval** | | | | | | |
| Weight gain in the 1st pregnancy (per 10 kg) | Continuous | 189 | 21.2 | 0.63 | 0.48-0.82 | 0.0008 |
| Weight at 1st farrowing (per 10 kg) | Continuous | 189 | 21.2 | 0.70 | 0.54-0.90 | 0.0054 |
| Weight at 1st weaning (per 10 kg) | Continuous | 189 | 21.2 | 0.73 | 0.57-0.93 | 0.0121 |
| Weight gain from the 1st AI to 1st weaning (per 10 kg) | Continuous | 189 | 21.2 | 0.67 | 0.52-0.87 | 0.0022 |
| 1st lactation length (per d)€ | Continuous | 189 | 21.2 | 0.77-0.80 | 0.65-0.96 | 0.0190 |
| Number of weaned piglets (per piglet weaned)€ | Continuous | 189 | 21.2 | 1.52-1.59 | 1.04-2.30 | 0.0291 |
| **Non-farrowing** | | | | | | |
| Weight at 1st weaning, kg | <159.5 | 59 | 13.6 | 4.73 | 0.94-23.67 | 0.051 |
| | 159.5-170.0 | 67 | 3.0 | 0.72 | 0.09-5.61 | 0.7579 |
| | >170.0 | 63 | 3.2 | Ref | NA | NA |
| Weight gain from the 1st AI to 1st weaning, kg | < 17.5 | 56 | 12.5 | 4.88 | 0.96-24.89 | 0.0565 |
| | 17.5-30.0 | 66 | 4.5 | 1.28 | 0.20-8.34 | 0.7948 |
| | >30.0 | 67 | 3.0 | Ref | NA | NA |
| 1st lactation length (per d) | Continuous | 189 | 6.3 | 0.74 | 0.57-0.96 | 0.0260 |

CI: confidence interval; NA = not applicable.

€ Minimum and maximum values for OR and CI are derived from multivariable models in which lactation length and number of weaned piglets were significant.

Low weight at the 1st insemination and low number of total born piglets in the 1st farrowing were associated with the occurrence of small litter sizes in both second parity and over three parities (Table 3). Sows with weight gain <25kg in the 1st pregnancy had higher odds of STB2 compared to sows gaining >35kg. Lower percentages of sows with STB2 were observed in those having a weight loss ≥0.5% compared to those with a weight loss <0.5%.

Table 3. Results of logistic regression analysis for variables associated with small total number of born piglets in the second parity (STB2: <11 piglets) or over three parities (STB3P: <34 piglets)

| Variable | Category | n | % Sows$^{\Omega}$ | Odds ratio | 95% CI | P-value |
|---|---|---|---|---|---|---|
| Sows with STB2 | | | | | | |
| Weight at 1st AI, kg | < 139 | 89 | 32.6 | 2.00 | 0.97-4.09 | 0.0508 |
| | ≥ 139 | 88 | 21.6 | Ref | NA | NA |
| Total born piglets in the 1st farrowing$^{\epsilon}$ | < 12 | 52 | 40.4 | 2.70-2.98 | 1.17-6.99 | 0.0203 |
| | 12-13 | 59 | 22.0 | 0.95-1.06 | 0.39-2.54 | 0.9180 |
| | >13 | 66 | 21.2 | Ref | NA | NA |
| Weight gain in the 1st pregnancy, kg | < 25 | 54 | 37.0 | 3.01 | 1.24-7.32 | 0.0149 |
| | 25-35 | 62 | 25.8 | 1.44 | 0.60-3.48 | 0.4108 |
| | > 35 | 61 | 19.7 | Ref | NA | NA |
| Weight loss in the 1st lactation, % | > 7.4 | 58 | 19.0 | 0.29 | 0.12-0.69 | 0.0052 |
| | 7.4-0.5 | 60 | 21.7 | 0.32 | 0.14-0.76 | 0.0096 |
| | < 0.5 | 59 | 40.7 | Ref | NA | NA |
| Sows with STB3P | | | | | | |
| Weight at 1st AI, kg | < 139 | 79 | 39.2 | 3.28 | 1.41-7.66 | 0.0060 |
| | ≥ 139 | 76 | 17.1 | Ref | NA | NA |
| Total born piglets in the 1st farrowing | Continuous | 155 | 28.4 | 0.66 | 0.55-0.78 | <0.0001 |

CI: confidence interval; NA = not applicable.
For both STB2 and STB3P, only sows that reached the 2nd and 3rd farrowing, respectively, without any interruption (return to oestrus, abortion or failure to farrow) were considered for the analysis.
$^{\Omega}$ Percentage of sows with small litter size at 2nd farrowing (STB2) or over three parities (STB3P).
$^{\epsilon}$ Minimum and maximum values for OR and CI are derived from multivariable models in which the number of total born in the 1st farrowing was significant.

Each 10kg of increase in weight at the 1st weaning or in weight gain from the 1st AI to the 1st weaning (Table 4) decreased (P<0.05) the total culling rate and culling by reproductive reasons. Sows with <12 piglets in the 1st parity increased the probability of culling until the 3rd farrowing compared to sows which farrowed >13 piglets in the 1st parity.

## DISCUSSION

The average weight of 140kg observed at approximately 210 days of age shows that some gilts reached the recommended weight for the first breeding before 230-260 days of age, which is considered the target age to obtain a good productivity (Rathje and Himmelberg, 2004; Danbred, 2012). In order to have a higher number of total piglets born in Danbred gilts, the sows should be exposed to mature boars at approximately 200 days of age and be bred when they weigh at least 136-138kg (Ketchem and Rix, 2009; Danbred, 2012). In the present study, the performance of Landrace x Large White Danbred gilts was not compromised even when they were bred at ≤210 days of age, showing that they can be bred at an earlier age than previously recommended provided that they reach at least approximately 140kg. In another genotype (Camborough C22), the farrowing rate, culling rate and piglets produced over three parities also was not affected when gilts were inseminated between 185 and 209 days of age compared to those inseminated at ≥210 days of age (Kummer *et al*., 2006).

Table 4. Results of multivariable logistic regression analysis for variables associated with total culling or culling by reproductive reasons until the third farrowing

| Variable | Category | n | % Culling | Odds ratio | 95% CI | P-value |
|---|---|---|---|---|---|---|
| **Total culling** | | | | | | |
| Weight at 1st weaning (per 10 kg) | Continuous | 196 | 10.2 | 0.71 | 0.54-0.93 | 0.0133 |
| Weight gain from the 1st AI to the 1st weaning (per 10 kg) | Continuous | 196 | 10.2 | 0.73 | 0.55-0.95 | 0.0218 |
| Number of total born in the 1st farrowing | < 12 | 61 | 18.0 | 2.46 | 0.85-7.09 | 0.0167 |
| | 12-13 | 62 | 4.8 | 0.57 | 0.14-2.37 | 0.1187 |
| | >13 | 73 | 8.2 | Ref | NA | NA |
| **Culling by reproductive reasons** | | | | | | |
| Weight at 1st weaning (per 10 kg) | Continuous | 196 | 4.1 | 0.57 | 0.38-0.85 | 0.0053 |
| Weight gain from the 1st AI to the 1st weaning (per 10 kg) | Continuous | 196 | 4.1 | 0.61 | 0.41-0.90 | 0.0119 |
| Number of total born in the 1st farrowing | < 12 | 61 | 9.8 | 7.85 | 0.92-67.1 | 0.0174 |
| | 12-13 | 62 | 1.6 | 1.18 | 0.07-19.3 | 0.4510 |
| | >13 | 73 | 1.4 | Ref | NA | NA |

CI: confidence interval; NA = not applicable.
The following reasons were included in the total culling: locomotor disorders, diseases (mastite, MMA syndrome), small number of born piglets and reproductive failures. Reproductive reasons included anoestrus after weaning, vulvar discharge, return to oestrus, abortion, and failure to farrow.

Weight at first mating can have a significant effect on lifetime performance, and females with an insufficient development when first selected and introduced into the farm generally fail to achieve a reasonable number of parities (Close and Cole, 2001; Foxcroft *et al*., 2004). Longevity is also influenced by gilt growth, compositional and structural soundness traits (Nikkilä *et al*., 2013). Even though gilts were bred weighing ≥135kg, those with a weight of >139kg produced more piglets over three parities, highlighting the importance of an adequate weight at first mating for females of the genotype used in the present study. However, the average maternal weight gain during first pregnancy (30.3 ± 1.13kg) was below the range of 40-50kg, which is considered ideal for young females (Close and Cole, 2001; Young *et al*., 2005). The fact that longer WOI was associated to lower maternal weight gain, and that a weight gain below 25kg during first pregnancy increased the number of sows with a smaller second litter size shows that even when the minimum weight at the 1st mating is reached it is essential to have an adequate weight gain during the first pregnancy.

The importance of adequate body reserves at first farrowing and weaning for a successful reproductive performance has been well documented in females of other genotypes (Mullan and Williams, 1989; Clowes *et al*., 2003; Schenkel *et al*., 2010). For the variables studied, weight at 1st weaning was found to be more important than weight at first farrowing. Hoving *et al*. (2010) showed that production in the second parity can be optimised if growth between the 1st AI and the 1st weaning is increased. In the present study, the weight gain until the first weaning was important to shorten the weaning-to-oestrus interval, to increase the farrowing rate and to reduce the culling rate until the 3rd parity.

Although it is well documented that high lactational catabolism can affect WOI (Zak *et al*., 1997; Yang *et al*., 2000), this was not observed in the present study, confirming that this variable can be less sensitive to body reserve losses in modern genotypes (Vinsky *et al*., 2006; Schenkel *et al*., 2010). On the other hand, modern genotypes can have embryonic survival (Vinsky *et al*., 2006) or piglet production in the second farrowing (Schenkel *et al*., 2010) compromised

by body reserve depletion during lactation. In the present study, the paradoxical higher risk of smaller second litters in sows that lost less weight during the 1st lactation (<0.5%) is probably explained by the fact that they were not able to overcome the detrimental effect of a reduced weight gain during the 1st pregnancy (22kg) and/or a reduced weight achieved at first farrowing (162kg) in contrast with the values of 38 and 179kg observed in sows that lost more weight during lactation.

A short WOI is important for the lifetime performance because primiparous sows mated within 5 days after weaning have higher farrowing rate and more piglets produced than females with longer WOI (Tantasuparuk *et al*., 2001; Poleze *et al*., 2006). The occurrence of shorter WOI in primiparous sows as the lactation increases is in agreement with other studies (Willis *et al*., 2003; Poleze *et al*., 2006; Soede *et al*., 2009), in which the WOI was consistently short when the lactation length was beyond 20 days. In the present study, a longer lactation length was also important to reduce the percentage of non-farrowing sows, corroborating the positive effect of an increasing lactation length on lifetime performance (Rathje and Himmelberg, 2004). A short lactation length has a negative effect on post-weaning follicular development and subsequent interval to oestrus, ovulation response and even farrowing rate and litter size (Soede *et al*., 2009). Furthermore, reproductive failures have been related to a short lactation length as a consequence of incomplete uterine involution (Le Cozler *et al*., 1997; Takai and Koketsu, 2007). The increase in the percentage of sows with longer WOI as the number of weaned piglets increased is probably related to the inhibition of hypothalamic-pituitary axis activity (Cox and Britt, 1982) which can lead to a later resumption of follicular development and return to oestrus (Quesnel *et al*., 2007).

Lifetime piglet production is one of the criteria used to decide if a sow remains in the herd or not. The association of litter size in the 1st farrowing with piglet production in subsequent farrowings (Hoving *et al*., 2010) was confirmed in the present study, explaining the higher culling rate observed in sows with <12 piglets born in the 1st farrowing. The culling rate until the 3rd farrowing was also affected by the weight at 1st weaning and the weight gain from the 1st AI and the 1st weaning, because these characteristics were associated with reproductive disorders (long WOI and non-farrowing at parity 2), which had been reported as factors contributing to low retention of sows in herds (Zak *et al*., 1997; Lucia *et al*., 2000; Tantasuparuk *et al*., 2001; Roongsitthichai *et al*., 2013).

## CONCLUSIONS

The variables concerning weight development from the 1st mating until 1st weaning affect the lifetime reproductive performance and the retention of Landrace x Large White Danbred sows in the herd, showing that if a minimum threshold is not achieved, in several phases of development until mature size, growth might be prioritised above reproduction. The weight gain between the 1st AI to the 1st weaning is the variable that best summarises the importance of adequate body reserves because it includes body reserve changes occurring during both pregnancy and lactation.

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