EVALUATION OF THE BREEDING VALUE OF DANBRED HYBRID GILTS

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Abstract

The study aimed to assess reproductive performance of DanBred female line primiparous sows. The investigated young females (n = 125) showed very good fertility with 17.00 total born piglets and 16.14 piglets born alive. The number of stillborn piglets was 0.85 and the average gestation length was 117 days. It was demonstrated that parameters such as the total number of piglets born per litter and the number of piglets born alive can be expected to decrease significantly with longer gestation lengths. No relationship was found between gilts' mating age and the investigated reproductive traits. There was a significant correlation between the number of total born piglets and the number of stillborn piglets (P≤0.01). The reproductive results obtained in the herd of primiparous sows can be considered as good, which justifies the practical use of the DanBred line in production herds.

Keywords: pigs, DanBred, primiparous sows, reproductive performance

Introduction

The efficient utilisation of the reproductive potential of farm-bred gilts and sows can be achieved with appropriate herd management. Pigs suitable as brood sows include females with high reproductive potential and well-equipped for breeding. A large number of factors influence the breeding performance of sows in each individual litter and across their overall lifetime productivity (Koketsu et al., 2017), such as climate zone (Tummaruk et al, 2000), nutrition, health condition, season, boar accessibility or lack of it (Young et al., 2008; Stalder et al., 2010), age, body weight and backfat thickness at first mating (Tummaruk et al., 2001, 2007, 2009; Rekiel and Więcek, 2018).

Gilts bred today are characterised by rapid growth, achieving 130-140 kg body weight at a young age (Szulc et al., 2015). The insemination of gilts at ages between 6 and 7 months is reasonable (Kummer et al., 2006) and the adverse effects of early mating can be avoided if their body growth from birth to 150 days of age is kept at around 700 g/day. Gilts that meet this criterion farrow large litters. However, body weight gains exceeding 770 g/day result in elevated stillbirth rates (Amaral Filha et al., 2010).

Optimum backfat thickness in the female at first mating provides protection from excessive weight loss or gain in subsequent cycles, while also helping to prevent reproductive problems, such as failure to conceive, complications at parturition, loss of oestrus once piglets are weaned and pre-mature culling from the herd (Kummer, 2008; Rekiel and Więcek, 2018). It makes sense to begin using gilts for breeding when their body weight reaches 130-140 kg

and their backfat is around 15-20 mm thick (Williams et al, 2005; Tummaruk et al, 2009; Amaral Filha et al, 2010; Matysiak et al, 2010; Flisar et al, 2012; Rekiel and Więcek, 2018).

The age of sexual maturity is a moderately heritable trait (0.38), which means that it can be improved by selection (Tart et al., 2013). Gilts reach reproductive maturity 20-40 days following sexual maturity. According to Lammers et al. (2007), this occurs at around 160-190 days of age, while Tummaruk et al. (2007) place it at approximately 6-7 months, the differences being attributable mainly to genetic differences between animals. Early maturity is favourable in terms of lifetime productivity. Females entering reproductive maturity relatively late tend to have more non-productive days within their service life, which is unfavourable. In such cases, the frequency of farrowing drops and the sow- and herd-level economic productivity declines (Lucia et al., 2000; Tummaruk et al., 2001, 2007).

The most suitable criterion in the assessment of sow fertility is average fertility calculated over several consecutive litters. However, it is possible to estimate the size of subsequent litters based on the first litter. Research shows that sows farrowing few piglets in their first litter also give birth to fewer piglets in their subsequent litters compared to sows that produce more numerous offspring in their first litter (Warda, 2019; Warda et al., 2021).

Proper herd management must be used in the case of sows with superior fertility. A high-performing sow is only able to feed as many piglets as she has active mammary glands. In such a herd, it is necessary to use litter standardisation and/or assign nurse sows.

The objective of the study was to assess the reproductive performance of primiparous DanBred dam line sows and to determine the relationship between gilt age at first mating, the length of gestation and the number of piglets born in the first litter.

Material and methods

The study covered 125 DanBred dam line hybrid gilts raised on a private farm specialising in pig keeping. The semen used to inseminate the gilts was sourced from DanBred×Duroc sire line boars characterised by good growth rate, low feed consumption and high meat quality.

For 10 days prior to insemination, all the gilts were flush-fed, followed by a full-ration mixture during pregnancy and lactation (3-4 weeks) as recommended (Grela and Skomiał, 2021).

The animals in the reproduction/gestation sector and in the farrowing quarters were kept on slatted floors in buildings/pens compliant with the requirements specified in the Regulation of the Minister of Agriculture and Rural Development of 15 February 2010 (Journal of Laws No. 56, item 344). The gilts underwent a lighting programme for 5 days prior to insemination (light intensity: 400 lux, duration: 16 hours a day from 6:00 pm to 10:00 pm). Each gilt was examined for oestrus and inseminated twice a day at 24-hour intervals. On the 28th day after mating, ultrasound apparatus was used to check whether conception occurred. Once pregnancy was confirmed, the gilts were transferred from individual pens to collective pens with individual feeding stations, and 7 days before parturition to tripartite pens in farrowing chambers. Lactation lasted 24 days on average. A prophylactic programme was extended to the females and the new-born piglets underwent routine zootechnical checks and care procedures. Litters were standardised, with 12-16 piglets left with the sow.

Studied traits, data compilation

The studied gilts were controlled for age at first mating and farrowing (days) and length of gestation (days). The breeding performance of the sows in the first litter was analysed in terms of the overall number of live- and stillborn piglets (heads), the number of weaned piglets (heads) and the average weight of weaned piglets (kg) (Table 1).

Table 1. Characteristics of the experimental animals (n = 125)

Cecha Traits	Średnia Mean	Minimum Minimum	Maksimum Maximum	Odchylenie standardowe Standard deviation	Zmienność (%) Variation (%)
Wiek pierwszego pokrycia (dni) Age at first mating (days)	265	219	330	30.21	11.4
Wiek pierwszego oproszenia (dni) Age at first farrowing (days)	382	336	448	30.25	7.9
Ciąża (dni) Gestation (days)	117	115	120	1.35	1.2
Liczba prosiąt urodzonych w pierwszym miocie: Number of piglets born in first parity:					
Ogółem Total	17.0	5	23	3.68	21.6
Żywych Live	16.1	4	23	3.56	22.1
Martwych Stillborn	0.85	0	4	1.16	136.5
Prosięta w dniu odsadzenia: Piglets on weaning day:					
Number Number	13.4	9	16	1.30	9.7
Masa ciała (kg) Body weight (kg)	6.5	3.9	9.6	1.07	16.5

Data were collected over an eight-month period (mid-August to May of the following year) in the AgroSoft programme used on the farm for herd management control. The data were statistically processed (IBM SPSS Statistics 28). The arithmetic mean, standard deviation, variability and frequency were calculated. Minimum and maximum values of individual traits were stated. Pearson correlation coefficients were calculated for selected reproductive indicators.

Results

There was a low percentage, 2.4% and 5.6% respectively, of young gilts 220 days old at first mating and older gilts that mated for the first time at the age of 311 days or later (Table 2). Gilts mating before nine months of age (up to day 270), which could be expected to farrow at about one year of age, accounted for only about 62% of all studied females. It should be pointed out that mating was introduced relatively late in the herd. The youngest gilts mated successfully at 219 days of age (3 head) and the oldest at 330 days, with the difference as much as 111 days (approx. 3.7 months).

No correlation was found between the mating age of the gilts and the combined number of live- and stillborn piglets (Table 3). The value of the phenotypic correlation coefficients between the length of gestation and the number of piglets per litter (live- and stillborn) was negative and showed a statistical relationship ($P \leq 0.05$).

The variation in the length of gestation between the gilts was 6 days (Table 4). The percentage of females that farrowed after slightly longer gestation (117-119 days) was 56.8%, while the percentage of females whose gestation lasted 115-116 days was 39.2%.

The percentage of sows that produced litters of 12 or fewer overall and live-born piglets was relatively small, standing at 10.4 and 13.6%, respectively (Table 5).

The number of stillborn piglets per litter showed high variability (Table 1). In more than 54% of the litters no stillborn piglets were found, and in about 5% of the litters there were 4 stillborn piglets (Table 6). Litters with one or two stillborn piglets accounted for more than a third of all litters – 34.4%.

Table 2. Age at first mating - number of events

Wiek pierwszego krycia (dni) Age at first mating (days)	Częstość Frequency	Procent Percentage	Procent skumulowany Cumulative percentage
≤ 220	3	2.4	2.4
221-230	15	12.0	14.4
231-240	13	10.4	24.8
241-250	23	18.4	43.2
251-260	1	0.8	44.0
261-270	23	18.4	62.4
271-280	5	4.0	66.4
281-290	13	10.4	76.8
291-300	9	7.2	84.0
301-310	13	10.4	94.4
311-320	3	2.4	96.8
321-330	4	3.2	100.0
Ogółem Total	125	100	-

Table 3. Coefficients of phenotypic correlation of age at first mating and gestation length with reproductive performance of primiparous sows

Cecha Traits	Wiek pierwszego krycia Age at first mating	Czas trwania ciąży Gestation length
Liczba prosiąt urodzonych w miocie Number of piglets born per litter		
Ogółem Total	0.018	-0.207*
Żywych Live	0.052	-0.211*
Martwych Stillborn	-0.101	-0.008

*P≤0.05

Table 4. Gestation length - number of events

Czas trwania ciąży (dni) Gestation length (days)	Częstość Frequency	Procent Percentage	Procent skumulowany Cumulative percentage
115	14	11.2	11.2
116	35	28.0	39.2
117	30	24.0	63.2
118	25	20.0	83.2
119	15	12.0	95.2
120	6	4.8	100.0
Total Total	125	100	-

Table 5. Number of total and live born piglets per litter - number of events

Liczba Number	Prosięta urodzone Piglets born					
	Ogółem Total			Żywe Live		
	Częstość Frequency	Procent Percentage	Procent skumulowany Cumulative percentage	Częstość Frequency	Procent Percentage	Procent skumulowany Cumulative percentage
4	-	-	-	1	0.8	0.8
5	1	0.8	0.8	1	0.8	1.6
6	2	1.6	2.4	1	0.8	2.4
7	1	0.8	3.2	1	0.8	3.2
9	2	1.6	4.8	2	1.6	4.8
10	1	0.8	5.6	2	1.6	6.4
11	3	2.4	8.0	4	3.2	9.6
12	3	2.4	10.4	5	4.0	13.6
13	6	4.8	15.2	10	8.0	21.6
14	8	6.4	21.6	6	4.8	26.4
15	9	7.2	28.8	9	7.2	33.6
16	10	8.0	36.8	16	12.8	46.4
17	16	12.8	49.6	25	20.0	66.4
18	14	11.2	60.8	12	9.6	76.0
19	15	12.0	72.8	9	7.2	83.2
20	17	13.6	86.4	9	7.2	90.4
21	10	8.0	94.4	9	7.2	97.6
22	2	1.6	96.0	1	0.8	98.4
23	5	4.0	100	2	1.6	100
Ogółem Total	125	100	-	125	100	-

Table 6. Number of stillborn piglets per litter - number of events

Liczba Number	Częstość Frequency	Procent Percentage	Procent skumulowany Cumulative percentage
0	68	54.4	54.4
1	28	22.4	76.8
2	15	12.0	88.8
3	8	6.4	95.2
4	6	4.8	100
Ogółem Total	125	100	-

Discussion

This study analysed the reproductive performance of primiparous sows. According to the primary literature, the age of gilts at first mating/insemination influences their subsequent breeding potential and service life, while also determining reproductive performance at herd-level (van Wettere et al, 2006; Patterson et al, 2010; Tummaruk and Kesdangsakonwut, 2014). Gilts added to the herd late and mated/inseminated at an older age (more than 260 days) were shorter-lived than females added at a younger age (Young et al., 2008), and showed reduced reproductive and economic performance (Lucia et al., 2000; Tummaruk et al., 2007). Late sexual maturity and late-onset oestrus combined with delayed first mating and farrowing are a serious aggravating factor that puts the female at a high risk of early removal

from the herd (Kulisiewicz et al., 2010). Young et al. (2008) demonstrated that gilts reaching sexual maturity earlier produced more piglets in litters 1 and 3 in comparison with older gilts. However, our study found no correlation between gilt age at first mating and the total number of piglets (live- and stillborn), a finding consistent with Szulc et al. (2009).

Sasaki and Koketsu (2007) report that gestation periods can vary from 105 to 125 days, with 70% of pregnancies lasting between 114 and 116 days and the average being around 115 days. Having analysed a very large amount of material (approx. 61,000 litters), Vanderhaeghe et al. (2011) showed that the gestation period in sows kept on commercial farms ranged from 109 to 121 days, with an average of about 115 days. In a study by Pietruszka et al. (2020), the gestation period ranged from 113 to 121 days, with an average of 117 days. Vanderhaeghe et al. (2011) recorded pregnancies shorter than 115 days in 27% of the studied sows. Our research recorded only one such case. Consistent with our own findings, Tummaruk et al. (2001) described this trait as having low variability. Rydhmer et al. (2008), Chen et al. (2010) and Imboonta and Kuhaaudomlarp (2012) identified a tendency for sows with a shorter gestation period to produce more live-born piglets. Our own study confirmed this, as the value of phenotypic correlation coefficients between the length of gestation and the number of piglets per litter, overall and live-born, was negative ($P \leq 0.05$). Similarly, Sasaki and Koketsu (2007) showed that sows with pregnancies of 113 to 116 days gave birth to more live piglets than sows with extremely short (<112 days) or extremely long (>117 days) pregnancies.

The percentage of young females that gave birth to between 13 and 21 piglets in a litter was 84%. The mean number of piglets born overall and alive per litter in our study, i.e. 17.0 and 16.1, respectively, was 1.1 and 1.0 higher than that reported by Pietruszka et al. (2020), who analysed the breeding performance of DanBred sows, but included also multiparous females. The fertility of multiparous sows (3^{rd}-6^{th} farrowing) compared to that of primiparous sows shows a rising trend (Szulc et al, 2009; Zapryanova & Malinova, 2018; Warda, 2019), which is a good outlook for higher herd productivity in the future. This was also true of the herds analysed in our study. In the study by Warda (2019), positive phenotypic correlation coefficients were found between the number of piglets born in the first litter and the number of piglets born in subsequent litters (up to and including litter 6). The values of the correlation coefficients were highest in litter 2 ($rp = +0.33$, $P \leq 0.01$) and lowest, but equally statistically significant, in litter 6 ($rp = +0.23$, $P \leq 0.01$). The positive and statistically significant correlations between reproductive performance obtained in litter 1 and subsequent litters confirm the view of Soltész et al. (2016) that litter size should be one of the most important reasons for leaving a female in the herd. Leaving females that have produced few piglets in the first litter in the herd will have an adverse effect on the economic outcomes in the subsequent years of the sow's life. In our study, about 46% of the total number of sows gave birth to more than 16 live piglets and about 10% of sows gave birth to fewer than 12 piglets – litters of this size need to be standardised (Devillers et al., 2016). In the former case, the sow would have been unable to feed all the piglets without human intervention due to an insufficient number of mammary glands. Supernumerary piglets should be transferred onto sows feeding smaller litters or onto nurse sows. In the latter case, by ensuring full occupancy of both mammary ridges and all mammary glands in sows that have given birth to a small litter, hyperplasia is stimulated in the glands sucked by the piglets and metabolic activity is elevated in subsequent lactations. Adequate stimulation of the mammary glands for growth is important especially in sows during their first lactation.

Pietruszka et al. (2020) analysed the stillbirth rate in relation to gestation duration and found its highest value of 0.947 in litters of sows with the longest gestation. In our study, there was no correlation between the length of gestation and the number of stillborn piglets (Table 3), but there was a positive correlation between the total number of piglets born and

the number of stillborn piglets (+0.255, P≤0.01). The primary literature also indicates such a relationship (Zapryanova and Malinova, 2018). As litter size increases, parturition time lengthens, making stillbirth more probable (Herpin et al., 2001)

The average weight of piglets at weaning was 6.5 kg and the average number of piglets weaned was 13.4, a very good result (Table 1). The duration of lactation depended on the organisational structure of the herd (24 days on average) and varied slightly (21-29 days), which was also due to the variation in the length of gestation in sows subjected to the experiment. According to Sasaki and Koketsu (2007), sows with shorter gestation periods feed piglets significantly longer than females with longer gestation periods. Increasing the length of gestation even by one day dramatically shortens the feeding period as necessitated by the organisation and management techniques applied to herds on large farms, with a significant number of technological groups of sows. The results obtained by Pietruszka et al. (2020) confirm that with a longer gestation period, the feeding period by multiparous sows is shortened (P≤0.05).

Summary

No correlation was found between the gilt age at first mating and the studied reproductive traits. With a longer gestation period, a significant reduction is to be expected for primiparous sows in the overall number of piglets born and the number of live-born piglets. A significant correlation was confirmed between the overall number of piglets born and the number of stillborn piglets. The reproductive performance reported for the DanBred primiparous sow herd is satisfactory, proving the reproductive predisposition of the gilts of that breed and justifying their use in commercial herds. With such genetic material on the farm, herd management is not easy, especially when it comes to farrowing and raising piglets. This is because the high number of piglets born in litters requires litter standardisation and the assignment of nurse sows.

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