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Correlations between fattening and slaughter performance test results of gilts and their subsequent reproductive performance

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ABSTRACT. The aim of the study was to estimate correlations between fattening and slaughter traits of gilts and their subsequent reproductive performance. A total of 5468 Polish Landrace gilts from nucleus farms were studied. Daily gain and selection index were positively correlated (0.14–0.22) with the number of piglets born and reared in successive litters. For the other traits, the correlations with reproductive traits were close to zero. The phenotypic correlations obtained between fattening and slaughter performance traits and subsequent reproductive performance of gilts are in most cases indicative of the low relationship between these traits.

Introduction

Pig fattening and slaughter traits have improved considerably over the years. Progress in reproductive traits has been less marked, however. The poor results of breeding programmes aimed at genetic improvement of reproductive traits were probably because the primary focus of selective breeding of pigs was to improve fattening and slaughter traits. It was not until the last decade that reproductive traits began to be used on a larger scale in selection models.

According to Johansson and Kennedy (1983) and Gaughan et al. (1995), selection for increased meat production delays the onset of sexual maturation. Gilts with thinner backfat are older at first farrowing, and after rearing litters they are late to show signs of oestrus. Carcass meat percentage has been reported to be negatively correlated to intensity of external oestrus signs and backfat thickness positively to progesterone concentration after the first oestrus (Eliasson, 1991, after Kawęcka, 2002). Problems with reproductive performance associated with high meat content have been noted in sows in Sweden, where as much as 11% of gilts are culled from the herd for anoestrus (Ehnvall et al., 1981, after Kawęcka, 2002). Tummaruk et al. (2001) report that gilts with thicker backfat at 100 kg body weight exhibited a highly significant shorter weaning-to-mating interval compared with gilts with thinner backfat, and were also characterized by 0.1 piglets per litter more.

According to DeNise et al. (1983), litter traits are also determined by selection of pigs for meat production. This selection was found to be particularly unfavourable for second-parity litters. Therefore, it

appears that less fat in the body, and thus smaller energy reserves, has an adverse effect on reproductive performance. This conclusion is also supported by Walkiewicz et al. (1994), who confirmed that gilts with thinner backfat produced smaller litters, had poorer rearing performance, and were late in showing signs of next oestrus. Milk from these gilts had less fat and unsaturated fatty acids.

Some studies, however, failed to provide conclusive evidence that fattening and slaughter traits are negatively and significantly correlated with reproductive performance. Owsianny et al. (1999) observed that the fattening and meat value of sows is not antagonistic to their reproductive value. These observations are confirmed by Ritze and Redel (1982), who obtained similar results, that is, low and non-significant correlations between backfat thickness and traits of reproductive performance in sows.

In this context, it is appropriate to verify earlier opinions and identify current relationships between reproductive traits and fattening and slaughter traits in a population of Polish Landrace pigs.

Material and methods

The experiment was carried out on 5468 Polish Landrace (PL) gilts from 231 nucleus farms. All gilts were performance tested to determine age on test (days), body weight on test day (kg), daily gain (g), P2 and P4 backfat thickness (mm), P4 fatness of *longissimus dorsi* muscle (mm), carcass meat (%) and selection index (pts). Backfat thickness and *longissimus dorsi* muscle were measured using a PIGLOG 105 device. The live evaluation was performed with methods applicable to the age range of 150–210 days. Gilts reproductive traits were determined based on the number of piglets born alive per litter, number of piglets at the 21 day in the parity 1 and 2, parity 1 to 3, and parity 1 to 4.

The experimental material was analysed using arithmetic means, standard deviations, and coefficients of variation. To determine whether the fattening and slaughter value of gilts is correlated to their subsequent reproductive performance, coefficients of phenotypic correlation were estimated between groups of traits characterizing these parameters using the SAS package v. 8.02 (2001). The estimates were made based on error variance and covariance from analysis that accounted for variation due to herds, based on the model:

$$\hat{y}_{ij} = \mu + a_i + e_{ij}$$

where: $\hat{y}_{ij}$ – observation, μ – overall mean, a_i – fixed effect of i-th farm, e_{ij} – random error.

Results

The values of fattening and slaughter traits for all of the experimental animals are presented in Table 1. As can be seen from the data, the age of the gilts on the test day averaged 170 days and their average body weight was 106 kg. Daily gain from birth to test day was 647 g. These traits showed some variation, as evidenced by standard deviations and coefficients of variation, which were estimated at v% = 8.4–11.9. The next traits included in the performance test were backfat thickness and carcass meat percentage. P2 and P4 backfat thickness were very similar, with a difference of only 0.1 mm.

Table 1. Means, standard deviations and coefficients of variation for fattening and slaughter traits of experimental gilts

Indices	o	δ	v%
Age on test, days	170	14.3	8.4
Body weight on test day, kg	106	12.5	11.8
Daily gain, g	647	77.0	11.9
P2 backfat thickness, mm	10.6	2.1	19.3
P4 backfat thickness, mm	10.5	2.0	19.3
Average backfat thickness, mm	10.5	1.9	17.8
Height of *longissimus dorsi* muscle, mm	53.4	5.6	10.5
Meat percentage	56.9	2.7	4.7
Index, pts	109	15.0	14.0

These traits showed similar variation, which was much higher than for fattening traits (v% = 19.3). Loin eye height was 53.4 mm. Variation for this trait was almost half (v% = 10.5) that for backfat thickness. The measurements of backfat thickness and loin eye height were used to calculate carcass meat percentage, which in the analysed population was 56.9%, with the lowest variation coefficient of all the traits measured on live animals (v% = 4.7). The ultimate result of the performance testing of fattening and slaughter traits was an estimated index based on daily gain and meatiness. For the material under analysis, it amounted to 109 pts.

Table 2. Means, standard deviations and coefficients of variation for reproductive traits of experimental gilts, parity 1 to 4

No. of piglets	o	δ	v%
Born in parity			
1	10.99	1.63	14.8
1–2	11.25	1.31	11.7
1–3	11.43	1.18	10.4
1–4	11.53	1.12	9.8
On day 21 in parity			
1	10.31	1.63	15.8
1–2	10.55	1.31	12.5
1–3	10.71	1.16	10.9
1–4	10.78	1.09	10.1

Table 3. Coefficients of correlation between fattening and slaughter traits of gilts and their reproductive performance

No. of piglets	Age on test day	Body weight on test day	Daily gain	P2 backfat thickness	P4 backfat thickness	Average backfat thickness	Loin eye height	Meat percent	Index pts
Born in parity									
1	–0.07	0.08	0.15	–0.05	–0.04	–0.05	0.07	0.05	0.15
1–2	–0.09	0.09	0.19	–0.04	–0.04	–0.04	0.07	0.04	0.17
1–3	–0.10	0.10	0.21*	–0.04	–0.04	–0.05	0.08	0.05	0.19
1–4	–0.12	0.10	0.22*	–0.04	–0.05	–0.05	0.09	0.05	0.21*
Born on day 21 in parity									
1	–0.04	0.10	0.14	–0.07	–0.06	–0.07	0.05	0.06	0.15
1–2	–0.05	0.11	0.17	–0.06	–0.06	–0.06	0.04	0.05	0.16
1–3	–0.06	0.12	0.18	–0.06	–0.07	–0.07	0.04	0.06	0.17
1–4	–0.07	0.12	0.19	–0.06	–0.07	–0.07	0.04	0.06	0.18

correlation significant *$P \leq 0.05$

Table 2 presents reproductive performance of gilts in parity 1, parity 1 and 2, parity 1 to 3, and parity 1 to 4. As the tabular data suggest, the number of piglets born and reared increased when more litters were considered (from 10.99 to 11.53 and from 10.31 to 10.78, respectively). The coefficients of variation show that these litters differed in the number of piglets (v% from 9.8 to 14.8).

The coefficients of simple correlation estimated between fattening and slaughter traits of the gilts and their reproductive performance (Table 3) suggest that these two groups of reproductive traits were completely unrelated or only marginally related.

The daily gain and selection index showed the highest positive correlations with the number of piglets born and reared in particular litters. These correlations were $r = 0.14$ between daily gain and number of piglets on day 21 in parity 1; $r = 0.22$ ($P \leq 0.05$) between daily gain and number of piglets born in parity 1 to 4; $r = 0.15$ between selection index and number of piglets on day 21 in parity 1, and $r = 0.21$ ($P \leq 0.05$) between selection index and number of piglets born in parity 1 to 4. For the other traits, the correlations with reproductive traits were close to zero.

Discussion

The main objective of the study was to determine how the fattening and slaughter traits of gilts are correlated to their reproductive performance. Significant but low phenotypic correlations were obtained only between daily gain and number of piglets born in three and four parities, and between selection index and number of piglets born in four parities.

Our results differ from those of some authors. Bereskin (1984), Ferguson et al. (1985), Cleveland et al. (1988) and Kerr and Cameron (1996) reported negative genetic correlations of fattening and slaughter traits with reproductive traits. The correlations between weight gain and number of piglets per litter on day 21 were estimated by Bereskin (1984) to be $r = –0.60$. Low, but mostly positive, correlations were reported by Serenius et al. (2004). For the number of piglets born, the coefficients of genetic correlation were $r = 0.14$ with daily gain, $r = 0.03$ with feed conversion, $r = –0.02$ with meat percentage, and $r = 0.17$ with fat percentage.

The studies cited above were mostly performed with foreign populations, which are characterized by a large genetic distance compared with the Polish population. This is probably due to the implementation of different breeding programmes, which improve the populations according to different preferences.

The results obtained by Matysiak et al. (2002) with line 990 sows showed that the coefficients of correlation between reproductive traits and fattening and slaughter traits evaluated on live animals were not high. The coefficients of phenotypic correlation between backfat thickness and number of piglets born alive per litter and number of piglets on day 21 were very low at $r = 0.01$ and $r = 0.07$, respectively. Negative, but also very low, correlations were obtained between average daily gain and the number of piglets born alive per litter and the number of piglets on day 21 ($r = –0.19$ and $r = –0.17$, respectively). In turn, the correlations calculated by Kasprzyk and Babicz (2006) between backfat thickness and number of piglets reared until 21 days of age were $r_P = 0.06$ for Polish Large White (PLW) and $r_P = –0.28$ for Polish Landrace (PL). The correlations between meat percentage and number of piglets born and reared per litter were $r_P = –0.03$ and $r_P = 0.27$ for the PLW breed, and $r_P = –0.05$ and $r_P = 0.27$ for the PL breed. For the number of piglets born and the number of piglets on day 21 from three successive litters, Kawęcka et al. (2009) calculated the phenotypic correlations to be $r_P = 0.18$ and $r_P = 0.15$ with average backfat thickness, $r_P = –0.43$

and $r_P = –0.35$ with height of *longissimus dorsi* muscle, and $r_P = –0.43$ and $r_P = –0.31$ with carcass meat percentage.

Mucha et al. (2010) estimated the coefficients of correlation between performance test traits and the number of piglets born and reared until 7, 14 and 21 days of age in PLW × PL pigs. These parameters were estimated separately for three successive litters. Significant correlations were obtained only in parity 1 between P4 backfat thickness and number of piglets on day 21 ($r = –0.276$), and in parity 2 between body weight and two measurements of backfat thickness and number of piglets on day 7 ($r = 0.247$ and $r = 0.252$, respectively), and between P4 backfat thickness and number of piglets on day 14 ($r = 0.234$). The other coefficients of correlation were low. In a study by Mucha et al. (2011), the body weight of gilts and their age at mating were non-significantly correlated to the number of piglets in three successive litters.

It is worth noting that studies performed two and three decades ago revealed clear negative correlations between slaughter and reproductive traits. Such correlations have not been observed, however, in recent studies; on the contrary, they report small but positive correlations. This may be indicative of considerable improvements in environmental conditions in pig houses, especially those for breeding pigs, which improved the reproductive performance of sows and caused reproductive results to become unrelated to the thickness of backfat, which serves as an energy reserve for animals.

Conclusions

The present findings concern a very large number of gilts, which represent the active population of the Polish Landrace breed. The phenotypic correlations obtained between fattening and slaughter performance traits and subsequent reproductive performance are in most cases indicative of the low relationship between these traits.

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