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Research article

Genetic parameters for proportion of piglet loss at birth in a Landrace population

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Abstract

The pedigree and reproductive performance of 1,160 Landrace sows (6,673 records) farrowed between March 2010 and January 2019 were used to estimate genetic parameters for the proportion of piglet loss at birth (PL), number of total born piglets (TB) and litter birth weight (LBW) and to compare the genetic ability of sows with and without piglet loss for lifetime production under a tropical environment. Covariances and variance components were estimated using the average information restricted maximum likelihood algorithm with a multiple trait repeatability animal model. Year-season at farrowing, parity and age at first farrowing of sows were considered as fixed effects whereas animal, permanent environment and residual were random effects. Sows were classified based on the presence of dead piglets at birth (sows without piglet loss and sows with piglet loss). Landrace sows lost their piglets at birth at 10.98% of the TB (11.85 piglets). Heritability (0.03 ± 0.01) and repeatability (0.05 ± 0.01) for PL were low. Genetic correlation between PL and LBW was high and negative (-0.73 ± 0.18). Sows without piglet loss had greater genetic abilities for PL, TB and LBW than sows with piglet loss ($p < 0.01$). These results implied that highly accurate genetic information, a large number of repeated records, importing genetic resource and unifying farm management are needed to reduce piglet loss at birth. Improving genetic ability to reduce PL might increase LBW. With higher genetic ability, sows without piglet loss should be a potential resource for breeding stock.

Introduction

Improving herd productivity is an alternative aspect to earn more profit for the pig enterprise that requires numbers of sows producing high numbers of weaned piglets in the breeding herd. Due to their great production efficiency, Landrace sows have widely been using as the maternal line in commercial pig farms (Plaengkaeo et al., 2020). However, a large litter size is a risk factor for piglet death at birth and during the lactation period, resulting in economic loss (Zhang et al., 2016). Reducing piglet loss could be a key factor to achieve a target focused on piglet production for commercial farming. Death of natal piglets is one issues of concern in the pig industry and may result from embryonic death during gestation and piglet death shortly before or during parturition that presents as mummified and stillborn piglets in the litter. In various populations, mummified piglets have varied from 3.4 to 13.9% (Borges et al., 2005; Pandolfi et al., 2017), while the presence of stillbirth piglets ranged from 5.6 to 11.5% (Borges et al., 2005; Strange et al., 2013; Westin et al., 2015). These data indicate the reduced number of piglets born alive and are the cause of lost economic return.

Piglet loss at birth has been considered from the perspective of number of mummies or stillbirths per litter (Chu, 2005; Lewis et al.,

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2009; Imboonta and Kuhaaudomlarp, 2012) and via the incidence of mummies or stillbirth separately (Borges et al., 2005; Segura-Correa and Solorio-Rivera, 2013). The latter observations cannot be used to indicate the piglet productivity of a sow or to make unbiased comparisons regarding sow performance where there are different numbers of total born piglets. If piglet loss at birth is considered as a summation of mummified and stillborn piglets in proportion to total born piglets, it could be used to reveal the efficiency of sow productivity, which might be used as a new selection criterion. Thus, genetic parameters for this trait need to be estimated and they should be considered for use in a genetic improvement program.

No piglet loss at birth is an ideal for commercial pig production. Sows who never lose their offspring in any litters could be good resource for breeding program to improve sow productivity. Nowadays, there have been few reports on genetic parameters for the proportion of piglet loss at birth and its correlation with other economically important productive traits, especially in Thailand. The genetic ability of sows without piglet loss has been unknown also. Thus, this research aimed to estimate the heritability, repeatability, genetic correlation and phenotypic correlation for the proportion of piglet loss at birth, total born piglets and litter birth weight in a Thai Landrace population and to compare the genetic ability for those traits of sows with and without piglet loss in their productive period.

Materials and Methods

Animals, traits and dataset

Individual production performance records were collected from purebred Landrace sows raised on a commercial pig farm in Northern Thailand (18°47′43″ N; 98°59′55″ E; elevation 310 m above sea level). The records consisted of sow identification, birth date, parity, farrowing date, number of total born piglets (TB), number of mummified piglets, number of stillborn piglets and litter birth weight (LBW) and the sire and dam information of the sow. In practice, the number of piglets born dead in the litter were accounted for in the number of stillborn piglets.

The numbers of mummified and stillborn piglets within a litter were combined in the statistic piglet loss at birth (NPL). The calculation for the proportion of piglet loss at birth (PL) was calculated as NPL / TB × 100. LBW was the entirety of body weight at birth of all live-born piglets in the same litter. All traits (PL, TB and LBW) were tested for normal distribution. Based on positive skewness (2.56), PL was transformed using natural logarithms [tPL = ln(PL + 1)] before data analysis (Lewis et al., 2009).

In total, 6,673 records were gathered from 1,160 commercial Landrace sows with parity numbers from 1 to 12. They were born from 812 matings between 178 sires and 524 dams and included 586 full-sibs, 492 parental half-sibs and 317 maternal half-sibs. The farrowing records were collected from March 2010 to January 2019. Only the repeated records of sows with age at first farrowing in the range 320–550 d were used in this study. Descriptive statistics for productive performances of sows in this dataset were calculated. Parity number was classified as 1, 2, 3, 4, 5, 6, 7, 8 and ≥ 9. Season at farrowing was classified as winter (November to February), summer (March to June) or rainy (July to October). Then, the combination of year and season at farrowing was considered as the contemporary group.

Feeding and management

All sows were raised under an evaporative cooling system with good agricultural practices for pig farming based on the guidance of National Bureau of Agricultural Commodity and Food Standards (National Bureau of Agricultural Commodity and Food Standards, 2015). Sows that had farrowed in the same season in each year were assumed to have received the same feeding program, management and health care. The amount and diet composition of concentrate feeds were provided to the sows differently depending on their age and production stage. Gilts and sows in their non-lactating period were fed twice a day (0700 hours and 1300 hours) at 2.5 kg/day with 16% crude protein (metabolizable energy; ME at 3,200–3,500 kcal/kg). In the lactating period, sows were fed four times a day (0700 hours, 1000 hours, 1300 hours and 1500 hours) at 5–6 kg/day with 17–18% crude protein (ME 4,060 kcal/kg). Replacement gilts and sows were detected for signs of estrus twice a day in the morning and afternoon based on visual appraisal and boar exposure. For replacement gilts, insemination was taken for the first time at age 8–9 mth or at a body weight of 140 kg. After observed estrus, gilts and sows were artificially inseminated twice (12 hr after detected estrus and the next 12 hr after the first insemination) with the same boar. During pregnancy and days open, gilts and sows were reared in individual stalls. They were transferred to the farrowing pens a week before the expected parturition date.

Statistical analysis

Genetic parameter estimation

Pedigree and performance data were combined to estimate covariances and variance components for tPL, TB and LBW using the average information restricted maximum likelihood algorithm (Gilmour et al., 2000) for multivariate analysis. Farrowing year-season (27 contemporary groups), parity (1, 2, 3, 4, 5, 6, 7, 8 and ≥ 9) and age at first farrowing of sows were examined as fixed effects in the repeatability animal model. Animal, permanent environment and residual were random effects in the model: $\mathbf{y} = \mathbf{Xb} + \mathbf{Za} + \mathbf{Wpe} + \mathbf{e}$; where $\mathbf{y}$ is the vector of observations for +PL, TB and LBW [$\mathbf{y} \sim \mathrm{MVN}(\mathbf{Xb}, \mathbf{V}_\mathbf{p})$], $\mathbf{b}$ is the vector of fixed effects (farrowing year-season, parity and age at first farrowing), $\mathbf{a}$ is the vector of random animal additive genetic effect [$\mathbf{a} \sim \mathrm{MVN}(0, \mathbf{V}_\mathbf{a})$], $\mathbf{pe}$ is the vector of permanent environmental effect [$\mathbf{pe} \sim \mathrm{MVN}(0, \mathbf{V}_\mathbf{pe})$], $\mathbf{X}$, $\mathbf{Z}$ and $\mathbf{W}$ are the incidence matrixes related to elements of vectors $\mathbf{b}$, $\mathbf{a}$ and $\mathbf{pe}$, respectively, and $\mathbf{e}$ is the vector of residual random effect [$\mathbf{e} \sim \mathrm{MVN}(0, \mathbf{V}_\mathbf{e})$]. Variance and covariance matrices of random effects were based on a hatation below:

$$V\begin{bmatrix} a \\ pe \\ e \end{bmatrix} = \begin{bmatrix} G\otimes A & 0 & 0 \\ 0 & P\otimes I & 0 \\ 0 & 0 & R\otimes I \end{bmatrix}$$

where A is the additive genetic relationship matrix, I is an identity matrix and G, P and R are the variance and covariance matrices of vectors a, pe and e, respectively. Bivariate analysis for tPL and NPL was done with the same repeatability animal model. Variance components (additive genetic variance, permanent environmental variance and residual variance) and covariances for given traits were used to estimate the genetic parameters which were heritability, repeatability, genetic correlation and phenotypic correlation. The significance of fixed effects on traits was tested using a general linear model.

Additive genetic prediction

Multiple traits analysis based on the repeatability animal model was used in the prediction of breeding values for tPL, TB and LBW. Estimated means in each subclass of fixed effects and estimated breeding values (EBV) for tPL were back transformed based on the exponential function [exp (trait) - 1]. Sows were categorized into two groups based on the appearance of piglet loss at birth during the data recording period: 1) sows without piglet loss at birth (132 sows) and 2) sows with piglet loss at birth at least once (1,028 sows). The orthogonal contrast in the general linear model was used to compare the mean difference of EBV for all traits between both groups of sows.

Results and Discussion

Descriptive statistics for proportion of piglet loss

Overall, the Landrace sows in this herd delivered their first progenies at age 410 d. They produced approximately 12 piglets of TB and lost 1.31 piglets at birth on average which was 10.98% as a proportion of TB, as shown in Table 1. The occurrence of piglet loss in this population was higher than reported in the other countries such as China (Zhang et al., 2016), southeastern Mexico (Segura-Correa and Solorio-Rivera, 2013) and France (Le Cozler et al., 2002) where piglet loss at birth was in the range 5.2–9.5%. Even in the same country, evidence of numbers of mummified and stillborn piglets was different from the current results, with lower numbers of piglet loss reported in purebred Landrace and Yorkshire sows (9.2%) by Tummaruk et al. (2004) and in Landrace-Yorkshire crossbred sows (9.9%) by Nuntapaitoon and Tummaruk (2015). These various results might have been due to differences in the genetic pool, farm management and environmental factors in the housing may have been conditional on the population.

About 11% of the sows in the population never produced mummified or stillborn piglets during the study period (Fig. 1A). They produced 11.14 (SD 2.74) piglets per litter on average. For sows with piglet loss, most of these sows (53%) lost their progeny at birth once to three times a production period. Almost 6% of sows lost their piglets in all parities, delivering 12.57 (SD 3.09) piglets per litter. According to these performance results, sows with greater numbers of total born piglets seemed to have a risk of losing some of their piglets due to embryonic death during gestation or piglet death at birth. Inadequate uterine space for fetus development has been mentioned as the cause of mummification which commonly occurs in prolific sows (Wu et al., 1988). In addition, prolonged farrowing in a large litter could bring a higher risk of asphyxia to the piglets resulting in a higher rate of stillbirth (Herpin et al., 2001). Without losing piglets at birth, sows produced a higher litter birth weight (18.71 kg) compared to sows losing their piglets in all parities (16.70 kg). This finding implied an opportunity for pig producers to take advantage of sows without piglet loss.

During the studied period, 48% of the litters had no piglet loss at birth and only 1% lost all piglets in the litter (Fig. 1B). About one-third of the litters had piglet loss of less than 20%. This distribution

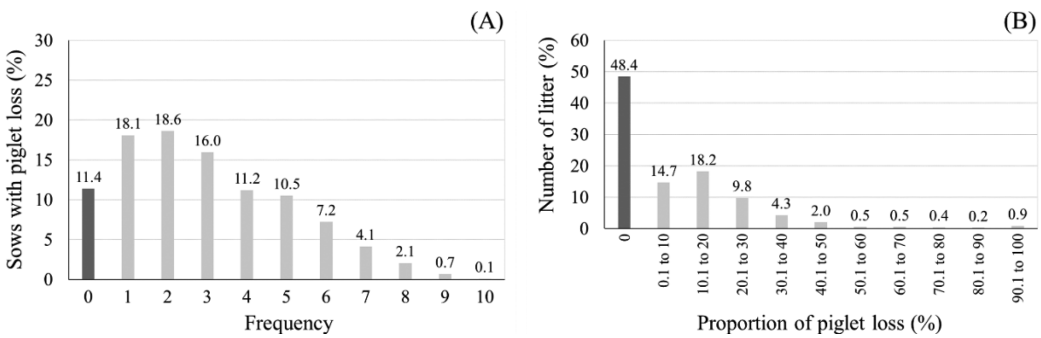

Fig. 1 Data distribution: (A) percentage of sows having piglet loss at birth by frequency; (B) distribution of proportion of piglet loss at birth in population

Table 1 Descriptive statistics for reproductive performances of Landrace sows

Variable	*n*	Mean	SD	Range
Parity	6,673	3.98	2.40	1–9
Age at first farrowing (d)	6,673	410.32	41.25	321–545
Number of total born piglets (piglet)	6,643	11.85	2.95	2–20
Number of dead piglet (piglet)	6,668	1.31	1.85	0–14
Proportion of piglet loss at birth (%)	6,673	10.98	16.21	0–100
Litter birth weight (kg)	6,659	17.89	5.11	0–32.40

indicated the wide range of proportional piglet loss (0–100%) in the population which indicated the different production efficiencies of sow. From the perspective of number per litter, dead piglets at birth varied from 0 to 14 piglets, presented in different sizes of litters (TB ranged from 2 to 20 piglets). These results suggested that considering piglet loss at birth as a proportion instead of as the number per litter might be a better choice to consider in reducing piglet loss at birth, as the pig producer could compare the productivity of a sow and select a replacement gilt without being concerned about various litter sizes.

Effects of year-season at farrowing, parity and age at first farrowing

Differences in year-season at farrowing, parity and age at first farrowing of sow had highly significant ($p < 0.01$) effects on tPL, TB and LBW. The estimated means for PL of sows in each contemporary group were different, ranging from 5.37% (summer 2017) to 14.52% (rainy 2013). The extreme estimated means for PL were in rainy 2013 and rainy 2014. Overall, the phenotypic performances for PL fluctuated during the nine years studied (Fig. 2). There was no clear pattern in piglet loss performance in the same season of the year. This phenomenon showed the clear impact of temporary environmental effects in each farrowing year-season on PL. Controlling the environment in each year-season to be suitable for the sow should be practiced at the farm level to minimize piglet loss at birth. The stability of the temporary environment could reveal genetic-based differences among animals which could benefit the breeding program.

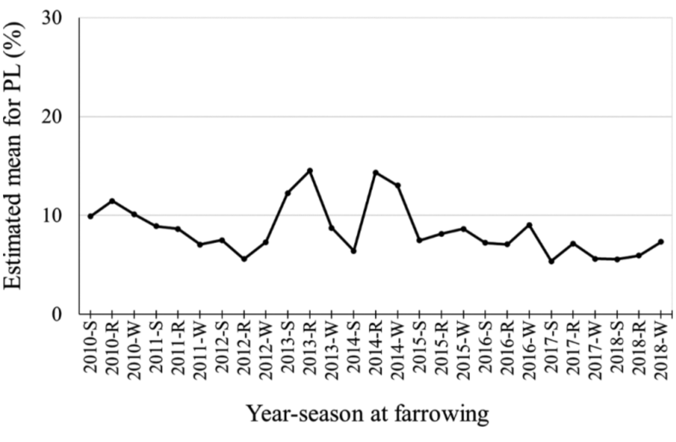

Fig. 2 Estimated mean for proportion of piglet loss at birth (PL) by year-season at farrowing of sow, where S = summer, r = Rainy and W = winter

The second parity sows had the lowest mean PL ± SD (10.45 ± 0.08%). In successive parties, PL tended to continuously increase and reached its peak in the eighth parity (11.17 ± 0.10%). The primiparous and old sows had a higher risk of loss of their piglets. In addition, they had low values for TB and LBW. Incomplete sexual maturity might have been a possible reason for the poor productivity in primiparous sows, as a narrow birth canal could be the cause of stillbirth (Pejsak, 1984) which was 63% of piglet loss at birth in the first parity. For sows in late parity, excessive fatness and poor uterine muscle tone were mentioned as probable factors associated with increasing numbers of dead piglets during delivery (Canario et al., 2006). The fatness of an old sow could lead to large amounts of adipose tissue surrounding the birth canal which could present as a physical obstacle in farrowing by reducing expulsion (Oliviero et al., 2010). Less efficient expulsion due to sow fatness and poor uterine muscle tone might have been reasons for prolonged farrowing that resulted in more stillborn piglets for the old sows. Although there was only a small impact of sow parity on PL (less than 1% change) in this population, pig producers should manage the herd structure properly to maintain sow productivity on their farms.

The estimated coefficients of age at first farrowing for PL, TB and LBW were -0.0008 ± 0.0005 ($p < 0.001$), -0.0056 ± 0.0013 ($p < 0.001$) and -0.0041 ± 0.0021 ($p < 0.05$), respectively. Small coefficients show a low relationship between age at first farrowing and these three traits. An age increase of 30 d for first farrowing resulted in a reduction of 0.02% in PL and decreases of 0.17 piglets for TB and of 123 g for LBW. Younger gilts at first farrowing lost slightly more piglets at birth than the older ones. However, they still had better performance based on a larger litter size and heavier birth weight in total. The small impact of sow age at first farrowing on the production traits in the current study implied that age at first farrowing of sow might not be an effective index for determining their productive performance in terms of piglet loss at birth, litter size and litter birth weight.

Genetic parameters

Variance components

The component of variances for three traits are shown in Table 2. Levels of additive genetic variances for all traits were exceedingly low at 2.8%, 8.5% and 6.2% in proportion to phenotypic variances for tPL, TB and LBW, respectively. Only 2.3–7.7% of phenotypic variances relied on permanent environment. Considering phenotypic variance for TB, this population had lower variation than Large White pig in China which reported 11.69 piglet^2 (Zhang et al., 2016) and 11.76

Table 2 Variance components and genetic parameters for production traits

Trait	Variance component				h^2	t
	V_a	V_{pe}	V_e	V_p		
tPL	0.06 ± 0.02	0.05 ± 0.02	2.04 ± 0.04	2.14 ± 0.04	0.03 ± 0.01	0.05 ± 0.01
TB	0.72 ± 0.16	0.65 ± 0.15	7.05 ± 0.13	8.42 ± 0.16	0.09 ± 0.02	0.16 ± 0.01
LBW	1.53 ± 0.40	1.88 ± 0.39	20.91 ± 0.40	24.31 ± 0.45	0.06 ± 0.02	0.14 ± 0.01

V_a = additive genetic variance; V_{pe} = permanent environmental variance; V_e = environmental variance; V_p = phenotypic variance; h^2 = heritability; t = repeatability; tPL = transformed proportion of piglet loss at birth; TB = number of total born piglets; LBW = litter birth weight.Values are presented as the estimate ±SE.

piglet^2 (Ye et al., 2018) for phenotypic variation. However, a similar distribution of TB was found in Japanese Landrace (8.06 piglet^2) and Large White pigs (7.21 piglet^2) by Ogawa et al. (2019) and in Korean Berkshire pig (8.52 piglet^2) by Lee et al. (2015).

Low estimated additive genetic variances could be a major obstacle in the selection of the great sire and dam. The similarity of animals in the herd might lead to slow genetic progress due to low genetic differences in current animals and selected animals. Therefore, high specific genetic information such as genotype or nucleotide polymorphisms are needed to identify genetic difference among animals. Moreover, importing breeding stock that having a great genetic ability for piglet productivity might increase genetic variation in the population (Falconer and Mackay, 1996). Increased genetic difference in an animal could provide an opportunity to select a replacement gilt with greater accuracy and convenience. It would benefit the breeding program to reduce piglet loss by sows in the next generation.

Heritability

Heritability values for tPL, TB and LBW were 0.03, 0.09 and 0.06, respectively. The lowest heritability was in tPL which was also lower than in a previous report ($h^2 = 0.09$) for piglet mortality at birth (Zhang et al., 2016). For TB and LBW, greater heritabilities were reported in other populations ranging from 0.12–0.18 (Zhang et al., 2016; Ogawa et al., 2019). Low heritability for these traits indicated a weak relationship between the variation of animal phenotype and additive genetic variance. Thus, selection based on an animal's performance record might not be an efficient strategy to reduce piglet loss at birth for a sow. Inaccurate selection could lead to slow genetic progress and be time consuming. Improving and maintaining proper farm management and a suitable environment throughout the production period could help selection accuracy to reduce piglet loss at birth and to increase productivity of the Landrace sow.

Based on the low heritability estimates for tPL, TB and LBW, the EBV for those traits of the individuals could help to increase selection accuracy. Combining genotype or marker information with pedigree and phenotypic records could increase the accuracy of EBV for litter size and piglet mortality of sows (Guo et al., 2015; Knol et al., 2016). If the profit from improving tPL, TB and LBW for Landrace sows is of interest, perhaps, genomic information could be considered to help improve the accuracy of selection and also the association between piglet loss, productivity at birth and other complex traits of Landrace sow.

Repeatability

All traits had low repeatability estimates in the range 0.05–0.16 (Table 2). For a single trait, repeatability was slightly higher than the heritability estimates, which indicated low permanent environmental variance in this population. The repeatability estimates for TB and LBW of this Landrace population were lower than those Landrace sows (0.21 for TB and 0.26 for LBW) reported by Ogawa et al. (2019). Low repeatability estimates for tPL, TB and LBW indicated there was little similarly between the performance of the consecutive parities of a sow in the population. Therefore, records from only the first or any single parity of the sow were not precise. Higher precision and accuracy are required, considering all repeated records of individual sows. Furthermore, a low repeatability estimate indicates large variation of temporary environments (Falconer and Mackay, 1996), which relates mostly to management practices within the population. Thus, unifying suitable management throughout the production period is a challenge for producers, not only to achieve high performance by the sows but also to allow unbiased comparison for genetic selection.

Phenotypic and genetic correlations

Phenotypic and genetic correlations between production traits are presented in Table 3. Negative genetic correlation was found between tPL and TB (-0.19 ± 0.22), and tPL and LBW (-0.73 ± 0.18), but not between TB and LBW (0.77 ± 0.07). However, genetic correlation (-0.19 ± 0.22) and phenotypic correlation (0.18 ± 0.01) between tPL and TB were in the opposite directions. This result confirmed that a breeding program to improve several traits simultaneously should be based on estimated genetic correlations in the target population. Considering the association between performance records could lead to unexpected consequence in the herd that might damage farm profitability in the long term. The negative genetic correlation between tPL and TB in this population disagreed with the report of Zhang et al. (2016) who found a positive genetic correlation between both traits in Large White sow, but the level of correlation was in the same range ($r_g = 0.17 \pm 0.13$). The difference in breeds (Landrace versus Large White), the definition of traits (the proportion of piglet loss in terms of mummies and stillbirths versus mortality at birth with unclear definition), software (ASREML versus DMU), models and environmental conditions might be possible reasons for the different directions in estimated genetic correlation between those populations.

Table 3 Genetic correlation (above diagonal) and phenotypic correlation (below diagonal) between reproductive traits

Trait	tPL	TB	LBW
tPL		-0.19 ± 0.22	-0.73 ± 0.18
TB	0.18 ± 0.01		0.77 ± 0.07
LBW	-0.33 ± 0.01	0.74 ± 0.01	

tPL = transformed proportion of piglet loss at birth; TB = number of total born piglets; LBW = litter birth weight. Values are presented as the estimate ± SE.

Nevertheless, genetic correlation between tPL and TB was low with a high standard error; there was no obvious pattern in the scatterplot between EBVs for PL and TB in this population (Fig. 3A). This implied that genetic ability for PL of sows from the consequence of replacement gilt selection for enlarged TB might be unpredictable. In practice, genetic improvement for these two traits could be done independently.

For tPL and LBW, high negative genetic correlation between both traits indicated the favorable outcome from piglet loss improvement in term of genetics. Sows having low EBV for PL tended to have high EBV for LBW (Fig. 3B). Each 1% decrease in EBV for PL resulted in an increase of 4.77 kg of EBV for LBW ($R^2 = 0.60$). Thus, selection based on EBV for PL would be a positive indirect improvement in LBW. In this case, genetic improvement for these two traits could be done simultaneously. Sows with negative genetic ability for PL had implied high piglet productivity at birth. Furthermore, they might also have good genetic ability for LBW which indicates the total weight yield in the litter. For this reason, genetic improvement to reduce PL could earn more profit on a commercial Landrace pig farm. However, due to the low heritability of both PL and LBW, increasing selection accuracy and unifying suitable management throughout the production period should be the focus to speed up the genetic improvement program.

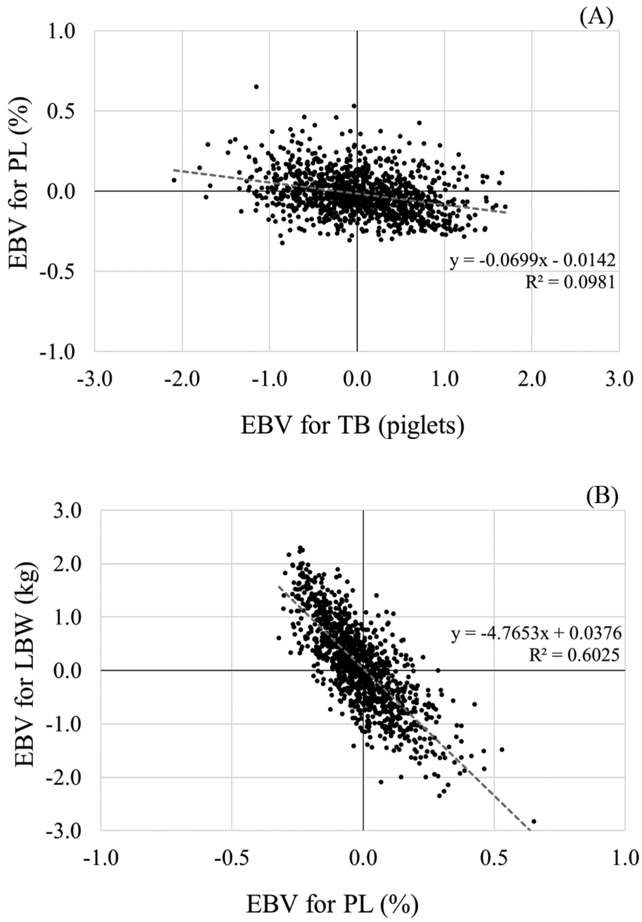

Fig. 3 Estimated breeding value (EBV) relationship with: (A) proportion of piglet loss at birth (PL) and number of total born piglets (TB); (B) proportion of piglet loss at birth (PL) and litter birth weight (LBW), where R^2 = a goodness of fit measure for linear regression models

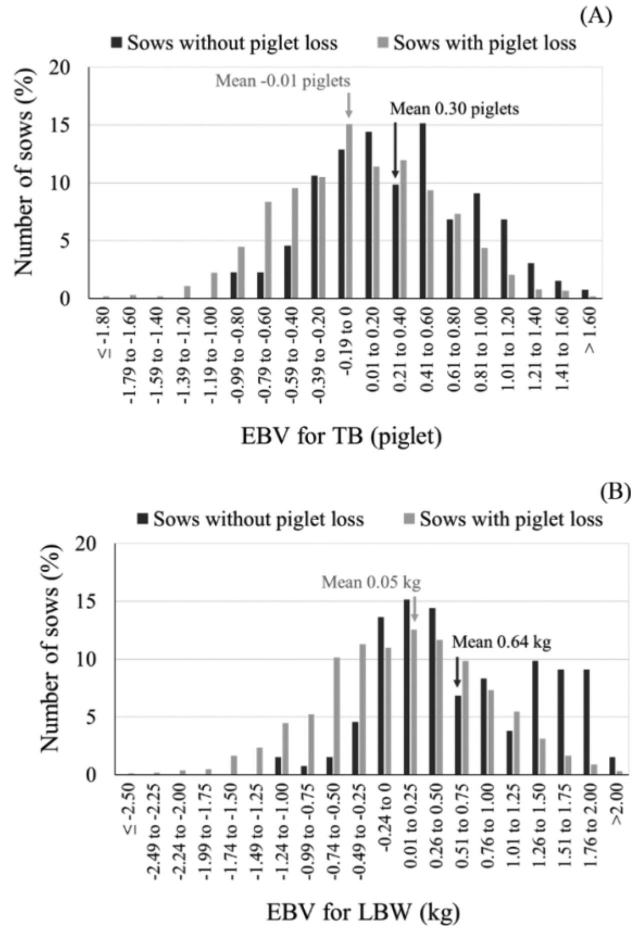

Fig 4 Estimated breeding value (EBV) distribution: (A) number of total born piglets (TB); (B) litter birth weight (LBW), where number of sows is presented as the percentage in each group of sows

Additionally, the high genetic correlation between tPL and LBW implied that performance of these traits might be controlled by the same gene or different genes located on the same chromosome, so that they are inherited together. In Hungarian Large White sows, two single nucleotide polymorphisms (SNPs) on chromosomes 5 and 6 were identified to be associated with both the number of piglets born dead and the litter birth weight by Balogh et al. (2019). These SNPs located near the same gene were *ARHGAP8* (SSC5), *PADI2* and *PADI1* (SSC6). However, there has been no report of a gene related to both PL and LBW directly. Furthermore, piglet loss at birth is a complex trait. Finding the gene related to fetal development, mummification and stillbirth might help the pig producer to better understand the association between piglet loss at birth and other production traits.

Lower negative genetic correlation between piglet mortality and litter weight at birth was observed by Zhang et al. (2016). Huby et al. (2003) reported a moderate positive genetic correlation between survival rate at birth and litter birth weight (0.49) in Large White pigs. The breed of sow, population structure, environment and model for estimation might be reasons for the differences in correlation levels among these studies.

According to bivariate analysis, heritability (0.04) and repeatability (0.06) for number of dead piglets in the litter were low which close to the proportion of piglet loss. Both traits had a high positive genetic correlation (0.97 ± 0.02). These results indicated that the proportion of piglet loss could be an alternative trait for improving piglet productivity of sows instead of the number of dead piglets in the litter. However, there has been no reported research on genetic parameters for the proportion of piglet loss as exactly described in this study. For further implementation, genetic parameters for this trait should be estimated in varying populations.

Genetic ability of sows without piglet loss

There were 132 sows in the total of 1,160 sows who had never lost a piglet at birth in any parity. The EBV distribution in Fig. 4 shows the different variations between those sows and sows with piglet loss. The EBVs of sows without piglet loss ranged from -0.25% to 0.12% for PL, from -0.97 piglets to 1.70 piglets for TB, and from -1.22 kg to 2.26 kg for LBW. The variation in EBV was larger in sows with piglet loss, ranging from -0.32% to 0.65% for PL, -2.09 piglets to 1.66 piglets for TB and -2.82 kg to 2.29 kg for LBW.

The evidence that the values of both the EBV for TB and LBW of sows without piglet loss were in the range of the EBV of sows with piglet loss might have been due to their inter relationship. According to the pedigree profile, about 98% of sows without piglet loss had relatives including sows with piglet loss in terms of full-sib, parental half-sib and maternal half-sib. On the contrary, only about one-half of the sows with piglet loss (54%) had a relative including sows without piglet loss. The difference in the genetic pools of the other half might have caused the larger EBV variation of sows with piglet loss. Unfortunately, the EBV for TB and LBW of sows with piglet loss inclined in a negative direction that could have been a possible reason for the lower EBV on average.

The genetic ability of both sow groups was highly significantly different ($p < 0.01$). There was greater genetic ability for all traits in sows without piglet loss. These sow groups had a lower EBV mean for PL but higher EBV means for TB and LBW with mean differences of -0.10 ± 0.01% for PL, 0.31 ± 0.05 piglets for TB and 0.60 ± 0.07 kg for LBW. Based on these results, sows without piglet loss could be a good genetic resource for maternal line development. Using occurrence of piglet loss at birth throughout the sow's productive life as the indicator might be an interesting option for replacement gilt selection. However, the productivity and longevity of sows without piglet loss should be investigated. In this population, sows with piglet loss had longer productive lives. They delivered progeny until their sixth parity on average, whereas about 55% of sows without piglet loss produced piglets only two times due to the productive performance of the sows in this dataset being gathered from sows that had finished their productive life and from sows that remained in the breeding herd to produce piglets. Therefore, the high percentage of incomplete productive life record of sows without piglet loss (approximately 61%) might be a possible reason for the shorter production period compared to sows with piglet loss (31%) that was composed of incomplete productive life records. Considering only complete productive life records of sows without piglet loss that performed only two parity, these sows had means for the EBV for TB (0.19 piglets) and LBW (0.41 kg) that were higher than for sows with piglet loss (both complete and incomplete records). Although sows without piglet loss had good genetic ability for TB and LBW, they might have other problems affecting their reproductivity, productivity and stayability of sows in this population. More characteristics of these sows should be collected using genetic evaluation for longevity or other economically important traits using the complete productive life records.

Although additive genetic variance for tPL was low, this trait could be an interesting choice for selection to reduce mummified or stillbirth piglets within the litter independently from the litter size of the sow. More importantly, pig producers could make unbiased comparisons of sow productivity without being concerned about TB differences. Furthermore, the advantage of genetic improvement for PL might also be achieved by increasing genetic ability for the LBW of replacement gilts on their farm. Due to the low heritability of tPL, controlling farm management strategy to optimize production could reduce the PL of sows in the short term. However, improving the PL through a breeding program might be possible by applying imported genetics resources, selection based on highly accurate genetic information and recording the litter performance of sows and all parities. To speed up genetic gain for PL, genomic information is necessary but its cost is large which might make committing to this a difficult cash flow decision for the farm owner. Finding an early indicator for PL could be an interesting solution to the reduce time for selection. There was greater genetic ability for PL, TB and LBW in sows that had not lost a newborn piglet. A Landrace pig producer might use these sows as an alternative genetic resource to develop replacement gilts in the next generation.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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