Philipp J Vet Anim Sci 2020 46(2):87-95

# EVALUATION OF BACKFAT THICKNESS IN PERFORMANCE-TESTED LANDRACE, LARGE WHITE AND THEIR $F_1$ CROSSES IN A LOCAL SWINE BREEDING FARM

Kiara Alessandra R. Lego[1] and Orville L. Bondoc[1]


## ABSTRACT

**This study evaluated backfat thickness (BFT) of 12,272 performance-tested pigs (3,351 boars and 8,921 gilts) belonging to Landrace (LDR), Large White (LRW), and their $F_1$ crosses. Backfat thickness at the shoulder (BFT1), mid-back (BFT2), loin (BFT3), and their average were significantly affected (*P*<0.01) by breed, year, month, and weight at the end of test. Backfat thickness was highest for BFT1 (15.67 mm for boars; 15.80 mm for gilts), followed by BFT3 (14.21 mm for boars; 15.21 mm for gilts), and lowest for BFT2 (11.95 mm for boars; 12.30 mm for gilts). Average BFT was positively (*P*<0.01) correlated with average daily gain, body length, age, and weight at the end of test. Average BFT was significantly (*P*<0.05) lower in boars than in gilts. Average BFT was significantly (*P*<0.05) higher in Landrace than in Large White. Differences in average BFT between F1 LDR x LRW and R1 LRW x LDR crosses were not significant (*P*>0.05). Heterosis for average BFT in boars (–3.37% or –0.45 mm) was higher than in gilts (–1.48% or –0.21 mm). While backfat thickness can be reduced by selection within a breed, backfat thickness may also be decreased by heterosis resulting from the production of $F_1$ crosses.**


Key words: backfat thickness, boars and gilts, Landrace, Large White, $F_1$ crosses

## INTRODUCTION

Backfat thickness comprises one of the selection criteria in performance testing programs for leaner pigs. When measured at 3 different sites, Kim *et al*. (2004) reported that backfat thickness was highest at the shoulder (on the 4th thoracic vertebrae), intermediate at the loin (on the last lumbar vertebrae), and lowest at the midback (on the last thoracic vertebrae). They also reported that backfat thickness was negatively correlated with days to 90 kg in Landrace (r = –0.04 to –0.17) and Large White (r = –0.10 to –0.13).

As the basic indicator of carcass fatness or grade and predictor of carcass lean yield, backfat thickness can be reduced within a breed through genetic selection. Bondoc *et al*. (2018) reported that heritability of backfat thickness of Landrace and Large White breeds were higher in boars (0.32 – 0.77) than in gilts (0.14 – 0.51). Furthermore, heritability estimates for backfat measurements at the shoulder, midback and loin, and an average of

[1]Animal Breeding Division, Institute of Animal Science, College of Agriculture and Food Science (CAFS), University of the Philippines Los Baños (email: olbondoc@up.edu.ph).

those backfat measurements were 0.34, 0.50, 0.42 and 0.46 in Landrace and 0.33, 0.52, 0.43 and 0.49 in Large White, suggesting that backfat thickness at the shoulder is less reliable as an indicator for breeding value for the trait (Kim *et al*., 2004).

In the Philippines, market hogs are produced by nucleus/multiplier breeding farms out of the cross between the Duroc (or Pietrain) terminal boars and the $F_1$ Landrace x Large White crossbred sows. While heterosis for reproductive traits of Landrace x Large White crossbred sows had already been evaluated (Bondoc *et al*., 2019), local evaluation of backfat thickness in young $F_1$ Landrace x Large White crossbred pigs is not common.

In this regard, the aim of the study was to evaluate breed differences for backfat thickness between performance-tested Landrace and Large White pigs, and heterosis resulting from their $F_1$ crosses in a local swine nucleus breeding farm.

## MATERIALS AND METHODS

Backfat thickness at the shoulder (BFT1), midback (BFT2), loin (BFT3), and their average were collected from 12,272 performance-tested pigs consisting of 3,351 boars and 8,921 gilts belonging to Landrace (LDR), Large White (LRW), and their $F_1$ crosses (i.e., $F_1$ LDR x LRW and its reciprocal cross R1 LRW x LDR). The 5-year data from 2014 to 2018 were taken from the performance testing program of the International Farms Corporation (INFARMCO) swine breeding farm located at San Isidro, Cabuyao, Laguna, Philippines (approx. 14° 14' 49.69" N, 121° 8' 34.41" E).

Backfat thickness was measured 5 cm from the right-hand side of the midline from three different sites (shoulder – BFT1, midback – BFT2, and loin – BFT3 at a position directly above the point of the elbow, last rib, and last lumbar vertebra) using a real-time ultrasound instrument (Renco-Lean-Meter® Ultrasonic Back Fat Detector, Renco Corporation, Minneapolis, MN USA).

Other performance-test data were also used including average daily gain (ADG), feed efficiency (for boars only), age, weight, and body length at the end of test. The ADG for boars was computed from the start until the end of test, while gilt ADG was computed from birth until the end of test. The average age and weight at the end of test were 147.6 ± 4.2 d and 95.0 ± 10.6 kg for boars and 155.3 ± 4.6 d and 90.9 ± 10.5 kg for gilts, respectively.

Simple descriptive statistics were determined for backfat thickness measurements and performance-test data, separately for boars and gilts (Table 1) using the MEANS procedure of SAS (2009). The Pearson product-moment correlation coefficients were then determined to measure linear relationships among backfat thickness and with performance-test records using the CORR procedure of SAS (2009). Performance-test records found to be consistently and significantly correlated with backfat thickness were included as covariates in the statistical model.

The general least squares procedures for unbalanced data were used to examine the principal sources of variation affecting backfat thickness measurements. Only those significant ($P$<0.05) fixed effects and covariates were included in the statistical model.

The following statistical model was used to determine, using an F-test, the appropriate model that would best describe each backfat thickness in performance-tested boars and gilts: $\mathbf{y_{ijklm} = \mu + Breed_i + Year_j + Month_k + Wt\text{-}EOT_l + e_{ijklm}}$ where $y_{ijklm}$ is backfat thickness (i.e., BFT1, BFT2, BFT3, average BFT), μ is the overall mean, $Breed_i$ is the ith

Table 1. Simple descriptive statistics for backfat thickness and performance-test records (2014-2018).

| | N | Average ± Std. Dev. | Range |
|---|---|---|---|
| **Boars** | | | |
| Backfat thickness (BFT) | | | |
| - BFT1 (shoulder), mm | 3,351 | 15.68 ± 3.00 | 7 – 26 |
| - BFT2 (midback), mm | 3,351 | 11.95 ± 2.23 | 6 – 23 |
| - BFT3 (loin), mm | 3,351 | 14.22 ± 2.74 | 6 – 27 |
| - Average BFT, mm | 3,351 | 13.95 ± 2.31 | 7.00 – 23.67 |
| Performance-test records | | | |
| - Ave. daily gain, kg/day* | 3,351 | 0.843 ± 0.119 | 0.358 – 1.429 |
| - Feed efficiency, g/g | 3,351 | 2.64 ± 0.34 | 1.41 – 5.64 |
| - Body length at the end of test, cm | 2,556 | 112.94 ± 4.19 | 90 – 150 |
| - Age at the end of test, days | 3,351 | 147.56 ± 4.15 | 140 – 168 |
| - Weight at the end of test, kg | 3,351 | 94.95 ± 10.64 | 62.5 – 129.0 |
| **Gilts** | | | |
| Backfat thickness (BFT) | | | |
| - BFT1 (shoulder), mm | 8,921 | 15.80 ± 3.01 | 4 – 29 |
| - BFT2 (midback), mm | 8,921 | 12.29 ± 2.31 | 4 – 24 |
| - BFT3 (loin), mm | 8,921 | 15.41 ± 2.90 | 5 – 26 |
| - Average BFT, mm | 8,921 | 14.50 ± 2.36 | 5.33 – 25.00 |
| Performance-test records | | | |
| - Ave. daily gain, kg/day** | 8,921 | 0.585 ± 0.064 | 0.294 – 0.803 |
| - Body length at the end of test, cm | 6,775 | 112.13 ± 4.03 | 89 – 126 |
| - Age at the end of test, days | 8,908 | 155.27 ± 4.55 | 141 – 180 |
| - Weight at the end of test, kg | 8,921 | 90.88 ± 10.52 | 43.2 – 128.0 |

*Boar ADG was computed from the start until the end of test.

**Gilt ADG was computed from birth until the end of test.

effect of breed (i.e., Landrace, Large White, F1 and R1 crossbreds), $Year_j$ is the jth effect of year (i.e., 2014 to 2018), $Month_k$ is the kth effect of month (January to December), $Wt\text{-}EOT_l$ is the lth covariate effect of weight (kg) at the end of test, and $e_{ijklm}$ is the error term.

Heterosis for BFT1, BFT2, BFT3, and average BFT were estimated separately for boars and gilts as the mean crossbred deviation expressed in percentage of mid-parent performance, where crossbred average = $(\overline{F1} + \overline{R1}) \div 2$ and purebred average = $(\overline{LDR} + \overline{LRW}) \div 2$.

Reciprocal or maternal effects for backfat thickness were computed as the difference in average F1 and R1 performance. In this study, the advantage (in terms of lower backfat thickness) of using a Large White or Landrace dam in the production of $F_1$ crossbred sows is equal to $\overline{F1} - \overline{R1}$ and $\overline{R1} - \overline{F1}$, respectively.

## RESULTS AND DISCUSSION

The backfat thickness at the shoulder, midback, loin, and their average were 15.68 ± 3.00, 11.95 ± 3.00, 14.22 ± 2.74, and 13.95 ± 2.31, respectively for boars and 15.80 ± 3.01, 12.29 ± 2.31, 15.41 ± 2.90, and 14.50 ± 2.36, respectively for gilts (Table 1). Similar to the study by Kim *et al*. (2004), backfat thickness was highest at the shoulder, intermediate at the loin, and lowest at the midback.

The correlations among backfat thickness at shoulder, midback and loin and average of those backfat measurements and performance test records for boars and gilts are given in Table 2. Backfat thickness at the 3 different sites for boars and gilts were highly correlated ($P<0.01$) with average backfat thickness (r = 0.84 to 0.89). Backfat thickness at the shoulder (BFT1) was positively correlated ($P<0.01$) with BFT2 (r = 0.66) and with BFT3 (r = 0.63). Backfat thickness at midback (BFT2) and loin (BFT3) were likewise correlated ($P<0.01$) with each other (r = 0.62). Similar relationships were reported by Bondoc *et al*. (2018) who

Table 2. Pearson correlation coefficients among backfat thickness and with performance-test records.

| | BFT1 shoulder | BFT2 midback | BFT3 loin | Average BFT |
|---|---|---|---|---|
| **Boars** | | | | |
| Backfat thickness (BFT) | | | | |
| - BFT1 (shoulder) | – | 0.66** | 0.63** | 0.89** |
| - BFT2 (midback) | | – | 0.62** | 0.85** |
| - BFT3 (loin) | | | – | 0.87** |
| Performance-test records | | | | |
| - Ave. daily gain, kg/day | 0.48** | 0.46** | 0.49** | 0.55** |
| - Feed efficiency, g/g | -0.36** | -0.35** | -0.36** | -0.41** |
| - Body length at the end of test, cm | 0.39** | 0.38** | 0.40** | 0.44** |
| - Age at the end of test, days | 0.27** | 0.22** | 0.30** | 0.31** |
| - Weight at the end of test, kg | 0.57** | 0.52** | 0.58** | 0.64** |
| **Gilts** | | | | |
| Backfat thickness (BFT) | | | | |
| - BFT1 (shoulder) | – | 0.63** | 0.61** | 0.88** |
| - BFT2 (midback) | | – | 0.59** | 0.84** |
| - BFT3 (loin) | | | – | 0.86** |
| Performance-test records | | | | |
| - Ave. daily gain | 0.52** | 0.48** | 0.56** | 0.61** |
| - Body length at the end of test | 0.40** | 0.40** | 0.39** | 0.45** |
| - Age at the end of test | 0.19** | 0.21** | 0.25** | 0.25** |
| - Weight at the end of test | 0.54** | 0.51** | 0.59** | 0.63** |

**correlation coefficient (r) is significantly different from zero ($P<0.01$).

also showed positive correlations of BFT1, BFT2, BFT3 and average BFT with weight at the end of test for boars (r = 0.42 to 0.57) and for gilts (r = 0.44 to 0.54). By comparison, Kim *et al*. (2004) reported slightly higher correlations between BFT1 and BFT2 (r = 0.73 to 0.75), between BFT1 and BFT3 (r = 0.82 – 0.84), and between BFT2 and BFT3 (r = 0.81 to 0.82) in Landrace and Large White pigs in South Korea.

Furthermore, backfat thickness at 3 different sites and their average were positively correlated ($P<0.01$) with ADG (r = 0.46 to 0.61), body length (r = 0.38 to 0.45), age at the end of test (r = 0.19 to 0.31), and weight at the end of test (r = 0.51 to 0.64). For performance-tested boars, backfat thickness measurements were negatively correlated ($P<0.01$) with feed efficiency (r = –0.35 to –0.41). Similar observations were reported by Serenius and Stalder (2004) who showed that average backfat thickness at 100 kg liveweight was positively correlated with ADG in Finnish Landrace and Large White pigs (r = 0.40).

Backfat thickness in boars was similar when taken from different sites, i.e., coefficient of variation (CV) ranged from 15.28% to 15.35% (Table 3). In gilts, however, backfat thickness was slightly more variable at the shoulder (CV = 15.73%) and midback (CV = 15.46%). Lower differences in backfat thickness were observed at the loin (CV = 14.90%).

The BFT1, BFT2, BFT3 and average BFT in both boars and gilts were significantly ($P<0.01$) affected by breed, year and month of test, and live weight at the end of test. However, BFT3 in gilts was not significantly affected ($P>0.05$) by breed.

In the comparisons between pure breeds, BFT1, BFT2, BFT3, and average BFT in boars were significantly ($P<0.05$) higher in Landrace than in Large White by 0.37, 0.61 mm, 0.59 mm, and 0.52 mm, respectively (Table 4). In gilts, BFT1, BFT2, and average BFT were

Table 3. Mean square F-tests for the effects of breed, year and month at the end of test (EOT), and the covariate effect of weight at the end of test on backfat thickness.

| | **Breed** | **Year EOT** | **Month EOT** | **Weight EOT** | **CV, %** |
|---|---|---|---|---|---|
| **Boars** | | | | | |
| Backfat thickness (BFT) | | | | | |
| - BFT1 (shoulder) | ** | ** | ** | ** | 15.28 |
| - BFT2 (midback) | ** | ** | * | ** | 15.35 |
| - BFT3 (loin) | ** | ** | ** | ** | 15.31 |
| - Average BFT | ** | ** | ** | ** | 12.34 |
| **Gilts** | | | | | |
| Backfat thickness (BFT) | | | | | |
| - BFT1 (shoulder) | * | ** | ** | ** | 15.73 |
| - BFT2 (midback) | ** | ** | ** | ** | 15.46 |
| - BFT3 (loin) | ns | ** | ** | ** | 14.90 |
| - Average BFT | ** | ** | ** | ** | 12.21 |

ns - no significant effect of independent variable ($P>0.05$).

*significant effect of independent variable ($P<0.05$).

**highly significant effect of independent variable ($P<0.01$).

Table 4. Backfat thickness (BFT) at the end of test (LSM ± SE) in different sex and breeds.

| | BFT1 shoulder, mm | BFT2 midback, mm | BFT3 loin, mm | Average BFT, mm |
|---|---|---|---|---|
| **Boars** | | | | |
| Landrace (LDR) | 15.90 ± 0.06[a] | 12.27 ± 0.05[a] | 14.50 ± 0.06[a] | 14.22 ± 0.04[a] |
| Large White (LRW) | 15.53 ± 0.06[b] | 11.66 ± 0.05[b] | 13.91 ± 0.06[b] | 13.70 ± 0.04[b] |
| F1 LDR x LRW cross | 14.71 ± 0.51[c] | 11.83 ± 0.39[ab] | 13.69 ± 0.47[b] | 13.41 ± 0.37[b] |
| R1 LRW x LDR cross | 15.28 ± 0.41[bc] | 11.46 ± 0.32[b] | 13.98 ± 0.38[b] | 13.57 ± 0.30[b] |
| **Gilts** | | | | |
| Landrace (LDR) | 15.89 ± 0.04[a] | 12.39 ± 0.03[a] | 15.36 ± 0.04[a] | 14.55 ± 0.03[a] |
| Large White (LRW) | 15.76 ± 0.04[b] | 12.17 ± 0.03[b] | 15.41 ± 0.04[a] | 14.44 ± 0.03[bc] |
| F1 LDR x LRW cross | 15.58 ± 0.24[bc] | 12.48 ± 0.19[a] | 14.88 ± 0.19[b] | 14.51 ± 0.17[ab] |
| R1 LRW x LDR cross | 15.41 ± 0.21[c] | 11.87 ± 0.16[c] | 15.45 ± 0.22[a] | 14.05 ± 0.15[c] |

Means within a column for boars or gilts without common letter superscripts are significantly different ($P<0.05$).

significantly ($P<0.05$) higher in Landrace than in Large White by 0.13 mm, 0.22 mm and 0.11 mm, respectively. BFT3 in gilts was not significantly different ($P>0.05$) between Landrace and Large White pigs.

In this study, the average BFT in Landrace was 14.22 mm for boars and 14.55 mm for gilts. For the Large White breed, the average BFT was 13.70 mm for boars and 14.44 mm for gilts. By comparison, a lower average BFT was reported by Choi *et al*. (2013) and Choy *et al*. (2015) for Landrace boars (11.92 mm to 13.50 mm) and gilts (13.03 mm to 14.25 mm), and Yorkshire boars (11.49 mm to 13.63 mm) and gilts (12.98 mm to 14.56 mm) in South Korea.

In the comparisons between $F_1$ crossbred pigs, BFT1, BFT2, BFT3, and average BFT in boars were not significantly different ($P>0.05$) between the F1 LDR x LRW and R1 LRW x LDR crosses. In gilts, BFT2 and average BFT were significantly ($P<0.05$) higher in F1 LDR x LRW than in R1 LRW x LDR crosses by 0.61 mm and 0.11 mm, respectively. However, BFT3 in gilts was significantly higher ($P<0.05$) in R1 LRW x LDR than in F1 LDR x LRW by 0.46 mm. BFT1 in gilts was not significantly different ($P>0.05$) between the $F_1$ crosses.

Backfat thickness was also significantly affected ($P<0.05$) by the year and month of performance testing. Backfat thickness was lowest in year 2016 and during the months of May and July (data not shown). Backfat thickness was also significantly ($P<0.01$) higher with higher weight at the end of test.

The BFT1, BFT2, BFT3, and average BFT in boars were lower in $F_1$ Landrace x Large White crosses compared to the average of purebred boars by 0.75 mm, 0.32 mm, 0.37 mm, and 0.47 mm, respectively (Table 5). As a consequence, negative heterosis values (i.e., –4.74%, –2.67%, –2.60%, and –3.37%) were estimated for BFT1, BFT2, BFT3, and average BFT, respectively.

In gilts, the BFT1, BFT2, BFT3, and average BFT in gilts were also lower in $F_1$ Landrace x Large White crosses compared to the average of purebred gilts by 0.33 mm, 0.11 mm, 0.22 mm, and 0.22 mm, respectively (Table 6). This resulted in negative heterosis

Table 5. Estimates of heterosis for backfat thickness in performance-tested boars.

| | BFT1 shoulder | BFT2 midback | BFT3 loin | Average BFT |
|---|---|---|---|---|
| **Pure breeds** | | | | |
| Landrace (LDR) | 15.90 | 12.27 | 14.50 | 14.22 |
| Large White (LRW) | 15.53 | 11.66 | 13.91 | 13.70 |
| Average | 15.72 | 11.97 | 14.21 | 13.96 |
| **Crossbreeds** | | | | |
| F1 LDR x LRW cross | 14.71 | 11.83 | 13.69 | 13.41 |
| R1 LRW x LDR cross | 15.23 | 11.46 | 13.98 | 13.57 |
| Average | 14.97 | 11.65 | 13.84 | 13.49 |
| **Heterosis, %** | -4.74 | -2.67 | -2.60 | -3.37 |
| Maternal effect using Large White dam | -0.52 | +0.37 | -0.29 | -0.16 |
| Maternal effect using Landrace dam | +0.52 | -0.37 | +0.29 | +0.16 |
| **Improvement due to heterosis (including reciprocal or maternal effects)** | | | | |
| $F_1$ cross | -0.71 | -0.31 | -0.36 | -0.45 |
| F1 LDR x LRW cross | -1.23 | +0.06 | -0.65 | -0.61 |
| R1 LRW x LDR cross | -0.19 | -0.68 | -0.07 | -0.29 |
| **Predicted crossbred performance** | | | | |
| $F_1$ cross | 14.97 | 11.65 | 13.84 | 13.49 |
| F1 LDR x LRW cross | 14.45 | 12.02 | 13.55 | 13.33 |
| R1 LRW x LDR cross | 15.49 | 11.28 | 14.13 | 13.65 |

Maternal and reciprocal effects were computed as F1 minus R1 and R1 minus F1, respectively.

estimates of –2.09%, –0.86%, –1.43%, and –1.48% corresponding to BFT1, BFT2, BFT3, and average BFT, respectively.

The negative heterosis estimates for average BFT for boars and gilts suggest that lower backfat thickness may also be influenced by non-additive genes (dominance, over-dominance, and epistasis). In boars, this is equivalent to a reduction of 0.71 mm, 0.31 mm, 0.36 mm, and 0.45 mm for backfat thickness at the shoulder, midback, loin, and average BFT of $F_1$ crosses. In gilts, a lower reduction of 0.32 mm, 0.10 mm, 0.22 mm, and 0.21 mm in backfat thickness at the shoulder, midback, loin, and average BFT, respectively were estimated for $F_1$ crosses.

Moreover, the maternal (reciprocal) effects to reduce average BFT were higher for $F_1$ crossbred boars with Landrace dams. The R1 LRW x LDR crossbred boars were predicted to have a lower average BFT than F1 LDR x LRW crossbred boars by 0.22 mm. In gilts, reciprocal effects to reduce average BFT were higher for $F_1$ crosses with Large White dams. The F1 LDR x LRW crossbred gilts were predicted to have a lower average BFT than R1 LRW x LDR crossbred gilts by 0.32 mm.

Table 6. Estimates of heterosis for backfat thickness in performance-tested gilts.

| | BFT1 shoulder | BFT2 midback | BFT3 loin | Average BFT |
|---|---|---|---|---|
| **Pure breeds** | | | | |
| Landrace (LDR) | 15.89 | 12.39 | 15.36 | 14.55 |
| Large White (LRW) | 15.76 | 12.17 | 15.41 | 14.44 |
| Average | 15.83 | 12.28 | 15.39 | 14.50 |
| **Crossbreeds** | | | | |
| F1 LDR x LRW cross | 15.58 | 12.48 | 14.88 | 14.51 |
| R1 LRW x LDR cross | 15.41 | 11.87 | 15.45 | 14.05 |
| Average | 15.50 | 12.18 | 15.17 | 14.28 |
| **Heterosis, %** | -2.09 | -0.86 | -1.43 | -1.48 |
| Maternal effect using Large White dam | +0.17 | +0.61 | -0.57 | +0.46 |
| Maternal effect using Landrace dam | -0.17 | -0.61 | +0.57 | -0.46 |
| **Improvement due to heterosis (including reciprocal or maternal effects)** | | | | |
| $F_1$ cross | -0.32 | -0.10 | -0.22 | -0.21 |
| F1 LDR x LRW cross | -0.15 | +0.51 | -0.79 | +0.25 |
| R1 LRW x LDR cross | -0.49 | -0.71 | +0.35 | -0.67 |
| **Predicted crossbred performance** | | | | |
| $F_1$ cross | 15.50 | 12.18 | 15.17 | 14.28 |
| F1 LDR x LRW cross | 15.67 | 12.79 | 14.60 | 14.74 |
| R1 LRW x LDR cross | 15.33 | 11.57 | 15.74 | 13.82 |

Maternal and reciprocal effects were computed as F1 minus R1 and R1 minus F1, respectively.

In conclusion, the average BFT was significantly lower in boars than in gilts. The average BFT increases with higher average daily gain, longer body length, older and heavier pigs at the end of the performance test. Landrace pigs had higher average BFT than Large White pigs. The average BFT was lower in $F_1$ crossbred pigs compared to the average BFT of purebred pigs. While a lower backfat thickness in performance-tested pigs belonging to Landrace and Large White breeds may be achieved by selection based on breeding values (additive genetic values), this study shows that a lower backfat thickness may also be expected in young $F_1$ Landrace x Large White crossbred pigs, due to both heterosis and reciprocal effects (non-additive genetic values). In future studies, the associations of average BFT in $F_1$ Landrace x Large White crossbred gilts with their reproductive performance should be investigated.

## ACKNOWLEDGEMENT

The authors would like to thank INFARMCO for allowing the use of boar and gilt performance test records.

## REFERENCES


Bondoc OL, Isubol JF and Chua MP. 2019. Heterosis in reproductive traits of Landrace x Large White crossbred sows from a local swine breeding farm in the Philippines. *Philipp J Vet Anim Sci* 45:1-10.

Bondoc OL, Isubol JF and Dela Cruz SF. 2018. Genetic and phenotypic parameters of on-farm performance testing of Landrace and Large White pigs from a local breeding farm in the Philippines. *Philipp J Vet Anim Sci* 44:95-102.

Choi JG, Cho II C, Choi IS, Lee SS, Choi TJ, Cho KH, Park BH and Choy YH. 2013. Genetic parameter estimation in seedstock swine population for growth performances. *Asian-Australas J Anim Sci* 26:470-475.

Choy YH, Mahboob A, Cho CI, Choi JG, Choi IS, Choi TJ, Cho KH and Park BH. 2015. Genetic parameters of pre-adjusted body weight growth and ultrasound measures of body tissue development in three seedstock pig breed populations in Korea. *Asian-Australas J Anim Sci* 28:1696-1702.

Kim JI, Sohn YG, Jung JH and Park YI. 2004. Genetic parameter estimates for backfat thickness at three different sites and growth rate in swine. *Asian-Australas J Anim Sci* 17:305-308.

SAS Institute Inc. 2009. *SAS/STAT ® 9.2 User's Guide*, 2nd ed.

Serenius T and Stalder KJ. 2004. Genetics of length of productive life and lifetime prolificacy in the Finnish Landrace and Large White pig populations. *J Anim Sci* 82: 3111-3117.