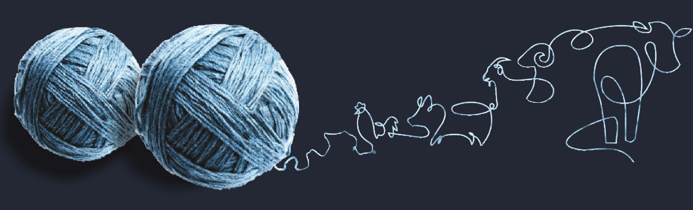
# 12th INTERNATIONAL SYMPOSIUM

# MODERN TRENDS IN LIVESTOCK PRODUCTION



## P R O C E E D I N G S

9 -11 October 2019, Belgrade, Serbia

**Institute for Animal Husbandry**
Belgrade - Zemun, SERBIA

12th INTERNATIONAL SYMPOSIUM

# MODERN TRENDS IN LIVESTOCK PRODUCTION

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# INVITED PAPERS

Proceedings of the 12th International Symposium
Modern Trends in Livestock Production
October 9-11, 2019

# THE VARIABILITY OF ECONOMICALLY IMPORTANT TRAITS MONITORED IN THE PERFORMANCE TEST OF GILTS UNDER THE INFLUENCE OF FARM, YEAR AND SIRE BREED

**Nenad Stojiljković[1], Dragan Radojković[2], Čedomir Radović[1], Marija Gogić[1], Vladimir Živković[1], Radomir Savić[2], Aleksandar Stanojković [1]**

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Original scientific paper

**Abstract:** The aim of this study was to determine the influence of sire, sire within the breed, genotype, farm and age on variability of production traits of gilts tested: age at end of the test (AET), life daily gain (LDG), backfat thickness 1 and 2 (BFT1 and BFT2) and back muscle depth (MLD). The production traits of gilts were examined in two pig herds and for three consecutive years. The study included 3605 gilts of 3 genotypes, originating from 82 sire boars. The test included only those boar sires who had 10 or more daughters. In the first herd there were 1233 and in the second 2372 tested gilts. There were 1962 gilts of Landrace (L) breed, 1324 of Large White (LW) and 319 gilts of Duroc (D) breed. Total of 885 animals were tested in the first year, 1145 in the second and 1575 in the third year. Based on the obtained results, it was determined that the genotype had a statistically significant effect ($P<0.001$) on BFT1, BFT2 and MLD, while the AET and LDG traits were not influenced ($P> 0.05$). Considering the farm as a source of variation of gilts' traits, it was concluded that it had a statistically very highly significant effect on the traits tested ($P<0.001$). The year of testing of gilts as a source of variation showed a very high statistical effect ($P <0.001$) on all traits examined. The sire breed statistically highly ($P<0.001$) led to the variation of the examined traits, which was also the case with the influence of the sires within the breed ($P<0.001$). The properties BFT1, BFT2 and MLD were highly statistically dependent ($P <0.001$) on weight at the end of the test.

**Keywords:** boars, genotype, gilts, performance test

# Introduction

The performance test of gilts represents a significant selection measure in pig production. Selection based on performance test results leads to increase in economically important traits (life gain, back fat thickness, MLD depth) by 2-3% per year (*Schinkel, 1999*). The aim of selection on farms is to improve the performance of the herd by increasing the frequency of desirable genes. The relation between hereditary and total variability in a population (herd) is defined by a heritability coefficient. Traits with high and medium heritability can be improved relatively easily by individual selection. Breeding and selection programs involve performing a performance test for these traits by measuring weight, while the thickness of back fat is measured by an ultrasound apparatus (*Đedović, 2015*).

The average backfat thickness values 1 and 2 measured by the PIGLOG 105 apparatus (*Petrović et al., 1999*) were 14.5 mm and 12.5 mm, respectively, these results were obtained at an average body weight at the end of the test of 97.8 kg and at 204 days of age, with an average daily gain of 478 g. In the work of *Michalska et al. (2008),* the following values are reported in a ten consecutive year study of tested Large White gilts with PIGLOG 105: average age at the end of the test - 180 days, body weight 96.6 kg, LDG 578 g, back fat thicknesses 1 and 2 both 11.4 mm and depth of MLD (back muscle depth) 48.1mm.

*Kosovac et al. (2009),* by examining the depth of MLD (*Musculus longissimus dorsi*) of the Swedish Landrace genotype have established an average value of 59.25 mm.

At an average body weight of 108 kg over a four-year test period, *Petrović et al. (2002)* have found an average meat content of the tested animals of 57.8%. The influence of breed and genotype on traits tested in performance test has been the subject of research by many authors (*Petrović et al. 1991; Brkić et al. 2001; Kernerová et al. 2006; Nowachowicz et al. 2009; Szyndler-Nędza et al. 2010; Radović et al., 2011)* who are not in concordance/agreement on the influence of these factors on the individual traits examined.

# Material and Methods

The production trait of gilts were examined in two pig herds for three consecutive years. The study included 3605 gilts of 3 genotypes, originating from 82 boars sires. The test included only those boar sires with 10 or more daughters. At the end of the test, body weight, fat thickness and MLD depth were measured by an ultrasound apparatus. In the firsther, there were 1233 gilts and in the second 2372 gilts tested. There were 1962 gilts of Landrace (L) breed, 1324 of Large

White (LW) and 319 gilts of Duroc (D) breed. In the first year, 885 gilts were tested, in the second 1145 and in the third 1575 gilts.

Data processing was performed using the appropriate computer program according to the procedure of the Least Squares Method (LSMLMW and MIXMDL-Harvey, 1990) in order to determine the significance (P<0.05) of systematic influences on the age at the end of the test, the life daily gain, the back fat thickness 1 and 2 and muscle depth in performance tested gilts. The models included: sire breed, sires within the breed, farm, age and genotype, as well as the regression effect of weight at the end of the test on the traits examined.

Model 1.

$$Y_{ijkm} = \mu + F_i + G_j + R_k + b_1 (X_1 - \quad _1) + \varepsilon_{ijkm}$$

where: Yijklm = expression of trait in *m* individual animal, *i* farm, *j* test year, of *k* genotype, μ = general population average, F = farm, G = year of testing, R = animal genotype, $b_1$ = linear regression effect of body weight at the end of the test, ε = random error, *i* = subscript for farm (*i* =1, 2), *j* = subscript for test year za godinu testiranja (*j* =1, 2, 3), *k* = subscript for animal genotype (*k* =1, 2, 3), *m* = subscript for offspring.

Model 2.

$$Y_{jkm} = \mu + R_j + O_{k:j} + b_1 (X_1 - \quad _1) + \varepsilon_{jkm}$$

where: Yijklm = expression of trait in *m* individual animal, *j* sire breed, of *k* sire within *j* breed, μ = general population average, R = sire breed, O = sires within a breed, $b_1$ = linear regression effect of body weight at the end of the test, ε = random error, *j* = subscript for sire breed (*j* =1, 2, 3), *k* = subscript for sires within *j* breed, *m* = subscript for offspring.

## Results and Discussion

All traits tested were reduced to the same weight at the end of the test at 111.00 kg. The average values and standard deviations of the traits examined are shown in Table 1.

**Table 1. Average values and variability of traits tested**

| Trait | | $\bar{x}$±*SD* |
|---|---|---|
| AET | Age at the end of test, days | 200.19±21.99 |
| LDG | Life daily gain, g | 578.10±58.53 |
| BFT1 | Back fat thickness 1, mm | 9.82±2.31 |
| BFT2 | Back fat thickness 2, mm | 8.92±1.97 |
| MLD | Back muscle depth, mm | 53.41±5.12 |

Tables 2, 3 and 4 show the $\bar{x} \pm$ SD values (average and standard deviation) of the examined traits of daughters by sires within the breed and values for the breed.

**Table 2. Average values and standard deviations of the examined traits per sire within the Landrace breed**

| Source of variation | | AET[2)], days | LDG, g | BFT1, mm | BFT2, mm | MLD, mm |
|---|---|---|---|---|---|---|
| SB[1)] | Sire | | | | | |
| Landrace | 33 | 183.52±10.58 | 587.36±47.69 | 8.73±1.10 | 8.18±1.17 | 54.58±2.09 |
| | 55 | 228.88±19.49 | 524.35±51.32 | 12.24±2.28 | 10.59±1.84 | 46.18±3.30 |
| | 72 | 227.47±13.81 | 499.41±32.84 | 13.41±1.93 | 12.06±2.86 | 47.06±5.38 |
| | 75 | 235.29±11.08 | 477.14±34.44 | 11.64±2.34 | 9.57±2.28 | 52.86±6.96 |
| | 76 | 224.10±9.11 | 487.52±36.95 | 10.93±2.15 | 9.48±1.72 | 46.86±5.31 |
| | 84 | 185.61±8.81 | 596.00±45.62 | 7.78±1.07 | 7.11±1.10 | 55.46±1.57 |
| | Average | 212.98±11.67 | 531.04±38.57 | 10.80±1.79 | 9.59±1.75 | 51.24±4.02 |

[1)] SB-sire breed; [2)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth

Table 2 shows the average values for studied traits of the Landrace boar sires' daughters. The offspring of sire number 33 are the youngest with an average AET of 183.52 days, while the oldest are daughters of sire 75 with age of 235 days. Daughters of sire number 84 show the lowest BFT1 (7.78 mm), while the highest value for this trait was recorded in daughters of sire number 72 (13.41 mm). The difference between the minimum and maximum values for BFT1 is 5.63 mm. The number 76 daughter's daughters are closest to the average for BFT1 within the Landrace breed. As with BFT1, the lowest BFT2 have daughters of sire 84 (7.11 mm) and the highest of sire 72 (12.06 mm), with the difference between the two values being 4.95 mm. The closest to the average for the BFT2 trait are the descendants of sire number 75. The average depth of the MLD is 51.24 mm with a variation from 46.18 to 57.91 mm.

Within the LW sire breed, the oldest are the offspring of sire number 89 (236.45 days), while the youngest the offspring of sire number 57 (182.40 days). Daughters of sire number 22 have the lowest BFT1 (7.96 mm), and the highest daughters of sire number 35 (the difference between being 6.04 mm). The lowest depth of the MLD is recorded in daughters of sire number 77 and the greatest in daughters of sire 19, the difference between them being 11.35 mm. The depth of the back muscle of the daughter of sire number 74 is closest to the average value of this trait for the sire breed LW. When selecting tested gilts as further candidates for selection *Kernerová et al. (2006)* established that for the genotype the Czech LW (CLW) body weight at the end of the test was 127 kg, at the age of 206 days and LDG of 531 g, while for the CLW- sire line genotype, they established an average mass of 124 kg, at the age of 202 days and an LDG of 511 g. In the present study (Table 3), LDG trait values vary across sires from 473.50 to 612.81 g, but the animals completed the test later (206 days) with a lower body weight (110.98 kg).

**Table 3. Average values and standard deviations of the examined traits per sire within the Large White breed**

| Source of variation | | AET[2)], days | LDG, g | BFT1, mm | BFT2, mm | MLD, mm |
|---|---|---|---|---|---|---|
| SB[1)] | Sire | | | | | |
| Large White | 18 | 215.67±15.26 | 522.73±34.22 | 12.00±2.59 | 10.47±2.33 | 50.13±2.61 |
| | 19 | 187.15±10.78 | 583.92±48.85 | 8.18±1.11 | 7.51±1.08 | 57.91±1.73 |
| | 22 | 187.83±7.34 | 566.33±31.26 | 7.96±0.74 | 7.43±0.77 | 55.59±3.58 |
| | 34 | 233.25±9.96 | 473.50±30.44 | 13.92±2.64 | 12.08±2.81 | 48.33±5.05 |
| | 35 | 229.95±8.04 | 502.42±37.19 | 14.00±2.19 | 11.79±2.78 | 46.89±4.37 |
| | 47 | 223.42±12.61 | 492.19±34.37 | 10.87±2.31 | 9.13±2.03 | 48.94±6.68 |
| | 57 | 182.40±8.90 | 612.40±42.64 | 8.06±0.79 | 7.48±0.77 | 57.32±5.03 |
| | 63 | 187.25±11.19 | 612.81±34.28 | 8.90±1.00 | 8.28±0.95 | 57.74±1.19 |
| | 74 | 186.00±7.14 | 576.39±27.15 | 8.50±1.05 | 8.05±1.03 | 53.73±3.03 |
| | 77 | 225.17±15.18 | 475.12±40.96 | 12.15±2.35 | 10.71±2.11 | 46.56±2.82 |
| | 89 | 236.45±12.63 | 480.77±31.63 | 11.71±2.12 | 10.42±1.98 | 48.74±5.10 |
| | Average | 205.77±10.33 | 542.81±38.41 | 10.14±1.64 | 9.05±1.53 | 52.21±3.60 |

[1)] SB-sire breed; [2)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth

**Table 4. Average values and standard deviations of the examined traits per sire within the Duroc breed**

| Source of variation | | AET[2)], days | LDG, g | BFT1, mm | BFT2, mm | MLD, mm |
|---|---|---|---|---|---|---|
| SB[1)] | Sire | | | | | |
| Duroc | 92 | 183.90±11.84 | 603.10±37.69 | 8.41±1.27 | 7.88±1.30 | 56.53±1.50 |
| | 25 | 232.86±8.73 | 486.36±47.83 | 15.57±1.27 | 13.71±2.20 | 50.43±7.11 |
| | 60 | 230.88±10.84 | 480.38±47.83 | 13.44±1.27 | 11.25±2.32 | 47.13±6.89 |
| | 62 | 192.50±11.80 | 606.60±47.83 | 10.16±1.27 | 9.47±0.84 | 54.32±1.10 |
| | Average | 207.54±10.53 | 545.19±33.96 | 11.44±1.60 | 10.37±1.49 | 51.30±4.10 |

[1)] SB-sire breed; [2)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth

Table 4 shows the variations of the examined traits of the daughters of Duroc sires. The lowest value for BFT1 have the daughters of sire number 92 and the highest daughters of sire number 25, with a difference between them of 7.16 mm. As with the BFT1, the lowest BFT2 have gilts from sire 92 and the highest daughters of sire 25 with a 5.38 mm gap between them. Daughters of sire number 60 have the lowest values for back muscle depth, and daughters of sire number 92 have the highest values, with a difference of 9.4 mm between them.

Table 5 shows LSM (Least Squares Average) ± SE values of the tested properties as effected by factors of farm, year and genotype.

**Table 5. LSM (Least Squares Average) ± SE values of monitored traits in the performance test of gilts with factors farm, age, and genotype**

| Source of variation | | AET[2)], days | LDG, g | BFT1, mm | BFT2, mm | MLD, mm |
|---|---|---|---|---|---|---|
| Farm | 1 | 222.43±0.45 | 495.63±1.32 | 11.91±0.06 | 10.43±0.06 | 49.20±0.15 |
| | 2 | 189.74±0.36 | 587.57±1.06 | 9.40±0.05 | 8.75±0.05 | 54.33±0.12 |
| Year | 1 | 210.43±0.50 | 531.44±1.45 | 11.08±0.07 | 9.91±0.07 | 50.14±0.17 |
| | 2 | 204.75±0.36 | 543.98±1.05 | 10.57±0.05 | 9.56±0.05 | 51.24±0.12 |
| | 3 | 203.07±0.45 | 549.37±1.30 | 10.31±0.06 | 9.30±0.06 | 53.92±0.15 |
| Genotype | 1[1)] | 206.12±0.23 | 541.46±0 .68 | 10.20±0.03 | 9.15±0.03 | 52.37±0.08 |
| | 2 | 205.74±0.29 | 542.11±0.85 | 10.12±0.04 | 9.06±0.04 | 52.35±0.10 |
| | 3 | 206.39±0.58 | 541.22±1.67 | 11.65±0.08 | 10.56±0.08 | 50.58±0.19 |

[1]) 1-SL, 2- LW, 3-D,[2)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth;

When considering the farm as a source of variation of the animals on farm 1 they completed the test with an average of 222.43 days and were by 32.69 days older than animals on farm 2. BFT1 and BFT2 increased on farm 1 by 2.51mm and 1.68 mm, respectively, compared to farm 2. It was found that farm 1 animals had lower back muscle depth by 5.13 mm compared to animals tested on farm 2. Considering gilts genotype, as a source of variation, the Duroc genotype animals were found to have the highest age at the end of the test, whereas the youngest were gilts of Large White breed.

Table 6 shows the significance levels of the effects included in the model on the properties tested in gilts.

**Table 6. Statistical significance (significance level) of the factors included in the models on the traits tested**

| Source of variation (effect) | | AET[1)] | LDG | BFT1 | BFT2 | MLD |
|---|---|---|---|---|---|---|
| Model 1 | Farm | ***[3)] | *** | *** | *** | *** |
| | Year | *** | *** | *** | *** | *** |
| | Genotype | NS | NS | *** | *** | *** |
| Model 2 | SB[2)] | *** | *** | *** | *** | *** |
| | S:L | *** | *** | *** | *** | *** |
| | S:LW | *** | *** | *** | *** | *** |
| | S:D | *** | *** | *** | *** | *** |

[1)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth; [2)] SB-sire breed; S:LW-sires within Large White breed; S:SL-sires within Landrace breed; S:D-sires within Duroc breed; [3)] NS=P>0.05; ***=P<0.001

Using model 1, it was found that farm and year statistically significantly influenced (P<0.01 and P <0.001) the expression of the tested traits. The gilt genotype statistically significantly (P<0.01 and P<0.001) affects BFT1- back fat thickness 1, BFT2 - back fat thickness 2, MLD - back muscle depth, while the traits AET - age at the end of the test; LDG - lifetime daily gain were unaffected (P> 0.05). The effect of year on back fat thickness and muscle depth of the performance tested gilts is consistent with the results obtained by *Nowachowicz et al. (2009).* In these studies, a significant and highly significant effect of the year on the thickness of P2 back fat tissue (measured behind the last rib 3 cm from the medial plane) was found. Also, *Petrović et al. (1999)* have found that gilt genotype and age had a statistically significant effect on the manifestation of traits in performance tested gilts, which is consistent with the results obtained in this study.

The sire breed and sires within the breed statistically highly significantly (P <0.001) affected all tested traits of performance tested gilts (Model 2). The results obtained are in agreement with the study of *Petrović et al. (1991)* that the production performance traits of the gilts tested varied under the influence of the sires. Also, the statistical significance of the influence of sires within SL and LW breeds was also determined, as confirmed by *Petrović et al. (1999).*

Table 7 shows the regression effect of the weight at the end of the test on the test traits included in Model 1 and 2 and its significance levels on the tested traits of the gilts.

**Table 7. Regression effect of weight at the end of the test on the traits tested and statistical significance (significance level) of the effect on the tested traits included in model 1**

| Source of variation | BFT1. mm | BFT2. mm | MLD. mm |
|---|---|---|---|
| WET(b)/model 1 | 0.085 | 0.078 | 0.071 |
| F-test/ model 1 | ***[2)] | *** | *** |
| WET(b)/model 2 | 0.081 | 0.076 | 0.079 |
| F-test/ model 2 | *** | *** | *** |

[1)] AET- Age at the end of test; LDG-life daily gain; BFT1-back fat thickness 1; BFT2-back fat thickness 2; MLD-back muscle depth; [2)] SB-sire breed; WET-weight at the end of the test; [2)] NS=P>0.05; *=P<0.05; **=P<0.01; ***=P<0.001

The regression effect of weight at the end of the test on the properties tested using Model 1 shows that with an increase in weight by 1 kg, BFT 1 increases by 0.085 mm and BFT2 by 0.078 mm and the back muscle depth increases by 0.071 mm. The regression effect of the weight at the end of the test on the tested traits (Model 2) shows that with an increase in weight by 1 kg BFT 1 increases by 0.081 mm. a BFT2 by 0.076 mm while the back muscle depth increases by 0.079 mm. The weight at the end of the test had a statistically significant effect on the properties of BFT1, BFT2 and MLD (P <0.001).

## Conclusion

Based on the obtained results, it was determined that the gilt genotype had a statistically significant effect (P <0.001) on BFT1- back fat thickness 1, BFT2 - back fat thickness 2 and MLD - back muscle depth, while AET - age at the end of the test and LDP - life daily gain were not influenced (P> 0.05). Considering the farm as a source of variation in gilt traits, it is concluded that the farm had a very statistically significant effect on the traits tested (P<0.001). The year of test as a source of variation showed a high statistical effect (P <0.001) on all traits examined. The sire breed had a statistically significant (P <0.001) effect on the examined gilt traits. Sires within the Landrace, Large, and Duroc breeds statistically highly significantly (P <0.001) affected all tested traits in gilts. The properties BFT1, BFT2 and MLD were highly statistically dependent (P <0.001) on weight at the end of the test. Observing by years, there was an increase in values for LDG, with a decrease in the values for BFT1 and BFT2 and at the same time an increase in the depth of the back muscle. Based on the table 5, animals with fewer days of AET have higher values for the LDG trait compared to older animals, and also have thinner back fat tissue and greater back muscle depth. In the future selection of gilts, it is recommended not to force excessive reduction of the thickness of the back fat, so that the animals would normally reach sexual maturity and successfully bring forth pregnancy and raise the first litter and without difficulty enter into subsequent reproductive cycles. Production on one farm depends directly on the quality of the breeding material. By monitoring and controlling the intensity of the growth in the test, gilts of adequate age and body weight at insemination are obtained. The gilts that do not have the right age, body weight and sufficient back fat thickness at the end of the test, or at the first insemination, do not provide profit, but reduce production efficiency. Low cost is not the goal of any production, which is why recording of different parameters and traits made during breeding of gilts are very important.

# Varijabilnost ekonomski važnih osobina praćenih u performans testu nazimica preko efekata farme, godine i rase oca

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## Rezime

Cilj ovog istraživanja je bio da se utvrdi uticaj rase oca, oca unutar rase, genotipa grla. farme i godine na varijabilnost proizvodnih osobina performans testiranih nazimica: uzrast na kraju testa (AET), životni dnevni prirast (LDG), debljina slanine 1 i 2 (DSL1 i DSL2) i dubina leđnog mišića (MLD). Proizvodne osobine nazimica ispitivane su u dva zapata svinja u tri uzastopne godine. Istraživanjem je bilo obuhvaćeno 3605 nazimica iz 3 genotipa, koje potiču od 82 nerasta-oca. Ispitivanjem su bili obuhvaćeni samo oni nerasti-očevi koji su imali po 10 i više kćeri. U prvom zapatu je bilo 1233, a u drugom 2372 testiranih nazimica. U okviru rase landras (L) bilo je 1962, veliki jorkšir (LW) 1324 i durok (D) 319nazimica. U prvoj godini testirano je 885, u drugoj 1145 i u trećoj 1575grla. Na osnovu dobijenih rezultata utvrđeno je da genotip statistički veoma značajno utiče ($P<0.001$) na DSL1, DSL2 i MLD, dok na osobine AET i LDG nema uticaj ($P>0.05$). Uzimajući u obzir farmu kao izvor variranja osobina nazimica, zaključuje se da ona ima statistički vrlo visoko značajan uticaj na ispitivane osobine ($P<0.001$). Godina testiranja nazimica kao izvor variranja pokazuje vrlo visok statistički uticaj ($P<0.001$) na sve ipitivane osobine. Rasa oca je statistički visoko značajno ($P<0.001$) dovodila do variranja ispitivanih osobina, što je bio slučaj i kada se radilo o uticaju očeva unutar rase($P<0.001$). Osobine nazimica DSL1, DSL2 i MLD su vrlo visoko statistički zavisile ($P<0.001$) od mase na kraju testa.

**Ključne reči:** nerasti, genotip, nazimice, performans test

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