

## EFFECT OF BREED ON PRODUCTION TRAITS OF PERFORMANCE TESTED BOARS<sup>1</sup>

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**Abstract:** The basic goal of these investigations was to establish differences among boars of three different swine breeds for production traits registered in performance test under conditions of a central test station. The investigation encompassed 473 Large White, 129 Swedish Landrace, and 136 Hampshire animals. The hypothesis of the effect of breed on variation of production traits was tested using the least squares method (Harvey, 1990).

The effect of breed was highly significant ( $P < 0.001$ ) for growth and feed efficiency traits, but not for daily feed intake ( $P > 0.05$ ). Body composition traits did not vary due to effect of breed ( $P > 0.05$ ), except backfat thickness between 3rd and 4th last ribs ( $P < 0.01$ ). Hampshire boars had the lowest weight gain, poorer feed efficiency and least desirable body composition traits.

**Key words:** boars, breed effect, production traits, performance test

### Introduction

On a global scale, today there are numerous breeds of swine. However, countries with developed swine breeding use very few breeds for production. Current swine breeding programs are mainly line cross-breeding programs using three or four breeds (Merks, 2001). On the whole, it can be said that the Large White, Swedish Landrace, and Hampshire play an important role, not only in our country (Vidović, 1997), but also in swine breeding in many other countries (Li and Kennedy, 1994; Wolf et al., 1998; Chen et al., 2002), primarily due to the fact that they have the most desirable level of production traits, and therefore assure highest economic gains. The Large White and Swedish Landrace breeds belong to dam – fertile breeds (Vidović, 1997; Wolfová et al., 2001), in which selection is targeted toward improving reproductive and fattening traits, while the Hampshire breed belongs to sire breeds, i.e. terminal breeds (Vidović, 1997), used primarily to improve growth rate, carcass quality (Robinson and Buhr, 2005) and feed efficiency (Johnson et al., 2002).

In view of the above, the principal goal of this research was to establish differences among boars of the three swine breeds for traits that are economically important, and which must exist. Results obtained will be used to investigate how to utilize their advantages or to pointed out disadvantages when they are applied in production of fattened swine for slaughter.

### Materials and Methods

Research according to set goals was carried out in the Station for testing production capacities of swine at Agricultural Corporation "Beograd" in Padinska Skela. The investigation encompassed a total of 738 tested animals belonging to: Large White ( $n = 473$ ), Hampshire ( $n = 136$ ) and Swedish Landrace ( $n = 129$ ) breeds. Young boars were tested in performance test during seven consecutive years, during the 1995 – 2001 period.

The least squares method (Harvey, 1990) was used to test significance of the effects of breed on variability of production traits. Following fixed models were used to analyze the effect of breed on variation of IWT [1], FWT [2], IAGE [3], FAGE [4], TD [4], LADG [4], ADG [4], TF [4], FCR [4], DFI [4], BF1 [5], BF2 [5], MD [5] and LM [5]:

$$Y_{ijklm} = \mu + B_i + S_{j:i} + Y_k + S_l + (YS)_{kl} + b_1 (IAGE_{ijkl} - \overline{IAGE}) + \varepsilon_{ijklm} \quad [1]$$

$$Y_{ijklm} = \mu + B_i + S_{j:i} + Y_k + S_l + (YS)_{kl} + b_1 (IAGE_{ijkl} - \overline{IAGE}) + b_2 (FAGE_{ijkl} - \overline{FAGE}) + \varepsilon_{ijklm} \quad [2]$$

$$Y_{ijklm} = \mu + B_i + S_{j:i} + Y_k + S_l + (YS)_{kl} + b_3 (IWT_{ijkl} - \overline{IWT}) + \varepsilon_{ijklm} \quad [3]$$

$$Y_{ijklm} = \mu + B_i + S_{j:i} + Y_k + S_l + (YS)_{kl} + b_3 (IWT_{ijkl} - \overline{IWT}) + b_4 (FWT_{ijkl} - \overline{FWT}) + \varepsilon_{ijklm} \quad [4]$$

$$Y_{ijklm} = \mu + B_i + S_{j:i} + Y_k + S_l + (YS)_{kl} + b_3 (IWT_{ijkl} - \overline{IWT}) + b_5 (WT_{ijkl}^{UM} - \overline{WT}^{UM}) + \varepsilon_{ijklm} \quad [5]$$

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where:  $Y$  = observation,  $\mu$  = overall population mean,  $B_i$  = the fixed effect of breed ( $i = 1, 2, 3$ ),  $SI_{j:i}$  = the fixed effect of sires nested within breeds ( $j:i_1 = 1, 2, \dots, 15; j:i_2 = 16, 17, \dots, 49; j:i_3 = 50, 51, \dots, 61$ ),  $Y_k$  = the fixed effect of year of test start ( $k = 1, 2, \dots, 6$ ),  $S_l$  = the fixed effect of season of test start ( $l = 1, 2, 3, 4$ ),  $YS_{kl}$  = interaction between year and season of test start ( $kl = 11, 12, \dots, 64$ ),  $b_{1, 2, 3, 4, 5}$  = the linear regression coefficient,  $_1$  = subscript for age at the beginning of the test,  $_2$  = subscript for age at the end of the test,  $_3$  = subscript for body weight at the beginning of the test,  $_4$  = subscript for body weight at the end of the test,  $_5$  = subscript for body weight at ultrasonic measurements,  $\varepsilon$  = the random error,  $m$  = subscript for tested animal ( $m = 1, 2, \dots, 738$ ). Abbreviations for production traits are in the legend of table 1.

The principal goal of the experimental design in which sires are nested within the fixed effect of breed is to calculate a part of the variability within especially interesting effects (effect of breed) which thus disclose the real differences between the level of fixed effect of breed.

### Results and Discussion

Knowing the effect of breed on variation of production traits is important not only from the aspect of the need to include this effect in models for calculating genetic parameters, but also since it may be useful when designing, monitoring, and improving a hybridization program aimed at upgrading commercial swine production.

As anticipated, the effect of breed was not significant for all analyzed traits (Table 1).

It must be emphasized that Hampshire (H) boars were oldest at start of test, indicating that they grow more slowly, which could be expected in comparison with boars of the Swedish Landrace (SL) and the Large White (LW). Average daily gain differed between investigated breeds. SL boars did not have statistically significantly higher average daily gain than LW boars (0.860 vs. 0.852 kg/day). However, Hampshire boars had statistically significantly lower average daily gain (0.807 kg/dan) than boars of the previous two breeds, and therefore their tests had the longest duration (87.9 days). In addition, boars of breed H consumed statistically significantly more feed during the test (200.68 kg), and required more feed per kilogram weight gain (2.85 kg/kg), than boars of SL and LW breeds. However, boars belonging to tested breeds did not differ ( $P > 0.05$ ) in body composition traits. The lean meat content was in the range between 55.2% (H) to 55.7% (SL).

Based on results in Table 1 it can be concluded that, for all analyzed traits, least squares means do not show a clear difference between dam breeds (SL and LW), and the terminal sire breed (H).

Table 1. least squares means (LSM), arithmetic means ( $\bar{X}$ ) and statistical significance of differences among breeds ( $P$ )<sup>1</sup>

Trait	P	SL		LW		H	
		$\bar{X}$	LSM	$\bar{X}$	LSM	$\bar{X}$	LSM
IWT <sup>†</sup>	***	32.62	32.21 <sup>a</sup>	31.36	31.23 <sup>b</sup>	31.77	32.33 <sup>a</sup>
FWT <sup>†</sup>	ns	102.31	102.45 <sup>a</sup>	101.86	102.08 <sup>a,b</sup>	102.79	101.22 <sup>b</sup>
IAGE	***	93.02	97.25 <sup>a</sup>	92.58	94.51 <sup>c</sup>	101.74	103.73 <sup>b</sup>
FAGE <sup>†</sup>	***	174.57	180.08 <sup>a</sup>	176.09	177.97 <sup>a</sup>	189.57	191.45 <sup>b</sup>
TD	***	81.55	82.86 <sup>a</sup>	83.51	83.44 <sup>a</sup>	87.84	87.91 <sup>b</sup>
ADG	***	0.863	0.860 <sup>a</sup>	0.852	0.852 <sup>a</sup>	0.816	0.807 <sup>b</sup>
LADG <sup>†</sup>	***	0.582	0.564 <sup>a</sup>	0.574	0.570 <sup>a</sup>	0.539	0.529 <sup>b</sup>
TF	***	189.22	191.63 <sup>a</sup>	192.93	192.55 <sup>a</sup>	199.82	200.68 <sup>b</sup>
FCR	***	2.72	2.72 <sup>a</sup>	2.74	2.74 <sup>a</sup>	2.82	2.85 <sup>b</sup>
DFI	ns	2.33	2.32 <sup>a</sup>	2.32	2.32 <sup>a</sup>	2.29	2.29 <sup>a</sup>
BF1	ns	16.28	16.30 <sup>a</sup>	16.89	16.66 <sup>a</sup>	16.00	16.29 <sup>a</sup>
BF2	**	13.36	13.25 <sup>a</sup>	13.79	13.57 <sup>a</sup>	14.33	14.37 <sup>b</sup>
MD	ns	46.27	46.31 <sup>a</sup>	46.61	46.86 <sup>a</sup>	46.43	46.34 <sup>a</sup>
LM <sup>†</sup>	ns	55.70	55.71 <sup>a</sup>	55.28	55.53 <sup>a</sup>	55.34	55.18 <sup>a</sup>

Abbreviations: SL = Swedish Landrace; LW = Large White; H = Hampshire; IWT = Body weight at the beginning of the test (kg); FWT = Body weight at the end of the test (kg); IAGE = Age at the beginning of the test (days); FAGE = Age at the end of the test (days); TD = Test duration (days); ADG = Average daily gain on test (kg/day); LADG = Lifetime ADG (kg/day); TF = Total consumed feed (kg); FCR = Feed

conversion ratio (kg/kg); DFI = Daily feed intake (kg/day); BF1 = Backfat thickness between 3rd and 4th last lumbar vertebra and 7 cm from the midline (mm); BF2 = Backfat thickness between 3rd and 4th last ribs and 7 cm from the midline (mm); MD = Muscle depth between 3rd and 4th last ribs and 7 cm from the midline (mm); LM = Lean meat content (%).

<sup>1</sup> - Least squares means in the same row with a different superscript letter are significantly different ( $P < 0.05$ ).

† - Traits where rank of breed was changed after application of appropriate least square model.

Least squares means show that tested Hampshire boars had the lowest growth rate and were the least successful in feed efficiency. In addition, boars of this breed had the least desirable body composition traits, since lean meat content for this breed was at the same level as for the other investigated breeds, while it was expected to be superior since they belong to terminal breeds, which are renowned for their excellent carcass characteristics. However, since breeding populations of SL and LW breeds are larger than the H population, it is probable that the selection pressure for parents of the Hampshire breed was lower, and that for this reason production results of this breed were below those for SL and LW. In addition, the number of imported SL and LW boars was probably larger than the number of those imported for the Hampshire breed, as a consequence of their role in breeding program, as well as the tendency to reduce the use of this terminal breed versus the Duroc. This could be some of the reasons why traits of growth rate and feed efficiency are better for SL and LW boars than for Hampshire boars.

Several authors (Lin et al., 1982; Savoie and Minvielle, 1988; Vidović, 1990; Vidović et al., 1993; Park et al., 1994; Engelland et al., 1997; Johnson et al., 2002; Chen et al., 2002) established during investigations of at least one dam and one terminal breed, with the exception of Engelland et al. (1997), that the effect of breed was a significant source of variation of investigated production traits of tested animals, as opposed to those that were not (Jesse et al., 1983). In addition to mentioned literature sources, results of the effect of breed on variability of various production traits confirming the investigated effect were also published by other authors (Snežana Trivunović, 1996; Baik et al., 1998; Gibson et al., 1998; Brkić et al., 2000). Wolf et al. (2000) established the effect of breed as a significant source of variation for production traits, in investigations of six sire breeds and lines of swine. As opposed to these investigations, Hermes et al. (2000), using data for Large White and Landrace breeds, established no significant effect of breed on the expression of growth and feed efficiency traits, except for average daily gain before start of test, but did establish such effect for traits of carcass composition and meat quality. Also, Lin et al. (1982) and Gibson et al. (1998) found no difference between breeds for feed conversion.

Results of these investigations at the same time pose a challenge to breeders of Hampshire breeding animals to adapt this breed to its role in the swine hybridization program, by increasing selection pressure for those traits of this breed which are important for commercial breeders, since if this is not done, they may be replaced by other terminal breeds.

### *Conclusion*

Results of these investigations permit the conclusion that, in contrast with what had been expected due to the fact that investigated breeds belong to different selection groups, the effect of breed was not significant for all analyzed traits.

Results obtained in this research show that commercial swine breeders who use Hampshire as the terminal sire breed in the cross-breeding program can not expect any significant improvement of body composition characteristics. If results of the direct test of Hampshire boars for traits of growth and feed efficiency are added to these conclusions, it can be said that presently this breed does not have the production potential to be included in cross-breeding utilizing three breeds, in view of the effects which are expected from offspring of three-breed crosses.

Results of these investigations show that for investigated breeds there should also be different selection pressures for economically more important traits, having in mind the need to adapt the Hampshire breed to the cross-breeding program.

## UTICAJ RASE NA PROIZVODNE OSOBINE DIREKTNO TESTIRANIH NERASTOVA

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### *Rezime*

Osnovni cilj ovih istraživanja je bio da se utvrde razlike između nerastova tri različite rase svinja za proizvodne osobine evidentirane u direktnom testu u uslovima centralne testne stanice. Ispitivanjem je bilo obuhvaćeno ukupno 738 grla (473 grla rase veliki jorkšir, 129 grla rase švedski landras i 136 grla rase hampšir) testiranih u priodu od 1995. do 2001. godine.

Efekat rase je bio signifikantan ( $P < 0,001$ ) za telesnu masu na početku testa, ali ne i za telesnu masu na kraju testa ( $P > 0,05$ ). Takođe, rasa nije imala statistički signifikantan uticaj ( $P > 0,05$ ) na variranje konzumacije hrane, dok je statistički vrlo visoko signifikantno uticala ( $P < 0,001$ ) na variranje svih ostalih osobina iskorišćavanja hrane i osobina porasta. Osobine kvaliteta trupa nisu varirale ( $P > 0,05$ ) pod uticajem efekta rase, izuzev debljine slanine u lednom delu ( $P < 0,01$ ).

*Ključne reči:* nerastovi, efekat rase, proizvodne osobine, performans test

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