ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 67 98 Number 5, 2019

THE EFFECT OF SIRES ON DAILY GAIN AND FAT THICKNESS

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To link to this article: https://doi.org/10.11118/actaun201967051139
Received: 19. 7. 2019, Accepted: 7. 10. 2019

To cite this article: GOGIĆ MARIJA, RADOVIĆ ČEDOMIR, STANOJKOVIĆ ALEKSANDAR, RADOJKOVIĆ DRAGAN, SAVIĆ RADOMIR, MANDIĆ VIOLETA, PETRIČEVIĆ MAJA. 2019. The Effect of Sires on Daily Gain and Fat Thickness. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 67(5): 1139–1145.

Abstract

The production characteristics of fatteners in this paper were examined in two farms of pigs in the Republic of Serbia. The research included 1166 pigs of both genders (female animals and male castrated heads) with various genotypes. Research examined influence of sire breed, sire within sire breed, gender of the pigs and the mass at the end of the fattening on the following characteristics of the fatteners: daily gain of the warm carcass side mass (PTP), rump fat thickness (DSK), backfat thickness (DSL) and sum of the fat thickness rump+back (DSKL). The pigs in this research come from the following sires: Large White (LW), Swedish Landrace (SL), Duroc and Crossbreed H × D. Data processing was done using the Harvey computer program. It was determined that all the involved effects in the model show a different level of influence on the researched traits ($P < 0.05$; $P < 0.01$; $P < 0.001$), whereas only one factor, sire within sire breed H × D does not influence the expression of the characteristic gain of the warm carcass side mass ($P > 0.05$).

Keywords: influence, fatteners, gain of the warm carcass side mass, fat thickness

INTRODUCTION

Currently, in the Republic of Serbia, still in effect the Regulations on Quality of Slaughtered Pigs and Pork Categorization (Regulation, Official Gazette of SFRY No. 2 and 12 from 1985). Fat tissue on the back, with skin, is measured in the middle of the back, where the fatty tissue is thinnest (intercostal space between the 13th and 15th 14th vertebra) and on the rump (at the place where the *M. Gluteus medius* muscle grows into the fatty tissue). The sum of these measures represent the thickness of the fat on the back. The production of pigs and pig carcasses depends on many factors. Data on mass and conformation, quantity, position and mutual relation of muscle and fat tissue are basic indicators of carcass quality. The quality of carcasses and meat varies under the influence of genetic and environmental factors (breeds, sires, breeding method, individuals, age and weight, gender, castration, nutrition, season, pre-slaughtering procedures as well as procedures during and after slaughter, etc.). The evaluation of the quality of carcasses also assesses the overall work in the field of genetics, selection, nutrition, reproduction and health care. The condition for working on the genetic improvement of pig quality is the knowledge of the variability of the production properties of breeding heads (Radović *et al*., 2007). The genotype of sires influences on the variability of the quality of the offspring carcasses (Petrović *et al*., 2004; Pušić and Petrović, 2004; Petrović *et al*., 2006), as well as the sires within the same race (Petrović *et al*., 2002; Kosovac *et al*., 1998; Radović *et al*., 2003). If commercial breeder wants to improve production traits on their farms, then the choice of superior sires within the breed is more important than the choice of the breed itself. This

is especially important for the quality carcasses, which today has become particularly important from the breeder's perspective, having in mind that it will greatly help to increase the selling of its heads in the market and, in addition, achieve greater economic profit. Bahelka *et al.* (2004) did not determine the significant effect of sires in different farms. The quality assessment of pig carcasses can be objectively determined using destructive and non-destructive methods or evaluated using mathematical equations specifically designed for it (Lukač *et al*., 2013). The economics of pig production depends on the duration of fattening, daily weight increase, food consumption, dressing percentage, the quality of carcasses, etc. In this context, race breed has a significant place. The most presented way to producing fatteners as croossbreds (between two breeds, or between 3 breeds) in Serbia. Also, the most numerous fatteners belong the next crossbreds Swedish Landrace and Large White, Swedish Landrace and Large White with Duroc, The Large White is one of the most represented breeds on farms in Serbia, primarily because of the extraordinary performances (Kosovac, 2002), while today the most frequent pig race in the Republic of Serbia is the Swedish Landrace. Sire lines which are more used in Serbia are Large White, Swedish Landrace, Duroc and croosbreed Duroc × Pietrain. In 2018 were 462 boar under productivity control of registered boars in the Central Serbia (228 sires were Large White, 54 Swedish Landrace, 63 Duroc and 14 Duroc × Pietrain), other breeds were less represented.

Large White is characterized by: rapid growth, high percentage of meat, low food consumption for 1 kg of growth and excellent meat quality (Kosovac, 2002).

The aim of this paper was to determine the influence of the sires, sires within the breed of the sires, gender and mass at the end of the fattening on the following characteristics: gain of the warm carcass side mass (PTP), rump fat thickness (DSK), backfat thickness (DSL) and sum of the fat thickness rump+back (DSKL).

MATERIALS AND METHODS

The production characteristics of fatteners in this paper were examined on two farms of pigs in the Republic of Serbia. The research included 1166 fatteners of both genders (female animals and male castrated heads) with various genotypes. There were 889 animals from Farm 1 and 277 animals from Farm 2. Sires were purebred and crossbreeds within the 4 genotypes: Swedish Landrace (SL, n = 160), Large White (LW, n = 509), crossbreed (Hampshire and Duroc, H × D, n = 159) and Duroc (D, n = 338). Animals were fed with standard farm mixture which contain 16% proteins. All tested animals were housed in groups of 12. Each group contained the same number of both gender (female animals and male castrated heads). At the end of the experiment, each animal was measured before the slaughter and weight recorded. After slaughter, the mass of the warm carcasses was measured. The fat on the back, with the skin, was measured in the middle of the back (between the 13th and 15th 14th vertebra) and rump fat thickness measured at the crosses at the place where the *M. Gluteus medius* muscle is the most embedded in fat. The sum of these measures represents the thickness of fat on the back. The research included the following characteristics: warm carcass side mass (PTP, g/day, the weight of the warm carcass side calculated on the age of the fattener at slaughter minus the piglet body weight at birth), rump fat thickness (DKS, mm), backfat thickness (DSL, mm) and sum of the fat thickness rump+back (DSKL, mm). Data processing was performed using a computer program, using the least squares method procedure (LSMLMW and MIXMDL-Harvey, 1990) in order to determine the significance ($P < 0.05$) of the systematic effects on the tested traits. The model included: breed of the sires, sires inside the sire breed, gender. The properties tested were corrected to the average body weight (BW, kg)massof fattener at the end of the fattening to 105.9 kg. The following model for the analysis of the tested effects was used:

Model

$$Y_{ijkl} = \mu + R_i + O_{j:i} + P_k + b_1 (x_1 - \bar{x}_1) + \varepsilon_{ijkl}, \quad (1)$$

where: R – sire breed; O – sires within the sire breed; P – gender of animal; $b_1(x_1 - \bar{x}_1)$ – regression impact of average body weight of fatteners.

RESULTS

All tested traits were corrected to the same mass at the end of the fattening (MASKT) of 105.9 kg. The average values and standard deviations (± SD), population averages and errors (μ ± SE) of the researched traits are shown in Tab. I. The average value for warm carcass side mass (PTP) was 406.45 g, the rump fat thickness (DSK) was 15.94 mm, the backfat thickness (DSL) was 20.51 mm, the sum of the fat thickness rump+back (DSKL) was 36.45 mm.

Tabs. II, III, IV i V shows LSM (least squares average) ±SE values of studied traits of offspring per sires within breed and values for breed.

Within breed of sire SL there was 7 sires (Tab. II). Average values of researched traits PTP, DSK, DSL, DSKL are: 403.35 g, 14.62 mm, 18.59 mm, 33.20 mm.

Tab. III shows average values for researched traits of offspring within sires of breed LW. Number of sires of LW was 11 in this research. Significant variation of values of individual traits is noticeable with these sires. For trait PTP we have variation between 371.78 g and 418.19 g. Trait DSK varies between 13.21 and 18.21 mm. Trait DSL varies between 16.97 and 21.97 mm. For sum of fat (rump+back) average is 35.94 mm.

I: *Average values and variations of tested properties*

TRAITS		$\bar{x}$ ± SD	μ ± S.E.
BW	Body weight, kg	105.90	105.90
PTP	Warm carcass side mass, g/day	406.45 ±54.56	397.58 ±0.40
DSK	Rump fat thickness, mm	15.94 ±4.99	14.99 ±0.19
DSL	Backfat thickness, mm	20.51 ±5.43	19.09 ±0.20
DSKL	Sum of the fat thickness rump+back, mm	36.45 ±10.02	34.08 ±0.36

II: *Least square average and standard error (LSM ±SE) of studied traits per each sire within Swedish Landrace breed*

Sources of variation		PTP [2], g	DSK, mm	DSL, mm	DSKL, mm
RO [1]	Sire no				
Swedish Landrace	6	414.45 ±1.78	15.91 ±0.85	20.41 ±0.88	36.32 ±1.62
	8	416.03 ±1.31	13.97 ±0.62	18.48 ±0.64	32.46 ±1.19
	16	406.90 ±2.42	13.29 ±1.15	17.59 ±1.19	30.87 ±2.20
	18	407.19 ±2.64	16.24 ±1.26	20.14 ±1.30	36.39 ±2.41
	19	414.66 ±1.61	16.42 ±0.76	19.97 ±0.79	36.39 ±1.46
	27	382.63 ±1.39	13.97 ±0.66	17.26 ±0.69	31.23 ±1.27
	28	381.60 ±2.42	12.51 ±0.15	16.24 ±1.19	28.75 ±2.20
	Average	403.35 ±0.76	14.62 ±0.36	18.59 ±0.37	33.20 ±0.69
F_{exp}	O:SL	***	*	**	**

[1] RO-sire breed; [2] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; * = P < 0.05; ** = P < 0.01; *** = P < 0.001

III: *Least squeare average and standard error (LSM ±SE) of studied traits per each sire within Large White breed*

Sources of variation		PTP [2], g	DSK, mm	DSL, mm	DSKL, mm
RO [1]	Sire no				
Large White	1	412.69 ±0.94	16.24 ±0.45	21.93 ±0.46	38.17 ±0.85
	2	414.61 ±0.37	14.79 ±0.65	19.74 ±0.68	34.52 ±1.25
	4	415.75 ±1.55	15.11 ±0.74	20.08 ±0.76	35.19 ±1.41
	5	418.19 ±1.16	16.89 ±0.55	22.61 ±0.57	39.50 ±1.06
	9	415.16 ±0.94	17.37 ±0.45	21.84 ±0.46	39.21 ±0.86
	12	410.95 ±2.64	13.21 ±1.26	19.04 ±1.30	32.24 ±2.41
	13	411.95 ±1.17	18.21 ±0.56	21.97 ±0.58	40.18 ±1.06
	22	383.13 ±1.07	13.97 ±0.51	16.97 ±0.53	30.94 ±0.98
	26	382.97 ±1.44	16.76 ±0.69	19.73 ±0.71	36.49 ±1.31
	30	379.54 ±1.11	14.97 ±0.53	18.76 ±0.55	33.74 ±1.01
	31	371.78 ±1.92	16.20 ±0.91	18.95 ±0.94	35.15 ±1.74
	Average	401.52 ±0.45	15.79 ±0.21	20.15 ±0.22	35.94 ±0.41
F_{exp}	O:VJ	***	***	***	***

[1] RO – sire breed; [2] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; *** = P < 0.001

Offspring of sires LW have higher values for fat thickness then the offspring of sires of SL breed.

Tab. IV shows the average traits of sires for crossbreed H × D. In this research only 3 sires on this genotype were included. Average values: gain of the warm carcass side mass, rump fat thickness, backfat thickness and sum of the fat thickness rump+back are: 413.36 g, 16.09 mm, 20.91 mm and 37.00 mm.

Observed by sires, offspring from sire number 15 has highest gain of the warm carcass side mass (414.10 g), thinness rump and back fat (14.44 and 19.43 mm), and thus lowest values of sum of the fat thickness rump+back (33.87 mm). In opposite, offspring of sire number 17 had the thickest rump fat (17.98 mm) and backfat (23.36 mm).

Tab. V shows values for researched traits for offspring of sires breed Duroc, and includes 8 sires. Significant variations were determined for trait PTP, and it varies between 377.98 and 417.47 g. Significant variation was also determined for rump fat thickness (varies between 13.35 and 18.58 mm) and fatback thickness (varies between 16.84 and 28.48 mm).

Tab. VI shows influence of gender of fatteners within the Model on researched traits of fatteners. It is shown that female pigs (Gender 1) have slightly lower daily gain of the warm carcass side mass (-1.28 g), thinner fat (DSK is thinner by -2.95 mm, and DSL by -3.3 mm) then male castrated pigs. Observing the mass at the end of fattening as linear regression influence, it is determined that it has statistically very high influence on manifestation on researched traits ($P < 0.001$). The regression effect of the weight at the end of the fattening on the tested traits shows that by increasing the weight at the end of the fattening by 1 kg, the values for all the investigated traits are increased. With an increase in body weight at the end of the fattening

IV: *Least squeare average and standard error (LSM ±SE) of studied traits per each sire within Hampshire × Duroc breed*

Sources of variation		PTP [2], g	DSK, mm	DSL, mm	DSKL, mm
RO [1]	Number of father				
H × D	11	412.86 ±0.92	15.86 ±0.44	20.94 ±0.45	36.80 ±0.84
	15	414.10 ±1.36	14.44 ±0.64	19.43 ±0.67	33.87 ±1.23
	17	413.11 ±1.38	17.98 ±0.65	22.36 ±0.68	40.34 ±1.25
	Average	413.36 ±0.71	16.09 ±0.34	20.91 ±0.35	37.00 ±0.65
F_{exp}	O: H × D	NS	***	**	**

[1] RO – sire breed; [2] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; NS = P > 0.05; ** = P < 0.01; *** = P < 0.001

V: *Least squeare average and standard error (LSM ±SE) of studied traits per each sire within Duroc breed*

Sources of variation		PTP [2], g	DSK, mm	DSL, mm	DSKL, mm
RO [1]	Sire no				
Duroc	3	415.89 ±1.48	16.09 ±0.70	21.25 ±0.73	37.34 ±1.35
	7	413.52 ±0.74	16.10 ±0.35	21.78 ±0.37	37.89 ±0.68
	10	413.54 ±1.71	15.61 ±0.81	28.48 ±0.84	36.09 ±1.55
	14	417.47 ±1.16	18.58 ±0.55	24.10 ±0.57	42.68 ±1.06
	20	416.53 ±1.23	14.36 ±0.59	18.21 ±0.61	32.58 ±1.12
	23	382.71 ±2.24	14.13 ±1.06	17.18 ±1.10	31.31 ±2.03
	24	377.98 ±1.43	13.35 ±0.68	16.84 ±0.71	30.19 ±1.31
	32	387.98 ±2.78	13.61 ±1.32	17.60 ±1.37	31.21 ±2.53
	Average	403.20 ±0.61	15.23 ±0.29	19.68 ±0.30	34.91 ±0.55
F_{exp}	O:D	***	***	***	***

[1] RO – sire breed; [2] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; *** = P < 0.001

VI: *Effect Gender on studied traits of fatteners (LSM ±SE)*

Sources of variation		PTP [1], g	DSK, mm	DSL, mm	DSKL, mm
Gender	1	404.72 ±0.43	13.96 ±0.21	18.18 ±0.21	32.14 ±0.40
	2	406.00 ±0.38	16.91 ±0.18	21.48 ±0.19	38.39 ±0.35
MASKT (b)		3.722 [2]***	0.150***	0.163***	0.314***

[1] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; MASKT – mass at the end of fattening; Gender-1-female animals; Gender-2-male castrated heads; [2] *** = P < 0.001

VII: *Statistical significance (level of significance) of effects included in the model on studied traits*

Sources of variation (effects)		PTP [2)]	DSK	DSL	DSKL
Model	RO [1)]	*** [3)]	**	***	***
	O:SL	***	*	**	**
	O:LW	***	***	***	***
	O: H × D	NS	***	**	**
	O:D	***	***	***	***
	Gender	*	***	***	***
	R^2	0.977	0.382	0.441	0.439

[1)] RO – sire breed; O:SL – sires within Swedish Landrace breed; O: LW – sires within Large White breed; O: H × D – sires within Hampshire × Duroc breed; O: D – sires within Duroc breed; R^2 – determination coefficient; [2)] PTP – daily gain of the warm carcass side mass; DSK – daily gain of the warm carcass side mass; DSL – backfat thickness; DSKL – sum of the fat thickness rump+back; [3)] NS = P > 0.05; * = P < 0,05; ** = P < 0.01; *** = P < 0.001

by 1 kg, rump fat thickness and back fat thickness is increased by 0.150 and 0.163 mm.

Tab. VII shows the levels of significance of the influence included in the model on the tested traits of the fatteners.

Sire breed (RO), sire within sire breed SL (O: SL), sire within breed LW (O: LW), sire within breed D (O: D) and gender of the fatteners (Pol) had influence the variation of all the traits of the fatteners; with different statistical significance. The sire within sire breed H × D (O: H × D) has no statistically significant effect on the manifestation of PTP. The determination coefficient R^2 shows that the effects included in the Model are explained by 97.7% of the PTP variation, 38.2% of the DSK variation, 44.1% of the DSL variation, and 43.9% of the DSKL variation. Thus, the effect of the factors on variation is explained most on PTP trait and at least the DSK trait.

DISCUSSION

Daily gain of warm carcass side mass, from the Expert Report of the Institute for Animal Husbandry Republic of Serbia (2016) for the offspring for the sires of Swedish Landrace was 424.71 g, Large White 426.33 g and Duroc 418.62 g, with these values higher than our research. In the research Radović *et al.* (2007) values for backfat thickness (DSL), rump back thickness (DSK), sum of the fat thickness rump+back (DSLK) for the offspring of the Swedish Landrace sires are 15.5 mm, 13.2 mm, 28.3 mm. Values for the same three traits for the offspring of the sires of Large White are 19.8 mm in diameter, 18.2 mm, 38.1 mm. The results obtained show that the characteristics of the offspring that were examined varied between the breed of sires, genotype and gender. The sires within breed of Swedish Landrace influenced the variation of the backfat thickness (middle of the back, rump, back + rump). The sires within the Large White breed influenced all the traits. Male castrated heads had on average ticker back and rump fat (19.8 and 18.3 mm relative to 15.5 and 13.2 mm), lower yield (34.8 to 35.9 kg) and meat share in carcasses (42.9 to 44.2%) compared to female pigs. Research Radović *et al.* (2003) found that sires influenced the variation of all traits. At an average length of carcass of 97.60 cm fat thickness (back and rump) at the Large White was 2.63 and 3.58 cm. The increased variability of some traits (fat thickness, mass of the Musculus longissimus dorsi) indicates the possibility of improvement through selection (Kosovac, 2002). Petrović *et al.* (2006) found that all investigated traits of the offspring varied under the influence of the genotype of sires on one farm, and on the other farm, the genotype of the sires did not show influence (P > 0.05) on variation of the daily gain of warm carcass side mass. The results of individual researches show that there are differences between the breeds in relation to the influence of sires on the variability of the characteristics of the offspring (Mijatović *et al.*, 2005). In research by Sonesson *et al.* (1998) found lower values for body weight (103.2 kg) and a much lower value for backfat thickness DSL (11.1 mm) than our research. Within the breed of sires Landrace in comparison with the results of Radović *et al.* (2007), it can be seen that the values in our study for the traits of fat thickness are higher. In research by Ventura *et al.* (2011), values for the backfat thickness DSL of 18.69 and 23.51 mm are showed, but for significantly higher body weight at the end of the fattening (130 and 160 kg) within the Duroc race. In this study, female heads had thinner fat than male castrated heads, which is in agreement with research by Radović *et al.* (2007). Offspring of the Large White have higher values for traits of fat thickness in comparison with offspring of Swedish Landrace sires, which is in accordance with the studies of Żak *et al.* (2009). Also in the sire breed of Swedish Landrace and the sires of the Large White breed, higher values for DSL and DSKL were established, except for DSK in comparison to research of Radović *et al.* (2007).

CONCLUSION

The goal of this research was aimed at determining the variability of the quality characteristics of the carcasses of various genotypes originating from 29 sires. Altogether, there were 1166 heads of both genders(female animals and male castrated heads) from twofarms. The following traits weretested: influence of the sire breed, sireswithinsirebreed, influence of the gender on thefattening characteristics, as well as the linear regressive effectof the mass of fatteners at the end of the fattening. Based on the research results, the following conclusions can be made:

- Average daily gain of the warm carcass side mass (PTP) of offspring from the sires of SL, LW, H × D and D was: 403.35 (SL); 401.52 (LW); 413.36 (H × D;) and 403.20 (D) g.
- Rump back thickness varied from 14.62 (offspring of the SL sires) to 16.09 mm (offspring of the H × D sires). The backfat thickness varied from 18.59 (offspring of the SL sires) up to 20.91 mm ((offspring of the H × D sires).
- The sires' influence was statistically very significant ($P < 0.001$) on the variation of PTP, DSL and DSKL properties, as well as high significance for the DSK's of the offspring.
- The sire within the sire breed H × D does not show statistically significant influence on the variability of the PTP offspring.

Acknowledgements

Research was financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia, project [TR 31081].

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