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EFFECT OF GILT GROWTH RATE AND BACKFAT THICKNESS ON REPRODUCTIVE PERFORMANCE

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ABSTRACT

Objective of this study was to analyze the effect of growth rate and backfat thickness at the end of test on reproductive performance in the first three parities, and association with lifetime productivity and longevity. Data of gilt productive and sow reproductive performance from large Slovenian multiplying farms was used. Altogether 8139 animals of two maternal genotypes were involved: Slovenian Landrace – line 11 (SL11) and hybrid 12 (Slovenian Large White × Slovenian Landrace – line 11). Statistical model included owner and sow genotype as fixed effects. Backfat thickness and growth rate were included as linear regression. Data was analyzed by GLM procedure in SAS/STAT. Average weight of gilts was 129.4 ± 9.6 kg at 206.7 ± 6.8 days of age, indicating average growth rate of 626 g/day. Gilts had 13.26 mm of backfat thickness, in range from 5.5 mm to 31.5 mm. The increase of 100 g of daily gain resulted in increase of 0.54 ± 0.08 liveborn piglets in the 1st, 0.71 ± 0.11 in the 2nd, 0.64 ± 0.11 in the 3rd parity. Sows with higher growth rate were culled earlier (47 days). Gilts with thicker backfat had smaller litter size in the first three parities. Backfat thickness did not influence lifetime productivity, although sows with 10 mm thicker backfat farrowed more litters (0.41 in average) in lifetime and were culled 50 days later. Growth rate and backfat thickness did not affect the cost per liveborn piglet as number of days per liveborn piglet did not change.

Key words: pigs / gilts / management / growth rate / backfat thickness / lifetime production / reproductive performance

1 INTRODUCTION

Gilt management has a major impact on reproductive performance and, consequently, on farm economics. For optimal performance, it is necessary to reach sufficient maturity and adequate reserves of body lean and fat at first mating. Age and weight at first mating with measure of backfat thickness are indicators of maturity required for good fertility.

Gilts should be first mated at the 2nd or 3rd estrus at the average age of 220 to 230 days, weighing between 130 to 140 kg and having 16 to 20 mm of backfat (Whittemore, 1998; Close, 2003). Williams *et al.* (2005) suggested higher target for body weight. Results of their study showed that optimal body weight at the first mating is between 135 in 150 kg. Gilts with less than 135 kg had smaller first three litters compared with those weighted more than 135 kg.

Growth rate influences subsequent reproductive performance (Martin and Crenshaw, 1989; Kummer *et al.*, 2006; Amaral Filha *et al.*, 2010). Amaral Filha *et al.* (2010) analyzed the effect of growth rate between birth and first mating on litter size in gilts. Greater growth rate resulted in increased number of liveborn piglets, however, growth rate >770 g/day did not reflect in additional liveborn piglets compared to gilts with 701–770 g/day. According to Kummer *et al.* (2006), insemination of gilts with a growth rate of more than 700 g/day between birth and the first mating can be made at their 2nd or greater estrus between 185 and 209 days of age, because the far-

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rowing rate, culling rate and total born produced over three parities are not affected when compared with gilts mated at >210 days of age. However, gilts with higher growth rate are more likely to be culled earlier due to locomotion problems (Sørensen *et al.*, 1993).

Importance of fat reserves at first mating for reproductive performance is often contradictory in different studies. Amaral Filha *et al.* (2010) found larger the first litter (+0.8 liveborn piglets) of gilts with 16–17 mm of backfat at mating compared to gilts with 10–15 mm of backfat depth. Gaughan *et al.* (1995) found positive correlation with lifetime performance. Gilts with backfat depth >17 mm at selection farrowed more litters and produced more liveborn piglets (3.75, 32.8) than gilts with 14 to 16 mm backfat (3.47; 30.86) and gilts with 9 to 13 mm backfat (2.81; 24.03). In contrast, some studies reported poor relationship between lifetime productivity and level of body fat (Rozeboom *et al.*, 1996; Williams *et al.*, 2005). Gill (2007) suggested that the main emphasis should be fitness and body condition and not fatness. It seems that fatness is less critical than achieving a targeted body weight for fertility.

The objective of this study was to analyze the effect of gilt growth rate and backfat thickness at the end of field test on fertility in the first three parities. Association with lifetime productivity and longevity was also investigated.

2 MATERIAL AND METHODS

2.1 DATA

Data of gilt productive and sow reproductive performance from Slovenian multiplying farm was used. Data was collected in routine performance recording. Performance test and genetic evaluation were conducted in accordance with national breeding program SloHibrid (Kovač and Malovrh, 2010).

Animals selected between years 2005 and 2008 with lifetime performance known were included in this study. Altogether, 8139 animals of two maternal genotypes were considered: Slovenian Landrace – line 11 (SL11) and hybrid 12 (Slovenian Large White × Slovenian Landrace – line 11). Animals originated from one farm, which supplied three locations with replacement gilts. Owner was defined as farm with production records.

Average body weight of gilts at the end of field test was 129.4 kg at 206.7 ± 6.8 days of age (Table 1), indicating average daily gain of 626 g per day, with a range from 486 g to 750 g. Average backfat thickness was defined as average of three measurements, two on the back behind last rib and one in the loin section (Kovač and Malovrh, 2010). At the end of test, average backfat thickness was 13.26 mm, with a range from 5.5 mm to 31.5 mm. As expected, litter size increased from 1st to 3rd parity with an average increase of 1.04 piglets from the first to second parity and 0.57 piglets from second to third parity was observed.

Production in the first two and three parities was defined as sum of liveborn piglets in two and three parities, respectively regardless when was culled. Reproductive performance in the first three parities increased for 8.66 liveborn piglets compared to production in the first two parities and the difference is smaller than increase from 1st litter to production in the first two parities (9.83). Smaller increase of production is expected due to smaller number of animals achieved 3rd parity.

Average lifetime production was 51.07 piglets in

Table 1: *Descriptive statistics of gilts production and sow reproductive performance*

Variable	Parity	N	Mean	Std Dev	Minimum	Maximum
Production performance		8139				
Weight (kg)			129.4	9.6	102.0	150.0
Age (days)			206.7	6.8	186	231
Growth rate (g/day)			626	43	486	750
Backfat thickness (mm)			13.3	2.8	5.5	31.5
Liveborn piglets (N°)						
	1	8139	11.76	2.76	0	22
	2	6249	12.80	3.29	0	24
	3	5275	13.37	3.11	0	24
	1+2	8139	21.59	7.11	0	40
	1+2+3	8139	30.25	12.62	0	57
	all	8139	51.07	34.77	0	180
NP		8139	3.95	2.39	1	11
Age at culling (days)		8139	867.8	348.7	340	1919
LPD/TNBA (days/piglet)		8134	16.16	9.60	8.0	255.0

NP – litters in lifetime, LPD/TNBA – female days per liveborn piglet

3.95 parities. Sows were culled in average 867.8 days of age, with minimum of 340 days and maximum of 1919 days. Female days per piglet were calculated as ratio between lifetime production days (age at culling-200) and total of liveborn piglets in lifetime. Difference (almost 247 days) was expected as sows with low production were culled after the first parity.

2.2 STATISTICAL ANALYSES

Following traits were analyzed: number of liveborn piglets in the first three parities, production in the first two parities, production in the first three parities, and number of total liveborn piglets as lifetime production. As longevity traits, age at culling and litters in lifetime, were considered. Sow efficiency was assessed by the number of female days per liveborn piglet.

Effect of gilt growth rate and backfat thickness on reproductive performance was analyzed using the following statistical model:

$$y_{ijk} = \mu + F_i + G_j + b_x(x_{ijk} - \bar{x}) + b_z(z_{ijk} - \bar{z}) + e_{ijk} \qquad (1)$$

where y_{ijk} is analyzed trait, μ is intercept, F_i is owner (i = 1, 2, 3), G_j is sow genotype (j = 1, 2), b_x is the regression coefficient for growth rate (x_{ijk}) and b_z is the regression coefficient for backfat thickness at the end of test (z_{ijk}), and e_{ijk} is a residual. Preliminary analysis showed that linear regression was sufficient. Nested regression in genotype was not significant. Statistical analysis were performed with SAS/STAT using GLM procedure (SAS, 2011).

3 RESULTS AND DISCUSSION

Reproductive and lifetime performance was affected by growth rate from birth to the end of field test (Table 2; Figure 1). Regression coefficients for growth rate differed among reproductive performance traits. The increase of 100 g per day resulted in addition of 0.54 liveborn piglets in 1st parity and these results are in agreement with Amaral Filha *et al.* (2010). Response of higher growth rate is larger in 2nd parity (0.71 liveborn piglets per 100 g of daily gain). Greater response to higher gilt growth rate in 2nd parity can be explained with critical weight loss during the first lactation of sows with low growth rate. Those sows were light weighted at the first farrowing

Table 2: *Parameter estimates with standard errors by General Linear Model*

		Growth rate (g/day)	Backfat thickness (mm)	Owner		Genotype	R^2
Variable	Parity	b_1	b_2	1–2	1–3	11–12	%
Liveborn piglets (N°)	1	0.0054 ± 0.0008	−0.072 ± 0.012	−0.34 ± 0.08	−0.38 ± 0.10	−0.33 ± 0.08	
		<.0001	<.0001	<.0001	0.0003	<.0001	1.58
	2	0.0071 ± 0.0011	−0.144 ± 0.016	−0.30 ± 0.11	0.51 ± 0.14	−0.69 ± 0.11	
		<.0001	<.0001	0.0049	0.0003	<.0001	2.75
	3	0.0064 ± 0.0011	−0.145 ± 0.016	−0.99 ± 0.11	−0.26 ± 0.14	−0.67 ± 0.11	
		<.0001	<.00016	<.0001	0.0620	<.0001	5.14
	1+2	0.0096 ± 0.0021	−0.148 ± 0.031	−1.50 ± 0.21	−0.53 ± 0.27	−1.76 ± 0.20	
		<.0001	<.0001	<.0001	0.0453	<.0001	3.29
	1+2+3	0.0095 ± 0.0036	−0.149 ± 0.055	−3.60 ± 0.36	−1.59 ± 0.47	−3.20 ± 0.35	
		0.0093	0.0066	<.0001	0.0007	<.0001	4.23
	all	−0.0198 ± 0.0098	0.058 ± 0.148	−15.78 ± 0.98	−4.22 ± 1.28	−9.21 ± 0.95	
		0.0440	0.6981	<.0001	0.0009	<.0001	7.34
NP		−0.0031 ± 0.0007	0.041 ± 0.010	−0.88 ± 0.07	−0.23 ± 0.09	−0.54 ± 0.07	
		<.0001	<.0001	<.0001	0.0095	<.0001	5.38
Age at culling		−0.4700 ± 0.0995	5.07 ± 1.50	−142.9 ± 9.9	−33.7 ± 12.9	−77.4 ± 9.6	
(days)		<.0001	0.0007	<.0001	0.0089	<.0001	6.04
LPD/TNBA		−0.0021 ± 0.0028	0.062 ± 0.042	1.63 ± 0.28	0.83 ± 0.36	1.92 ± 0.27	
(days/piglet)		0.4587	0.1400	<.0001	0.0224	<.0001	2.01

NP – litters in lifetime, LPD/TNBA – female days per liveborn piglet

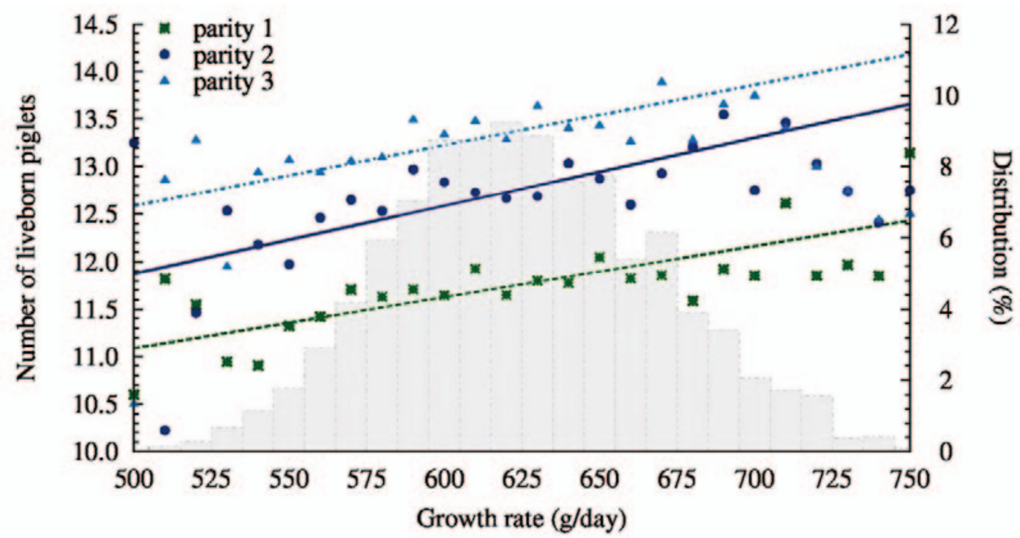

***Figure 1:** Relationship between litter size and growth rate with the distribution of growth rate*

and additional weight loss during lactation reflected as smaller litter size in 2nd parity. The 3rd parity litter size was also affected by gilt growth rate, however the increase of 0.64 liveborn piglets per 100 g was smaller compared with 2nd parity. The 100 g greater daily gain had greater benefit in reproductive performance over two parities (Figure 2). The 100 g greater daily gain contributed additional 0.96 ± 0.21 liveborn piglets. The contribution to performance over three parities was very similar (0.95), probable due to balanced feeding to avoid larger weight loss during the 2nd lactation.

Association between growth rate and lifetime productivity and longevity was significant, but effect was negligible (Table 2). Although higher daily gain resulted in better reproductive performance in the first three parities, lifetime productivity was lower for −1.98 liveborn piglets per increase of 100 g/day. Animals which grew 100 g/day faster were culled 47 days earlier. Total number of litters in lifetime (NP) was smaller. However, difference of growth rate did not result in differences in sow efficiency (female day per piglet).

Gilts with thicker backfat had smaller litter size in the first three parities (Table 2), what was in contrast with findings of Gaughan *et al.* (1995) and Amaral Filha *et al.* (2010). In the 1st parity decrease was −0.072 liveborn piglets per 1 mm. The decrease was larger in sub-

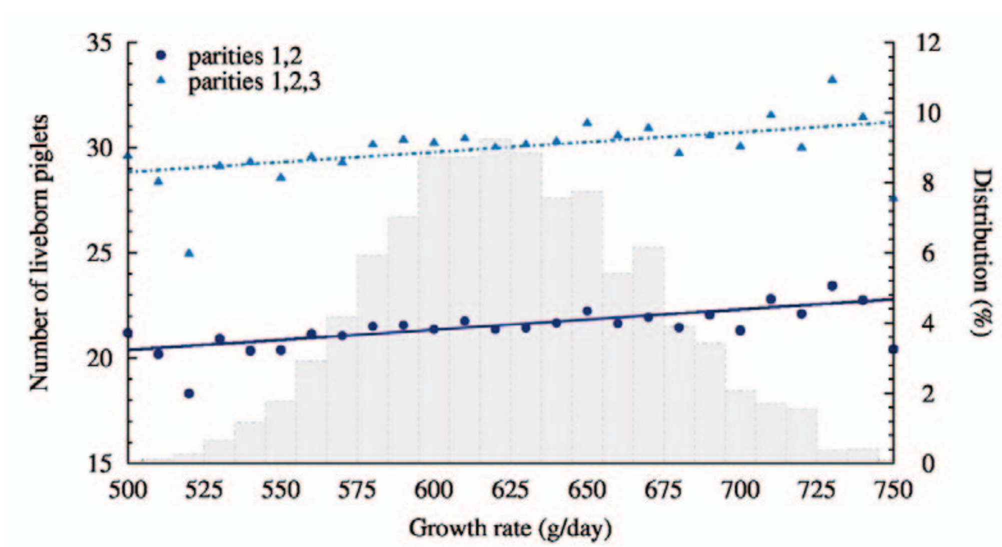

***Figure 2:** Relationship between reproductive productivity of the first two and the first three parities and growth rate with the distribution of growth rate*

sequent parities (–0.144 and –0.145 liveborn piglets/mm). Therefore, sows with 10 mm additional backfat had almost 1.5 less liveborn piglets in the first two parities. Backfat thickness did not influence lifetime productivity (P-value = 0.6981). Our results confirmed poor relationship between backfat thickness and lifetime productivity reported by Rozeboom *et al.* (1996) and Williams *et al.* (2005). Sows with 10 mm thicker backfat farrowed more litters (0.41 in average) in lifetime and were culled 50 days later, but sow efficiency was not affected by backfat depth.

Reproductive productivity and sow efficiency was the highest for owner 2 (Table 2). According to smaller number of litters in lifetime (–0.88) and age at culling, owner 1 culled sows earlier. Owner 2 had the lowest cost per piglet (–1.63 days and –0.8 days). Hybrids had larger litters, farrowed 0.54 litters more in average and had fewer days per piglet.

4 CONCLUSION

Analysis revealed positive relationship between growth rate and litter size in the first three parities. Higher growth rate contributed to better performance of the largest farrowing group – sows in 1^{st}, 2^{nd}, 3^{rd} parity. The increase of 100 g of daily gain resulted in increase of 0.54 ± 0.08 liveborn piglets in the 1^{st}, 0.71 ± 0.11 in the 2^{nd}, 0.64 ± 0.11 in the 3^{rd} parity. Sows with higher growth rate were culled earlier. Gilts with thicker backfat had smaller litter size in the first three parities. Backfat thickness did not influence on lifetime productivity, although sows with 10 mm thicker backfat farrowed more litters (0.41 in average) in lifetime and were culled 50 days later. Growth rate and backfat thickness did not affect the cost per liveborn piglet as number of days per liveborn piglet did not change.

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