Invited paper

PHENOTYPIC RELATION GROWTH RATE IN PERFORMANCE TEST AND LITTER SIZE OF SOWS

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Abstract

In this study we investigated influence of weight gain level of gilts reached during performance test on the expression of important reproductive traits. For the purpose of research, data on the litter size from 2nd to 9th parity of 700 tested gilts were monitored. Characteristics that were examined are: growth at the end of the test, the number of piglets born alive, stillborn and weaned piglets per parity and a total from 2nd to 9th parity, and the percentage of sows entering the next farrowing. Results obtained in this study indicate that gilts with a lower weight gain in performance test have smaller number of live born (8.8:9.23 $p<0.01$) and reared piglets (8.46:8.55, $p<0.01$) in regard to the higher weight gain gilts, but a larger number of stillborn piglets (0.35:0.29). Also, gilts with the lowest weight gain during the performance test had smaller average litter size from 2nd to 9th parity. Even greater difference is determined if the average litter size from 3rd to 7th parity (9.8:10.0 and 10.4) is observed. The largest percentage of sows farrowing for the second time was in gilts with the highest weight gain during the performance test (39.5%: 14.8% and 15.5%) which expressed statistically significant difference ($p<0.01$). Gilts with a lower gain weight in performance test had a higher percentage of sows included in the next farrowing. Data showed a large drop in the number of sows with the second and third parity in the total sample, where the percentages of earned second and third litters were 16.5 and 45.3%, while the percentages of actual parity from the 4th to 7th parity were: 79.2; 94.7; 83.3; 96.7; 72.4 and 90.5%.

Key words: *gilts, litter size, live births, parity, sows, weight gain*

Introduction

Pig production, in addition to poultry, is one of the most intensive type of production, which requires the perfect operation of all technological processes. Great emphasis is placed on the production of breeding material, mainly gilts (Stančić et al., 2006), which after proper selection are to be engaged in production (Hughes et al., 2010), with the assumption that, as Prunier et al. (2003) and Hoving et al. (2010) stand out, they will remain in production long enough to cover the costs of purchasing and breeding. In this case, it is primarily related to gilts/sows longevity with achieving maximal reproductive performance (Lucia and March, 1999; Lucia et al., 2000a; Serenius et al., 2006; Filha et al., 2010). For this reason, it is necessary to correct the traditional breeding technology (Foxcroft et al., 2005), even if it is, in addition to the impact of growth, difficult to define effects of age, weight and thickness of a side of bacon on reproductive efficiency (Bortolozzo et al., 2009).

A current problem in production is high percentage of culled sows which, according to Linda Engblom et al. (2007) reaches an average of 49.5% on commercial farms in Sweden, which is also similar to the results obtained in other EU countries (Boyle et al., 1998; Lucia et al., 1999; Lucia et al., 2000a and 2000b). For the purpose of ensuring a sufficient number of animals for herd repair, it is necessary to pay special attention to gilt raising, in order to align the appropriate body weight and age at the first possible moment of fertilization so they could effectively be involved in breeding (Radović, 2002; Stančić et al., 2003; Radović et al., 2007). Factors influencing the moment of reaching puberty and reproductive efficiency are numerous, from the influence of sow genotype and boar impact (Langendijk et al., 2000; Kemp et al., 2005) up to factor of accommodation (Stančić and Šahinović, 1998; Stančić et al., 2003; Akos and Bilkei, 2004). Recently, emphasis has been placed on defining the criteria for identification and exclusion of sows with low productivity (Gordon, 1997; Takai and Koketsu, 2007).

In addition to these factors, an essential factor is nutrition (Kirkwood et al., 1998*).* Feeding during the growth period has to provide a high daily gain, efficient food conversion and good carcass quality, as they are main criteria for assessing the performance test in the gilts and their involvement in reproduction *(Main Pig Breeding Program, 2010).* However, according to Rydhmer et al. (1995) and Chen et al. (2003), high meatiness caused by high weight gain affects reproductive parameters. Gerasimov et al. (1997) and Imboonta et al. (2007) indicate that, because of different degree of heritability of reproductive and fattening characteristics, it is not possible to apply the same methods of selection in order to obtain corresponding phenotype with a good reproductive characteristics, which according to Radović et al. (2006) and Petrović et al. (2006) represent the secure key for the future successful production.

In our production conditions only data from performance test are used for gilts selection. Obtained data favor growth characteristics, which later represent the basis for a decision on the gilt use in breeding (*Main Pig Breeding Program*, 2010; Radojković et al., 2012). Takai and Koketsu (2007) and Filha et al. (2010) pointed out that for maximum utilization of genetic potential of gilts first fertile insemination should be done with the body mass of 120 kg and a minimum backfat thickness of 16 mm.

Due to the foregoing, there is always an interest to find the links between growth of gilts in performance test and their subsequent reproductive potential, with the aim to determine optimal selection strategy and management of gilts breeding technology.

Material and methods

Study was carried out on the farm with capacity of 2,500 sows. For the purpose of research data on litter size from 2nd to 9th parity of 700 gilts that finished performance test were monitored. Performance test lasted from 25 to 100 kg body weight. Animals were placed in a box in a group of three and were fed with a standard meal for gilts in up-growth. Daily gain for each one of gilts has been calculated at the end of the test. Groups were defined on the basis of growth in performance test: first group (I) with a growth rate of 295-418 g; second group (II) with a growth rate of 419-542 g and third group (III) with a growth rate of 543-665 g. Within the defined groups the number of live births, stillbirths and weaned piglets was calculated. Calculations were performed in the descriptive statistics, analysis of variance, using the general linear model and phenotypic correlations between growth in test performance and litter size of parity. Due to a large number of first litter sows to be excluded from breeding, as a result of applied technology and set of selection criteria, the results of the total number of live births, stillbirths and weaned piglets were analyzed and monitored for each sow, ranging from 2nd to 9th parity, respectively, only in those animals that have begun to be actively used in the reproduction. In particular, an average litter size from 3rd to 9th parity was calculated regarding the period that potentially includes sows that, based on reproductive performance and according to the selection criteria on the farm, could enter the nucleus level. The percentage of sows included in the next parity has been calculated in relation to the number of sows that made prior farrow.

Results and discussion

Table 1 shows results of the number of live births, stillbirths and weaned piglets from 2nd to 9th parity, based on the weight gain in performance test. Results show that gilts with lower gain in performance test had less live births (8.8:9.23, $p < 0.05$) and reared piglets (8.46:8.55, $p < 0.05$) compared to gilts with higher gain. Serenius et al. (2004) and Serenius et al. (2005) reported that a small gain, as a result of low food intake, causes great loss of backfat during lactation, which is directly related to the longevity of sows and its reproductive performance. The same authors (Serenius et al., 2006) state that there is insufficient information in the literature about the influence of genetic factors on food intake and backfat loss during lactation. Number of stillborn piglets (Table 1) gives us information that gilts with lower gain had more stillborn piglets (0.35:0.29) than gilts with higher weight gain, which is inconsistent with the results of Filha et al. (2010), where gilts with weight gain over 770g had a higher number of stillborn piglets. The same authors suggest that taking into account the cost of food, number of non-productive days, number of piglets born alive and uniformity of weight of piglets the production should be focused on obtaining gilts with less gain in the moment of first fertilization.

Table 1. *Number of liveborn, stillborn and weaned piglets in the first parity in relation to the daily gain in performance test*

Liveborn					
Gain, g	**Valid N**	**Mean**	**Variance**	**Std.Dev.**	**Stand. Error**
295-418 (I)	147	8.8^{A}	5.58	2.36	0.19
418.4-542 (II)	454	8.99	5.21	2.28	0.11
543-665 (III)	38	9.23^{A}	7.02	2.65	0.43
Stillborn					
Gain, g	**Valid N**	**Mean**	**Variance**	**Std.Dev.**	**Stand. Error**
295-418 (I)	147	0.35	0.036	0.061	0.05
418.4-542 (II)	454	0.34	0.04	0.065	0.03
543-665 (III)	38	0.29	0.03	0.056	0.09
Weaned					
Gain, g	**Valid N**	**Mean**	**Variance**	**Std.Dev.**	**Stand. Error**
295-418 (I)	147	8.46	2.31	1.52	0.13
418.4-542 (II)	454	8.5	1.81	1.34	0.06
543-665 (III)	38	8.55	1.66	1.29	0.21

Values with the same superscript are significantly different ($p<0.05$)

In order to determine the reproductive efficiency of sows by parity, Table 2 shows the number of sows, average number of live-born piglets from 2nd to 9th parity, and the average number of live-born piglets from 3rd to 7th parity depending on the gain that gilts achieved during the performance test. It also shows the percentage of sows that made next farrowing.

Table 2. *Total number of liveborn piglets and percentage of included sows from 2nd to 9th parity in relation to the daily gain in test*

Gain		**Parity**										
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**3.-7.**	**2.-9.**
295-418 (I)	**No. of sows**	148	23	22	16	16	12	12	6	5		
	% of included sows	100.0%	15.5%^{B}	14.9%	10.8%	10.8%	8.1%	8.1%	4.1%	3.4%		
	liveborn		9.0	9.4	9.3	9.4	10.7	10.3	10.3	10.4	9.8	9.8
419-542 (II)	**No. of sows**	458	68	22	19	18	16	15	13	13		
	% of included sows	100.0%	14.8%^{A}	4.8%	4.1%	3.9%	3.5%	3.3%	2.8%	2.8%		
	liveborn		8.9	9.7	9.9	9.9	10.0	10.2	10.0	9.6	10.0	9.8
543-665 (III)	**No. of sows**	38	15	4	3	2	2	2	2	1		
	% of included sows	100.0%	39.5%^{AB}	10.5%	7.9%	5.3%	5.3%	5.3%	5.3%	2.6%		
	liveborn		7.3	9.5	11.6	9.0	9.9	11.7	10.8	10.0	10.4	10.0
Total of sows	644	106	48	38	36	30	29	21	19			
% of included sows	100	16.5%	45.3%	79.2%	94.7%	83.3%	96.7%	72.4%	90.5%			

Values with the same superscript are significantly different ($p<0.01$)

According to Takai and Koketsu (2007), the objective of piglet production is to provide a sufficient number of sows in parities from 2nd to 9th because of the great potential of sows in litter size in those parities. In our study, the results obtained by analyzing the reproductive efficiency of sows by parity (Table 2) show that gilts with the smallest gain (group I) during the performance test had a lower average number of live-born piglets from 2nd to 9th parity compared to gilts of group III. Even greater difference appears if one considers the average litter size from 3rd to 7th parity (9.8:10.4). According to Lucia et al. (2000a) this is explained by higher selection pressure on sows in these parities and high weight gain in performance test, which are potential nucleus animals, i.e. producing animals. Takai and Koketsu (2007) point out that the percentage of gilts that do not satisfy the selection criteria in the commercial farms is approximately 20%. The same authors state that those are the sows with low reproductive index which causes reduction of farrowing percentage by 10%. Moreover, low reproductive index later causes extended service intervals with an increase of non-productive days and a reduction in herd productivity. Among the abovementioned values statistical significance was not manifested because of the small percentage of sows involved in the next farrowing and a small number of recorded litters. Highest percentage of second farrowing sows was in gilts with the greatest weight gain during performance test (39.5%: 14.8% and 15.5%), where a statistically significant difference was expressed ($p<0.01$) compared to gain of gilts in the first and second group. This demonstrates the efficient translation to the second farrowing sows category of those animals that as gilts had the largest gain in performance test. Todd (2000) states that in order to ensure quality production on commercial farms, optimal parity structure should not have more than 18 - 22% of first farrowing sows related to total number of sows on farm. According to Brisbane and Chesnais (1997), reduction of longevity of sows increases the cost of their replacement, ie.with the reduction in parity from 6 to 5.8 price of replacement of sows increases by 1.2%, while the reduction in parity from 3 to 2.8 increases the price of sows replacement up to 5%. Radović et al. (2008) state that the optimal period of use of sows in order to recover the investment in gilt production is from 3rd to 8th parity, and in the case of poor production they were excluded from breeding after 8th parity. For more precise way of making decisions about the culling of sows Kim et. al. (2014) recommended AHP - technique (Analytical Hierarchy Process) to make decisions based on multiple criteria. Percentage of sows involved in farrowing from 2nd to 9th parity is shown in Chart 1 and Table 2.

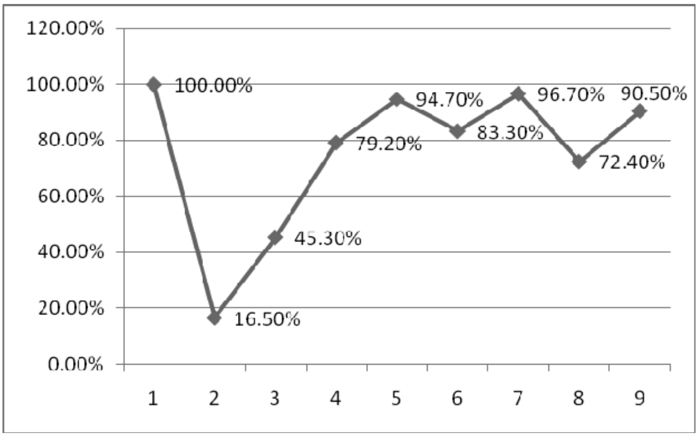

Chart 1. *Number of farrowing sows in relation to the number of sows in previous farrowing*

A large decline in the number of second and third farrowing sows in total sample was manifested, where percentage of realized second and third litters is only 16.5 and 45.3% (Table 2, Chart 1). According to Linda et al. (2007) and Hughes et al. (2010) most common reasons for exclusion of lower parity sows are reproductive problems, locomotory problems, a small number of piglets born alive and increased number of non productive days. The same authors state that there is a high percentage of unplanned culling exactly in this category of young sows.

In addition, the results show (Table 2, Chart 1) that the number of realized litters from parities 4 to 7 decreased in a much lesser extent and the percentage of actual farrowing was 79.2; 94.7; 83.3; 96.7; 72.4 and 90.5%. Observed by the groups, gilts with less weight gain in performance test had a higher percentage of sows included in the next farrowing. Reasons for exclusion of sows in subsequent parities, according to Linda et al. (2007) are: reproductive disorders (26.9%), age (18.7%), udder problems (18.1%), low productivity (9.5), problems with the locomotor apparatus (8.6%) and traumatic injuries (7.1%). These authors state that the most common reasons for exclusion of sows from parities 4 to 6 are problems with udder, while in sows after 7th parity the most common reason is age.

Conclusion

The results obtained in this study show a positive impact of the weight gain in performance test of gilts to the total number of live births and reared piglets, as well as the percentage of the realized next farrowing. Further research on the impact of characteristics of performance test on subsequent reproductive efficiency of sows can provide guidance in defining the criteria for characteristics in the aggregate genotype, which would give a more accurate estimation of breeding values of animals.

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