EFFECT OF REARING INTENSITY ON SOW'S LIFETIME PERFORMANCE

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Abstract

The objective of this study was to investigate the lifetime performance of overweight sows and evaluate the effects of rearing intensity in a multiplier population. Dataset included growth and farrowing information about 1423 crossbred Dutch Large White and Dutch Landrace sows belong to a Hungarian farm. Sows were divided into two categories (optimal and overweight) according to their body weight. Based on the results of the comparative examination, it was observed that the survival curves of two categories differed from each other and the overweight sows had significantly lower survival rate ($P<0.001$) after the 4th parities. The estimation of the hazard ratio indicated that the probability of culling was 1.455 times higher in case of the overweight sows if the sows completed at least 5 parities. In addition, it was observed that the overweight sows had significantly weaker reproductive performance under the last 4 parities. On average, the overweight sows completed less parities ($P<0.001$), farrowed 13 piglets less ($P<0.001$) and weaned 8 piglets less ($P<0.001$) than the optimal ones. Based on the results it can be said that the body condition have statistically significant effect for sow's lifetime performance. To support large litters, sows should be kept in proper body condition.

Key Words: Body condition, lifetime performance, sows, survival analysis

Longevity and reproductive efficiency are critical for producers managing commercial farms. From an economic perspective, estimates for optimal sow herd life have ranged from four to eight parities (Rodriguez-Zas et al. 2006, Abell et al. 2010), and according to Lucia et al. (2000) at least three litters should complete a sow before there is positive cash flow for the producer.

In last decades can be observed an excessive proportion of sows are replaced at early parities before reaching peak productivity. The reported average parity number at removal is fewer than five litters, with a range from 3.1 to 4.6 (Rodriguez-Zas et al. 2003, Hoge and Bates 2011) and nearly one-third of the females that entered the herd were removed as gilts (Knauer et al. 2011).

The main causes for culling in early parities are reproductive failures and different leg problems (Boyle et al. 1998, Lucia et al. 2000, Engblom et al. 2008), depending on the animal's genetics, environment, nutrition and also the management policies of farm (Sasaki and Koketsu 2010). Nowadays, there is a big problem that the management of several farms feed the gilts for sale more intensively than stipulated by technological specification – either for faster financial outcomes or for certain professional reasons – resulting overweight by the gilts. Several studies have been reported that the inadequate gilt growth to be unfavorable genetic correlation with sow lifetime performance (Yazdi et al. 2000, Serenius and Stalder 2004, Knauer et al. 2010). However, there was not found studies that compare the lifetime performance of sows having optimal and overweight body condition.

Consequently, the objective of present study was to investigate the length of lifetime and the productivity traits of overweight sows and estimate the effect of rearing intensity in a multiplier population.

Material and Methods

Animals

This study was carried out in a multiplier farm which belongs to a commercial swine integration in Hungary. The complete dataset included individual information about 1423 crossbred Dutch Large White and Dutch Landrace sows. The records were collected over the period from January 2012 until December 2013.

On the farm the feeding and hygienic conditions met the requirements of breeding and production standards. The feed was liquid feed produced by the integration. Animals were housed in stalls on a partially slatted floor and sows at farrowing were housed in a farrowing unit. Piglets were weaned at about 4 weeks of age.

Traits

To the examination of growth traits the gilts were tested between 80 and 110 kg of body weight corresponding to the national standard regulation (MgSzH, 2009). Individual records of gilts included age at growth test (AGT), body weight (BW), backfat thickness (BF) measured at two point and longissimus muscle depth (LMD). BF and LMD were measured by the same ultrasound equipment (SONOMARK 100). BF was measured 8 cm from central line, between the 3rd and the 4th lumbar vertebra (BF I.) and 6 cm from central line, between the 3rd and the 4th ribs from the end (BF II.). Longissimus muscle depth was measured at the same place as BF II. There was calculated the average daily gain (ADG) as the average weight gain per day from birth until the growth test, in addition, the lean meat percentage (LMP) was determined using the following formula based on the Pig Performance Testing Codex (MgSzH 2009):

$$LMP = 56.33 - 0.12*BF\ I. - 0.78*BF\ II. + 0.01*BF\ II.*BF\ II. + 0.24*LMD$$

The end of the study period the farrowing traits of sows were also collected including the age at first mating (AFM), number of parity (NP), total number of piglets born (TNB),

number of piglets born alive (NBA), number of piglets stillborn (NSB) and number of weaned piglets (NWP). In addition, the total data set contained the date of sow birth and if the animals were culled, the date of culling (AC) and the culling reason (CR). Reasons for culling were recorded by either the veterinary or the producer when females were removed from the herd.

Lifetime (LT) of sows was defined in days from birth to removal or termination of data collection.

Statistical analyses

The results were evaluated with the statistical program SPSS 21.0 software.

To the comparative examination the gilts were divided in two categories (optimal and overweight) based on the standard growing curves came from the farm. The records of the growth and farrowing traits were compared by nonparametric Mann-Whitney U test between the categories (Table 1.). Lifetime was analyzed using two methods of survival analysis: Kaplan Meier (KM) method and Cox proportional hazard model. For both analyses the data were treated as censored if the sow was transferred or still alive at the end of the study period. The KM model estimated the survival rate at each time point when the event (culling) occurred and indicated the significance of difference between the categories with the result of the log rank test. The Cox model was applied to examine the effect of treatments (body weight and farrowing traits) in function of time-dependent variable. The final statistical model included the LT as time variable, the farrowing traits (NP, TNB, NBA and NWP) as covariant and the category of body weight (C_BW) as categorical variable. The result of point estimate given the hazard ratio (HR) for the effect of the treatment.

Results

In the study 15.5% (n=220) of the females had higher body weight than the optimal according to the standard growing curves and 13.8% of the females were transferred to other farm or were still in production at the end of the study period (n=160 by optimal and n=37 by overweight sows). Table 1 shows the descriptive statistics for growth and farrowing traits comparing the optimal and overweight animals.

Gilts were weighed at a mean age of 156 days (SD=8.9 days) and at an average body weight of 92 kg (SD=8.2 kg) with a range from 72 to 110 kg. However, the overweight gilts showed on average 10 kg heavier body mass ($p<0.001$) which was completed significantly earlier ($p<0.001$) than the optimal ones. Consistently, the overweight females gained more rapidly, and the average daily weight gain was 660 g that differed from the standard ($p<0.001$). These gilts had significantly higher backfat thickness ($p<0.001$) and higher longissimus muscle depth ($p<0.001$).

Concerning the farrowing traits, the first time of mating was on average 250 days of age (SD=16.4 days), although the overweight gilts were serviced average 1 day later ($p<0.001$) than the gilts with optimal body weight. The non-mated gilts were removed due to fertility failures (67% of gilts were anoestrus) and due to euthanasia similarly by both categories. The mated but not farrowed females were culled mostly due to return to oestrus (>40%) and due to negative pregnancy diagnosis (>35%). However, the frequency of these culling reasons differed between the categories because of the high proportion of overweight gilts (50%) which were culled due to negative pregnancy diagnosis.

Table 1. Descriptive statistics for optimal and overweight animals[1]

Category	Optimal			Overweight			Sig.
Traits[2]	Mean	St. deviation	Range	Mean	St. deviation	Range	
AGT, d	156.8	9.1	135–184	152.8	6.9	132–164	***
BW, kg	91.1	7.7	72–110	100.8	5.5	88–110	***
ADG, g/day	580.9	30.8	510–640	659.7	23.6	620–742	***
BF I., mm	15.0	3.2	8–24	16.2	3.1	9–24	***
BF II., mm	11.6	2.2	6–18	12.7	2.5	6–18	***
LMD, mm	51.0	6.3	30–77	53.2	7.9	33–68	***
LMP	58.5	2.2	51–65	58.2	2.8	52–70	n.s.
AFM, d[4]	249.8	16.7	225–327	251.2	14.7	230–289	***
NP[5]	3.6	2.6	1–9	3.4	2.2	1–9	n.s.
TNB[5]	40.6	32.8	0–120	37.1	25.7	7–115	n.s.
NBA[5]	37.2	30.2	0–114	33.7	23.6	6–104	n.s.
NSB[5]	3.4	3.7	0–23	3.4	3.6	0–17	n.s.
NWP[5]	33.8	27.2	0–96	31.5	22.9	0–86	n.s.
LT, d[5]	817.9	397.7	326–1578	782.0	341.9	352–1577	n.s.
AC, d[6]	702.5	392.1	221–1578	671.6	320.8	259–1440	n.s.

n.s. – not significant; ** – $p\leq0.01$; *** – $p\leq0.001$.

[1]Number of animals 1203 and 220 (optimal and overweight, respectively).

[2]APT – age at growth test; BW – body weight, ADG – average daily weight gain; BF I. – backfat thickness, BF II. – backfat thickness, LMD – longissimus muscle depth, LMP – lean meat percentage, AFM – age at first mating, NP – number of parity, TNB – total number of piglets born, NBA – number of piglets born alive, NSB – number of piglets stillborn, NWP – number of weaned piglets, LT – lifetime, AC – age at culling.

[4]Number of mated animals 1133 and 210 (optimal and overweight, respectively).

[5]Number of farrowed animals 1023 and 187 (optimal and overweight, respectively).

[6]Number of culled animals 1043 and 183 (optimal and overweight, respectively).

Among the farrowed females, the overweight sows had weaker reproductive performance including lower farrowing traits and a shorter lifetime. But the result of the test statistic was not showed significant difference for neither of farrowing traits (p>0.05).

Females (gilts and sows) with optimal body weight were removed on average 702.5 days of age which corresponds to an age of 1 year and 11 months. The overweight females were removed on average one month earlier, but significant difference was not found in the culling age (p=0.922) between the groups. Regarding females that were removed from the farm, reproductive failures were the most frequent culling reason causing 37.7% and 34.4% of all removals (optimal and overweight, respectively). However, it could be observed a high percentage of culling due to leg problems by the overweight sows resulting 23% of all removal. According to the farm management policy, less than 2% of overweight sows completed the required number of farrowing and thus were removed due to old age. Over this, 12% of optimal females completed 8 parities and were removed due to old age.

Figure 1 shows the probability of staying in production for the two categories of females. It can be observed that the distance between the curves increased over the time. In addition, the tendency of curves changed to the opposite approximately at 850 days of lifetime: before this day the curve of overweight females showed at a slightly higher survival rate, while the survival probability of these females decreased greatly after 850 days. However, the results of the test statistic did not showed significant difference in case of the total lifetime (Chi-square=1.946 and p=0.163). According to the tendency of curves, it was detected that the sows before 850 days of lifetime completed up to 4 parities (the average lifetime of sows culled after 4 parities was 871±72.6 days and 859±64.4 days, optimal and overweight sows respectively). Thus, based on the number o f completed parities, the lifetime was divided into Period I including the sows with up to 4 parities and Period II including the sows with at least 5 parities.

Examining the lifetime separately, significant difference was found in both periods. In Period I the overweight sows showed a higher survival rate (Chi-square=5.802; p=0.016), while in Period II the sows with higher body weight had significantly lower survival probability (Chi-square=24.635; p<0.001). In this period the median of age were 1416 and 1239 days, optimal and overweight sows, respectively.

Similarly, the reproductive performance under the first period showed better average values in case of overweight sows (Table 2). The rapidly gained sows completed on average more than 2 parities (p=0.013) and farrowed on average 3 piglets more than the optimal sows (p<0.001). However, the productivity of the overweight sows with at least 5 parities decreased significantly (p<0.001). On average, the overweight sows completed less parities (p<0.001) and farrowed 13 piglets less (p<0.001) than the sows with optimal body weight. In addition, it can be observed that the overweight sows weaned 8 piglets less than the optimal ones (p<0.001).

Table 3 shows that the body weight influenced significantly (p<0.001) the sow lifetime performance when sows farrowed at least 5 times. The hazard ratio was 1.455 indicating that the probability of culling was 1.455 times higher in case of the overweight sows if the sows completed at least 5 parities.

The farrowing traits also influenced significantly (p<0.05) the risk of sow culling in both periods of lifetime. According to the values of harazd ratio (HR<1.000), increasing in the number of any productivity traits resulted decreasing in culling risk. The most significant effect can be observed in case of the number of parity (p<0.000), indicating that for each additional parity, the culling risk reduce by 70% and 50% (Period I and Period II, respectively).

Figure 1. Survival curves of the females with optimal and overweight body condition

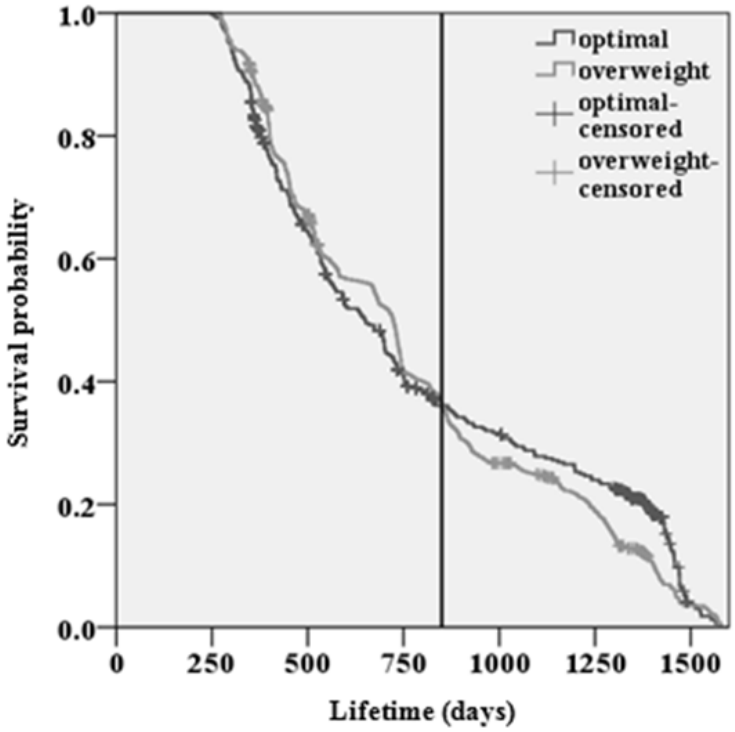

Table 2. Reproductive performance of sows under the two periods of lifetime

Traits[1]	Period I			Period II		
	Optimal (n=687)	Overweight (n=130)	Sig.	Optimal (n=336)	Overweight (n=57)	Sig.
NP	1.98 ± 1.08	2.13 ± 1.09	*	7.03 ± 1.06	6.35 ± 1.08	***
TNB	20.05 ± 13.69	23.10 ± 13.14	***	82.46 ± 16.64	69.24 ± 17.44	***
NBA	18.40 ± 12.87	21.05 ± 12.46	***	75.55 ± 15.81	62.71 ± 16.45	***
NSB	1.65 ± 2.19	2.05 ± 2.36	**	6.90 ± 3.72	6.53 ± 4.13	*
NWP	16.67 ± 11.49	18.67 ± 11.75	***	68.86 ± 12.11	60.82 ± 13.00	***

* – p≤0.05; ** – p≤0.01; *** – p≤0.001.
[1]see Table 1 for the traits name.

Table 3. Effect of the body weight[1] and the farrowing traits[2] on the sow lifetime

	Period I				Period II			
	B	SE	HR	Sig.	B	SE	HR	Sig.
C_BW	- 0.077	0.059	0.926	n.s.	0.035	0.104	1.455	***
NP	- 1.205	0.074	0.300	***	- 0.628	0.142	0.534	***
TNB	- 0.028	0.011	0.972	*	- 0.065	0.011	0.937	***
NBA	- 0.057	0.012	0.945	**	- 0.082	0.013	0.921	***
NWP	- 0.203	0.008	0.817	***	- 0.086	0.014	0.917	***

B – regression coefficient, SE – standard error of B, HR – hazard ratio.
n.s. – not significant; * – p≤0.05; ** – p≤0.01; *** – p≤0.001.
[1]category of body weight (0 – optimal, 1 – overweight).
[2]see Table 1 for the traits name.

Discussion

This study determined that the overweight relates to sow lifetime performance. Faster growth rate during the rearing period resulted overweight by the sows and later these sows produced at a significantly lower level than the required. Similarly, studies based on crossbred sows reported that higher average daily weight gains negatively influence sow lifetime and decrease the reproductive performance (Yazdi et al. 2000, Holendová et al. 2007, Serenius and Stalder 2007, Hoge and Bates 2011). In recent study, the overweight sows with at least 5 parities had 1.455 times higher culling risk than the sows with optimal body weight. In addition, it was observed a high proportion of culling due to leg problems resulting 23% of all removals by the overweight females. Jorgensen and Sorensen (1998) presented that high intensity of gilt rearing lead to leg problems because of the extra weight, and the insufficient body condition increases the possibility of reproductive failures, too.

In this study was observed a decreasing reproductive performance and an increasing culling risk by the overweight sows completed at least 5 parities. Retaining of these sows can lead to economic losses for the producer because the maximum parity associated with profitability ranged from 5 to 8 (Lucia et al. 2000). Furthermore, it can be observed (regardless of the body condition), that increasing in number of parity decreased significantly the risk of culling, especially under the first 4 parities. However, it is obvious that all sows eventually will be removed, resulting a high removal hazard for the last parities. Engblom et al. (2008) published that compared with sows in parity 1, sows in parities 2 to 7 had a lower hazard for removal, whereas sows in parity 8 and above had a greater removal hazard. Similarly, Tarres et al. (2006) determined that the greater risk found in older parities. There were other factors associated with increased survivability like number of piglets born alive and litter size at weaning. According to Guo et al. (2001) study, for each additional piglet born alive per parity, a sow remained about five days longer in the nucleus herd.

Conclusion

In conclusion, it can be stated, that the body condition have statistically significant effect for sow's lifetime performance. After a certain age the overweight sows produce lower piglets than the optimally fed sows with normal body weight. In addition, the high proportion of removal gilts can result expressive financial losses in breeding farm. Therefore, it is important to identify gilt composition and conformation traits associated with good reproductive performance throughout several parities. Compliance to the technological specifications is the interest of the management, because the optimally kept animals produce on the best during their lifetime.

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