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ANALYSIS OF PIGLET LOSSES IN FARROWING HOUSES WITH DIFFERENT TECHNOLOGIES

P. Nevrkla, M. Čechová, Z. Hadaš

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Abstract

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The aim of this study was to analyse the losses of piglets caused by different factors (due to overlaying, biting and/or other reasons) within the period from birth to weaning, reared with their mothers in different types of housing technology. The experiment involved 90 hybrid sows (Czech Large White x Czech Landrace) housed in two farrowing houses with two different types of technology. Each experimental variant involved 45 sows with 45 litters and the aim was to demonstrate the effect of the technology on losses of piglets. One variant (Technology I) was modern and originated from the year 2002 while the other (Technology II) was older (1994). Piglets were weaned in age of 28 days. The obtained results indicate that the overlaying was the most significant cause of piglet losses till the age of 7 days. As far as the overlaying as a cause of losses was concerned, there was a highly significant differences between both technologies ($P < 0.001$) in sows on the 2nd and 3rd litter while on the 4th and 5th litter the differences between both technologies were only significant ($P < 0.05$). The effect of biting and other causes of losses till the age of 7 days was insignificant. As compared with the first week of life, the losses within the period from the 8th day of life to the day of weaning were very low. It was demonstrated that the technology of housing of lactating sows influenced losses of piglets within the period from birth to weaning. In general, it can be concluded that in a more modern Technology I the parameters of sow performance were better than in the older Technology II, where the analysed losses from birth to weaning were higher. This indicates that it is very important to modernize technologies installed in farrowing houses.

technology, losses, piglets, sow, reproduction

As far as the optimisation of pig farming is concerned, numbers of reared piglets per sow per year play an important role (Roehe and Kalm, 2000). Production of piglets is closely associated with the process of reproduction. The aim of farmers is not only the process of reproduction *per se* but also the support and stimulation of maternal instincts of sows. It is expected that in modern large-scale operations, where the intensity of swineherd's supervision is lower, the maternal role of sows becomes to be more and more important. Genetic studies are therefore focused to the heritability of parturition length, nursing activities, impassivity (i.e. lack of interest in piglet squealing), nervousness and/or aggressivity of sows etc. (Čeřovský, 2005).

The prosperity of sow rearing and production of piglets is influenced by many factors and the new technologies definitely belong to them. It can be said that modern technologies enable to exploit maximally the actual genetic potential of sows because of several reasons. An optimum use of sow's production potential and the maintenance of its good health condition are surely in the foreground. Modern technologies should not only enable savings of energy, feed, and labour but also comply with natural requirements of animals. In this process, elimination of negative effects on the environment and a marked reduction of labour consumption play an important role (Rodríguez *et al.*, 2012).

In the Czech Republic, parturition crates were introduced into the practice above all after the year 1950 and nowadays individual crates for pregnant/delivering and lactating sows represent the most popular housing system. Andersen *et al.* (2005) mentioned that the adjustable length of crates reduced the risk of overlaying. According to Olivieri *et al.* (2008), the main reason for the use of crates was an effort to reduce losses of piglets due to overlaying. As compared with loose housing in individual pens with limited amounts of litter, the losses of piglets in crates are actually a little lower; however, it is necessary to point out in this context that confinement systems have also some disadvantages. From the economic point of view their acquisition costs are really high. As far as the behaviour of sows is concerned, the stay in crates practically prevents them to move and this represents a great stress for them. This fact was documented by increased levels of the stress hormone cortisone in their blood (Špinka and Illmannová, 1995).

To protect piglets, it is necessary to create a certain restricted space with local heating (i.e. nest). In principle, this can be solved in two different ways, viz. by means of heated floor (using electric heating or hot-water tubes) and/or by air heating (using infrared radiators or infrared lamps). Although the installation of floor heating is more expensive, it is better from the physiological (and also operational) point of view because it protects sensitive abdominal organs of piglets. As mentioned by Weary *et al.* (1996), the localisation of heat source is very important because it attracts piglets to rest. The heated nest should be localised outside of sow's reach but not too much because piglets want to be near their mother during the first hours of their life. This was corroborated also by Špinka and Illmannová (1995) who mentioned than newborn piglets got cold because they tried to be close to their mother's udder during the first days of their life in spite of the fact that they had also a heated nest available.

Regarding the fact that the Czech Republic is now a member country of EU, it should be said that Czech pig farmers are under a strong pressure from the side of their foreign competitors (Nejedlý, 1999). As mentioned by Rodríguez *et al.* (2012), the continuously stricter and stricter EU regulations concerning welfare of sows make production of piglets more and more complicated. According to Ahmadi *et al.* (2011), it can be expected that these tendencies will continue also in future. These authors point out that crate systems are banned in Switzerland, Sweden and Norway and that in these countries such alternative farrowing systems are used that respect and improve the welfare of sows. The aforementioned trends indicate that, as far as the welfare of pregnant sows is concerned, the future development will be oriented to new technologies and development of new housing systems for pregnant and delivering sows (Damm *et al.*, 2006).

The aim of this study was to analyse mortality of newborn piglets (i.e. from birth to weaning) due to overlaying, biting and/or other causes of death. In this study, a special attention was also paid to the rank of litter as a significant criterion.

MATERIAL AND METHODS

The experiment involved 90 hybrid sows (Czech Large White x Czech Landrace) housed in farrowing houses with two different types of technology. Each variant involved 45 sows and 45 litters and the aim was to demonstrate the effect of the technology on losses of piglets. One variant (Technology I) was modern and originated from the year 2002 while the other (Technology II) was older (1994). Piglets were weaned in age of 28 days. Experiments were performed from May to August. All sows received the same feed mixture and feeding rations were given individually according to the performance of animals.

In the total set of 90 experimental sows, the rank of litters was as follows: fifteen 1st litters; ten 2nd and 3rd litters; nine 4th and 5th litters and eleven 6th and later litters in Technology I. In Technology II, the corresponding ranks were as follows: sixteen 1st litters; ten 2nd and 3rd litters; six 4th and 5th litters, and thirteen 6th and later litters (Tab. I).

Technology I was modern and dated back to the year 2002. The size (length x width) of farrowing pens was 250 × 170 cm. Barriers of these parturition pens were made of plastic material. The floor of the pen was made either of concrete (in the front part) or of plastic grids (in the rear). Crates could be opened from the side. Their rear parts were telescopic and could be adjusted to the required length of sow's body. Dimensions of crates were as follows: width 60 cm, height 110 cm, minimum length 200 cm, and maximum length 235 cm. In this type of crates, the laying sow is partly fixed by side barriers (metal arcs) that reach to that space where the sow is lying; this means that she can lay down not too quickly so that piglets have enough time to escape and to protect themselves. The floor of nests for piglets is heated and the infralamp is mounted on a plastic plate that partly overlaps the barriers of the nest.

Technology II was older and was installed already in 1994. The size of farrowing pens was 260 cm x 190 cm. Barriers of farrowing pens were made of wood and the floor of concrete (with some straw as litter). Crates could be opened and also adjusted to the length of sow's body. Dimensions of crates were as follows: width 60 cm, height 110 cm, minimum

I: *Rank of analysed litters (n = 90)*

Litter	1st	2nd–3rd	4th –5th	6th and later	Total
Technology I	15	10	9	11	45
Technology II	16	10	6	13	45

length 210 cm, and maximum length 220 cm. Crates were not equipped with internal side barriers preventing the overlaying of piglets. An optimum temperature for piglets was assured by heated pads placed on the floor.

In both farrowing houses, there was a positive-pressure ventilation: incoming air was supplied from ventilation slots situated below the ceiling and air outlet was solved by fans installed in outer walls.

In both technologies the following basic data for evaluation and analysis were monitored: number of living newborn piglets, number of weaned piglets, number of piglets dying within the period from birth to weaning, piglet mortality due to overlaying, biting and other death causes till the Day 7 of age, and piglet mortality due to overlaying, biting and other factors after the 8th day of age (till weaning). Rank of the litter was very important factor at evaluation the piglet mortality. Recorded data were statistically analysed and processed using the software packages STATISTICA, Version 8.0. and Microsoft Office Excel 2010. Significance of differences was tested by means of t-test and the used symbols were as follows: NS ($P > 0.05$); * ($P < 0.05$); ** ($P < 0.01$) and *** ($P < 0.001$).

RESULTS AND DISCUSSION

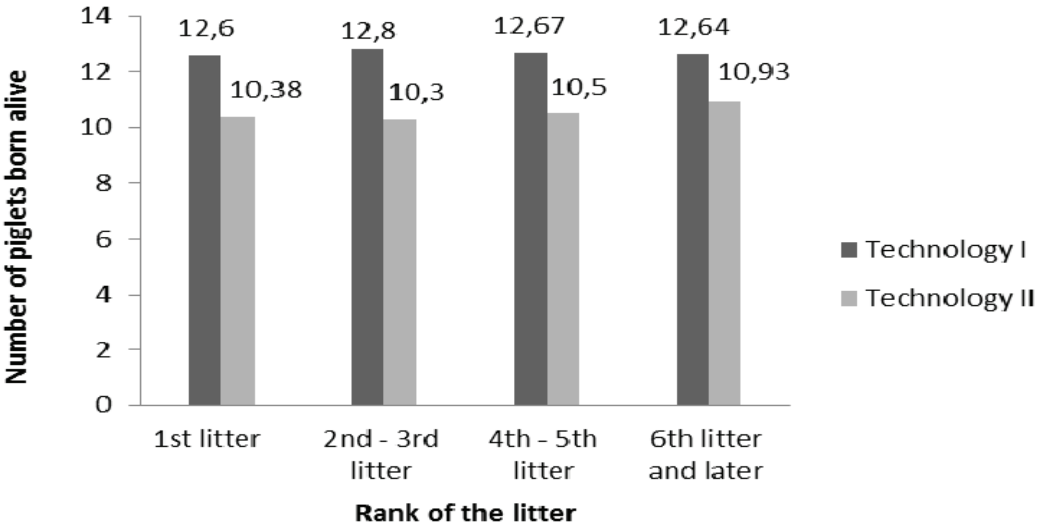
Analysis of reproductive parameters of sows

Numbers of piglets born alive in individual litters are presented in Fig. 1. In Technology I, the highest numbers of piglets born alive were recorded in the category of the 2nd–3rd litter (12.80 ± 2.86), followed by the 4th–5th litter (12.67 ± 2.29), and the 6th and later litters (12.64 ± 3.26); the lowest number of piglets born alive was recorded in the group of sows on the 1st litter (12.60 ± 2.56). In Technology II, the numbers of piglets born alive were a little lower: the highest numbers were recorded in the category of the 6th and later litters (10.93 ± 2.81), followed by the 4th–5th litter (10.50 ± 1.57), the 1st (10.38 ± 1.93), and the 2nd–3rd litter (10.30 ± 1.16)

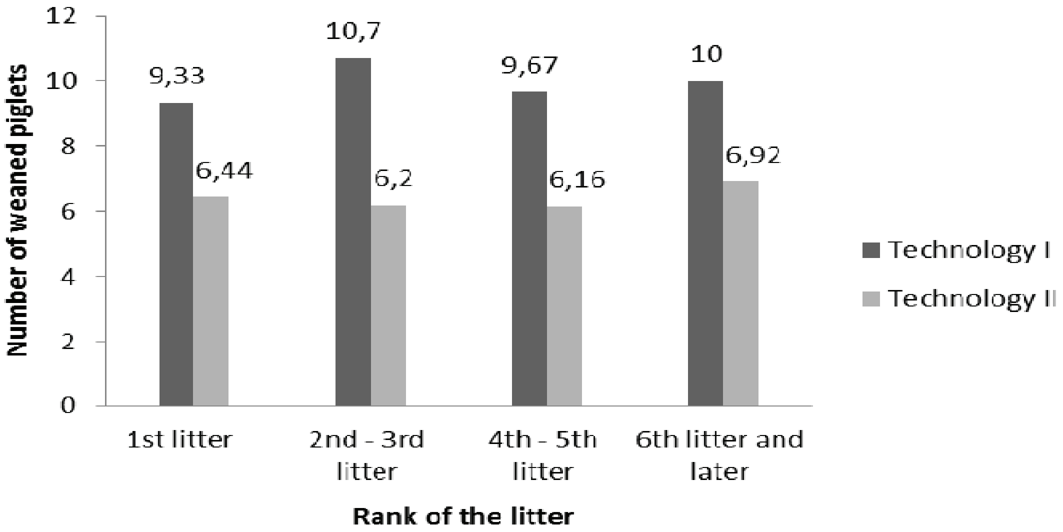
Results obtained in Technology I corresponded with optimum results recorded in other contemporary herds (Vanderhaeghe *et al.*, 2011). These authors presented the following results: 11.5 piglets on the 1st litter; 12.2 piglets on the 2nd litter and 12.8 piglets in the category of the 3rd–6th litter. Gu *et al.* (2011) in their evaluation of farrowing pens mentioned 11.2 piglets born alive; this corresponded with results (11.0) published by Kilbride *et al.* (2012). A little lower numbers of piglets born alive published Knap and Hájek (1970) who in their evaluation of different housing technologies recorded 9.79 piglets born alive. This value corresponded with results (9.70) published by (Arango *et al.*, 2006). Our results recorded in Technology II (category of the 2nd and 3rd litter) corresponded also with these lower numbers.

Numbers of weaned piglets per litter in individual technologies and groups of animals are presented Fig. 2. In Technology I the obtained results were better than in Technology II. In Technology I and Technology II, numbers of piglets weaned from sows on the first litter were 9.33 ± 1.68 *vs.* 6.44 ± 1.46, respectively. In the group of the 2nd–3rd litter, the corresponding numbers were 10.70 ± 1.42 *vs.* 6.20 ± 0.92 piglets, respectively, in the group of the 4th–5th litter 9.67 ± 1.22 *vs.* 6.16 ± 1.47 piglets, and in the last group (the 6th and later litters) 10.00 ± 2.14 *vs.* 6.92 ± 1.80 piglets, respectively.

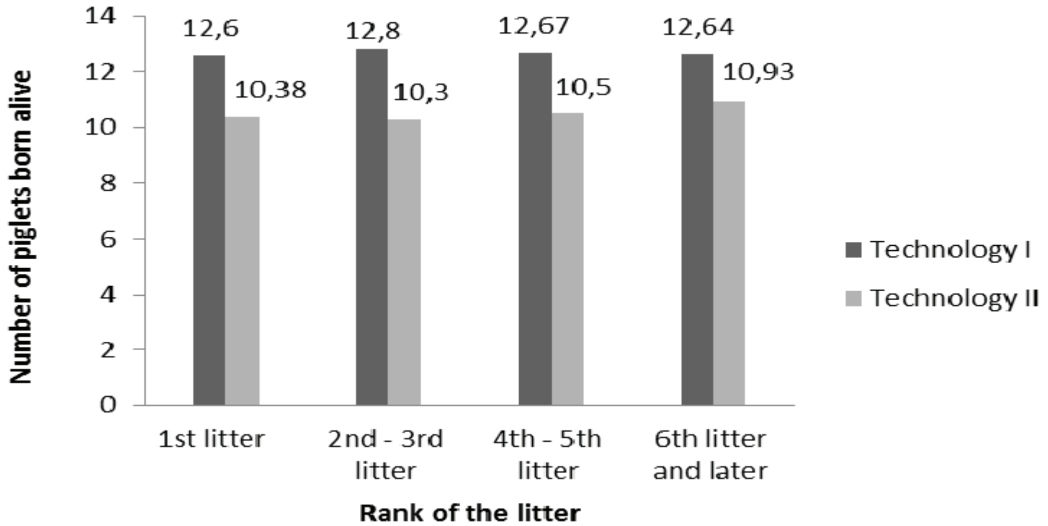
According to Vanderhaeghe *et al.* (2010), the number of weaned piglets is the most important parameter of sow's performance. Rodríguez *et al.* (2012) recorded in their study evaluating the linear optimisation model on pig farms the following numbers of weaned piglets in individual groups of sows: on the 1st litter = 10.17; on the 2nd litter = 10.30; on the 3rd litter = 10.82; on the 4th litter = 11.18; on the 5th litter = 11.09; on the 6th litter = 10.74, and on the 7th litter = 10.38 of weaned piglets. These results were



1: *Numbers of piglets born alive in both technologies and in individual litter categories*



2: *Numbers of weaned piglets in both technologies and in individual litter categories*



3: *Numbers of piglets dying until weaning in both technologies and in individual litter categories*

better than ours from Technology I. Knap and Hájek (1970) in their earlier study, which was performed in farrowing houses with older technologies. Recorded 8.37 weaned piglets; this was by 1.93 piglet more than in Technology II. Similar results were published also by Andreevov, Ilievov and Todorov (1990) who analysed performance of lactating sows and mentioned 8.24 reared weaned piglets per litter. This means that results obtained in Technology II can be evaluated as very bad.

The difference between piglet losses, as recorded in both technologies, is illustrated in Fig. 3. Although in Technology II the number of piglets born alive was lower, the recorded losses of piglets were much higher in all litter categories. As one can see, on the 1st litter, the mortality in Technology I and Technology II was 3.27 ± 1.83 *vs.* 3.94 ± 1.34 piglets, respectively. The most prominent difference between both technologies was found out in the group on the 2nd–3rd litter, 2.10 ± 1.73 piglets *vs.* 4.10 ± 0.88 piglets, respectively. In the group of sows on the 4th–5th litter, the corresponding mortality till weaning was 3.00 ± 1.58 *vs.* 4.33 ± 1.21, respectively, and on the 6th and later litters 2.64 ± 1.75 *vs.* 3.85 ± 2.03, respectively.

Paška (1997) mentioned that in the group of sows of the Large White breed, the loss was 1.20 piglets while in the group of hybrids Large White x Czech Improved Meaty White it was equal to 1.60 piglets. Similar results were published also by Kašpar and Vejnar (1980) who found out that losses in pens and in a combined system of housing were 1.56 *vs.* 1.47 piglets per litter, respectively. When comparing our results with these data, it can be concluded that the mortality of piglets in both technologies under study was relatively high.

Analysis of piglet losses within the period from birth until weaning

Causes of piglet losses within the time internal from birth to Day 7 of age are presented in Tab. II. As one can see, in the group of sows on the 1^{st} litter altogether 2.27 ± 1.10 *vs.* 2.82 ± 0.98 piglets were laid on in Technology I and Technology II, respectively. Losses caused by biting were 0.67 ± 1.29 *vs.* 0.63 ± 1.45 piglets in Technology I and Technology II, respectively. The effect of other causes of death (health problems, malformations, weakness) was very low in all groups of sows. In the group of sows on the 2^{nd}–3^{rd} litter, laid on were 1.50 ± 1.35 *vs.* 3.90 ± 0.96 piglets in Technology I and Technology II, respectively. In this group, no biting was recorded as the cause of death. In the group of sows on the 4^{th}–5^{th} litter 2.11 ± 1.27 *vs.* 3.50 ± 1.04 piglets were laid on in Technology I and Technology II, respectively. Biting of piglets was only exceptional, viz. 0.33 ± 1.00 piglets in Technology I. On the 6th and later litters, 2.09 ± 1.30 vs. 2.77 ± 1.64 piglets were laid on in Technology I and Technology II, respectively. Biting of piglets was again only exceptional, 0.40 ± 1.26 piglets in Technology II.

As far as the causes of death were concerned, there were no statistically significant differences between both technologies in groups of sows on the 1^{st} litter. However, in the group of sows on the 2^{nd}–3^{rd} litter, the difference between both technologies in losses caused by overlaying was highly significant ($P < 0.001$). In other loss causes (biting etc.), the difference between both technologies was not significant. In the group of sows on the 4^{th}–5^{th} litter, the difference between both technologies in losses caused by overlaying was significant ($P < 0.05$). Also in this group the differences in other loss causes (biting etc.) were not significant. Finally, in the last group of sows (on the 6^{th} and later litters) there were no statistically significant differences between both technologies in all loss causes.

The obtained results indicated that in individual technologies the overlaying of piglets was the most frequent cause of losses. This observation corresponded also with data published by (Mellor and Stafford, 2004; Vaillancourt *et al.*, 1990). Weary *et al.* (1996), who compared different types of farrowing houses, mentioned that piglets ware laid on most frequently on the first day of their life (i.e. immediately after their birth) than later on. This could be explained by the fact that the on the day of parturition the sow was more active than in the following days. Important was also the protective role of metallic barriers that reduced the risk of overlaying and, last but not least the necessity of assurance of thermal comfort in nests situated out of sow's reach. The importance of adequate structural elements and localisation of the heat source out of sow's reach was mentioned also by (Damm *et al.*, 2000). Marchant *et al.* (2000) emphasised the importance of adjustable lengths of crates. As one can see in Tab. I, the biting of piglets as a loss cause was less frequent. This loss cause was

II: *Causes of piglet losses till Day 7 of age*

Rank of litter	Technology	Total number of dead piglets (causes)			Loss causes and numbers of dead piglets in individual littres		
		n			A	B	C
		A	B	C	$\bar{x} \pm s_x$	$\bar{x} \pm s_x$	$\bar{x} \pm s_x$
1^{st}	I	34	10	1	2,27 ± 1,10	0,67 ± 1,29	0,07 ± 0,26
	II	45	10	4	2,82 ± 0,98	0,63 ± 1,45	0,31 ± 0,60
2^{nd}–3^{rd}	I	15	0	2	1,50 ± 1,35	0,00 ± 0,00	0,20 ± 0,42
	II	39	0	0	3,90 ± 0,96	0,00 ± 0,00	0,00 ± 0,00
4^{th}–5^{th}	I	19	3	2	2,11 ± 1,27	0,33 ± 1,00	0,22 ± 0,67
	II	21	0	3	3,50 ± 1,04	0,00 ± 0,00	0,50 ± 0,84
6^{th} and later	I	23	0	5	2,09 ± 1,30	0,00 ± 0,00	0,45 ± 1,51
	II	36	6	1	2,77 ± 1,64	0,46 ± 1,26	0,08 ± 0,28

Statistical significance of individual loss causes

Loss cause	Technology	1^{st} litter	2^{nd}–3^{rd} litter	4^{th}–5^{th} litter	6^{th} and later llitters
Overlaying (piglets/litter)	I	NS	***	*	NS
	II				
Biting (piglets/litter)	I	NS	NS	NS	NS
	II				
Other	I	NS	NS	NS	NS
	II				

Loss cause: A = overlaying; B = Biting; C = Other;
NS = Non Significant; * ($P < 0.05$); *** ($P < 0.001$)

the most frequent among sows on the 1st litter and this fact corresponded also with the observation published by Čeřovský (2005) who concluded that this phenomenon was genotype- dependent and occurred mostly among young sows on the 1st litter. Lawrence *et al*. (1997) pointed out that the nesting instinct is genetically fixed and that the commercial crates did not allow its manifestation so that it could result in biting, which most frequently occurs among young sows.

A survey of loss causes after Day 8 of age until weaning is presented in Tab. III. As one can see, 0.13 ± 0.35 and 0.25 ± 0.58 piglets ware laid on in Technology I and Technology II, respectively, in the group of sows on the 1st litter. In the group on the 2nd–3rd litter, the corresponding numbers were 0.20 ± 0.42 and 0.60 ± 0.32 piglets in Technology I and Technology II, respectively, while in the group on the 4th–5th litter, the losses of piglets were 0.33 ± 0.71 and 0.33 ± 0.52 in Technology I and Technology II, respectively. On the 6th and later litters the risk of overlaying was 0.09 ± 0.30 and 0.15 ± 0.38 in Technology I and Technology II, respectively. As compared with the first seven days of life of piglets, the biting and other causes of death were really very low after Day 8 of life and none of piglets was killed due to biting. There were no significant differences between both technologies in death causes after Day 8 of life.

According to Andersen *et al*. (2005), who analysed losses of piglets due to overlaying, the highest losses occurred within the first five days of life of piglets; this observation corresponded also with our results.

CONCLUSION

This study demonstrated that the technology influenced losses of piglets within the period from birth to weaning. Until Day 7 of age of piglets, overlaying was the most frequent and the most significant cause of death. In the group of sows on the 2nd–3rd litter, this cause of losses was the most frequent and the difference between both technologies was highly significant ($P < 0.001$); in the group on the 4th–5th litter, this difference was only significant ($P < 0.05$).

It can therefore be concluded that in the modern Technology I, the performance parameters of sows were better than in the obsolete Technology II where the losses of piglets within the period from birth till weaning were higher. This indicates that it is very important to modernize technologies installed in farrowing houses.

III: *Causes of piglet losses between Day 8 of age and weaning*

Rank of litter	Technology	Total number of dead piglets (causes)			Loss causes and numbers of dead piglets in individual littres		
		n			A	B	C
		A	B	C	$\bar{x} \pm s_x$	$\bar{x} \pm s_x$	$\bar{x} \pm s_x$
1st	I	2	0	2	0,13 ± 0,35	0,00 ± 0,00	0,13 ± 0,52
	II	4	0	0	0,25 ± 0,58	0,00 ± 0,00	0,00 ± 0,00
2nd–3rd	I	2	0	2	0,20 ± 0,42	0,00 ± 0,00	0,20 ± 0,00
	II	1	0	1	0,60 ± 0,32	0,00 ± 0,00	0,17 ± 0,41
4th–5th	I	3	0	1	0,33 ± 0,71	0,00 ± 0,00	0,00 ± 0,00
	II	2	0	1	0,33 ± 0,52	0,00 ± 0,00	0,00 ± 0,00
6th and later	I	1	0	0	0,09 ± 0,30	0,00 ± 0,00	0,00 ± 0,00
	II	2	0	1	0,15 ± 0,38	0,00 ± 0,00	0,08 ± 0,28

Statistical significance of individual loss causes

Loss cause	Technology	1st litter	2nd–3rd litter	4th–5th litter	6th and later llitters
Overlaying (piglets/litter)	I	NS	NS	NS	NS
	II				
Biting (piglets/litter)	I	NS	NS	NS	NS
	II				
Other	I	NS	NS	NS	NS

Loss cause: A = Overlaying; B = Biting; C = Other;

SUMMARY

The aim of this study was to analyse the losses of piglets caused by different factors (due to overlaying, biting and/or other reasons) within the period from birth to weaning, reared with their mothers in different types of housing technology. Rank of the litter was very important factor at evaluation the piglet mortality. The experiment involved 90 hybrid sows (Czech Large White x Czech Landrace) housed in two farrowing houses with two different types of technology. Each experimental variant involved 45 sows with 45 litters and the aim was to demonstrate the effect of the technology on losses of piglets. Piglets were weaned in age of 28 days. In both technologies the following basic data for evaluation and analysis were monitored: number of living newborn piglets, number of weaned piglets, number of piglets dying within the period from birth to weaning, piglet mortality due to overlaying, biting and other death causes till the Day 7 of age, and piglet mortality due to overlaying, biting and other factors after the 8^{th} day of age (till weaning). Numbers of piglets born alive in individual litters are presented in Fig. 1. In Technology I, the highest numbers of piglets born alive were recorded in the category of the 2^{nd}–3^{rd} litter (12.80 ± 2.86). Numbers of weaned piglets per litter in individual technologies and groups of animals are presented Fig. 2. In Technology I the obtained results were better than in Technology II. The highest diference between technologies at evaluation the number of weaned piglets was observed at 2^{nd} and 3^{rd} rank of the litter (Technology I 10.70 ± 1.42; Technology II 6.20 ± 0.92). The difference between piglet losses, as recorded in both technologies, is illustrated in Fig. 3. Although in Technology II the number of piglets born alive was lower, the recorded losses of piglets were much higher in all litter categories. Until Day 7 of age of piglets, overlaying was the most frequent and the most significant cause of death. In the group of sows on the 2^{nd}–3^{rd} litter, this cause of losses was the most frequent and the difference between both technologies was highly significant ($P < 0.001$); in the group on the 4^{th}–5^{th} litter, this difference was only significant ($P < 0.05$). There were no significant difference between both technologies in death causes after Day 8 of life. This study demonstrated that the technology influenced losses of piglets within the period from birth to weaning.

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Address

Ing. Pavel Nevrkla, prof. Ing. Marie Čechová, CSc., Ing. Zdeněk Hadaš, Ústav chovu a šlechtění zvířat, Mendelova univerzita v Brně, Zemědělská 1, 613 00 Brno, Česká republika, e-mail: NevrklaPavel@seznam.cz, marie.cechova@mendelu.cz, zdenek.hadas@mendelu.cz