Influence of technological factors on the reproductive performance of sows in an industrial breeder

A I Daryin, N N Kerdyashov, A A Busov and E A Zykina
Penza State Agrarian University, 30 Botanicheskaya St., Penza, 440014, Russia

E-mail: dariin.a.i@pgau.ru

Abstract. The most important element of pork production technology is herd reproduction. Among all reproductive qualities of sows, the most important are prolificacy, heavy litter, and preservation of piglets during the suckling period. Therefore, the study of reproductive qualities of pigs is relevant to the theory and practice of pig breeding. The research was carried out under reproductive conditions in an industrial pig breeding complex. It is noted that the greatest increase in sows prolificacy is observed when the service-period is 21-28 days, i.e. when one heat is skipped, as compared to sows with a service-period of 1-7 days, i.e. without heat skipping. The highest farrowing rate was observed in groups of sows without heat skipping, but taking into account the prolificacy, the highest number of piglets was obtained in groups of sows with a service-period of 21-28 days - 33.35-34.70 animals. The survival rate of piglets in all groups of sows was 90.3%. Stillbirth rate was 0.85 heads per sow. Slight variations in this indicator from 0.79 to 0.95 were recorded depending on the service period of the sows. On average the crushed piglets amounted to 0.76 animals per nest. There were slight fluctuations from 0.73 to 0.79 depending on the service-period of the sows. Fetal mummification of fetuses was 0.37 per nest. It is noted that there is a tendency to increase the number of mummified fetuses with increasing service-period of sows. The number of mummified fetuses increases with increasing multiplicity of sows, which was observed in groups of sows with a service period of 21-28 and 45 days or more.

1. Relevance
Weaning technology at 18 days of age increases the weaning live weight of piglets up to the fifth farrowing. When weaning technology was used at 21 days of age, the increase in weaning weights was observed until the third or fourth farrowing period. A significant influence of the farrowing number of sows on the weaning live weight or the influence of the maternal body is related to the duration of lactation. The shorter the lactation period, the greater was this influence. As the lactation period increases, the influence of the maternal body decreases and the individual characteristics of young pigs increase.

One of the fastest growing, most technologically advanced and economically efficient industries is pig breeding, which provides a high return of investment. The most responsible and technologically complex stage of pork production is herd reproduction. The reproduction of pigs ultimately determines the number of young pigs received for fattening and the profitability of the entire pig breeding industry [1,2,3].

The reproductive qualities of pigs have a low hereditary condition and are caused to a greater extent by technological factors of feeding and housing animals. Therefore, only using more perfect
technological methods of keeping and use of sows in reproduction can significantly improve the reproductive qualities and obtain more piglets from one sow per year of its productive use [4].

Industrial pig farms operating under intensive technologies use hybrid meat animals, which are highly productive, but also quite demanding to environmental factors. Productive qualities of hybrid pigs are 18-25% higher than those of purebred animals, and 12-15% higher than those of crossbred pigs. Therefore, when organizing reproduction, rearing and fattening, it is necessary to keep in mind that hybrid pigs are more sensitive to changes in feeding and housing conditions than purebred animals, and it is more difficult to ensure optimal environmental conditions for them [5,6,7,8]. Therefore, one of the main tasks of pig breeding specialists is to improve the technology of using sows and boars in reproduction in order to maximize the lifetime productivity of the animals.

Nowadays, a decrease in reproductive rates is observed in the technological conditions of industrial pig breeding enterprises. There is an increase in the number of empty sows, the presence of agalactia in some animals, i.e. complete absence of milk after farrowing. An increased number of weak, dead and mummified piglets are also observed during farrowing. These problems usually occur at the beginning of the productive use of sows [9]. Therefore, at present, the efforts of domestic and foreign specialists are aimed at finding and introducing optimal, more perfect methods of breeding, maintenance and selection of young pigs, as well as ways to improve the reproductive qualities of sows and boars [10,11].

The research was carried out in the conditions of a reproduction pig breeding complex in Penza region with a capacity of 110,000 pigs. The experimental part of the work was carried out in the conditions of the industrial area of pig-breeding complexes on crossed sows. Only hybrid animals obtained by crossing selected lines, breeds and types of pigs with high combining ability and a high heterosis effect were used in the reproduction unit of the pig breeding complex for pork production. The sows were kept in typical production halls with a high level of mechanization of production processes. The parameters of pig housing, the features of the microclimate of the pig-keeping premises corresponded to the generally accepted norms.

2. Methods
Nine groups of sows with different duration of service-periods (interval of the reproductive cycle of sows from weaning to fertile insemination) and lactation (suckling period) were formed for the studies. The duration of the service period is one of the main indicators of sow performance. Therefore, in order to reduce the number of unproductive days, this stage should be reduced as much as possible. It is known that it is not only related to the non-productive period, but it is also capable of having a much greater impact on other reproductive performance.

According to the scheme of experiment the first experimental group was used with a service period of 1-7 days and a sucking period of 18 days; the second group - a service period of 21-28 days and a sucking period of 18 days; the third group - a service period of 45 days and more and a sucking period of 18 days; the fourth group - a service period of 1-7 days and a sucking period of 21 days; the fifth - a service period of 21-28 days, a sucking period of 21 days; the sixth - a service period of 45 days and more, a sucking period of 21 days; the seventh - a service period of 1-7 days, a sucking period of 24 days; the eighth - a service period of 21-24 days, a sucking period of 24 days; the ninth - a service period of 45 days and more, a sucking period of 24 days.

The selection of animals in the experimental groups was carried out using the paired-analysis method, taking into account age, sex, live weight, fatness and origin. All animals used in the experiments were clinically healthy. The total number of sows used in the studies was 3,647.

3. Results
The results of the studies showed that the multiple fertility of sows when weaning piglets at 18, 21 and 24 days, depending on the length of the service period, increased with the longest service period. When weaning at 18, 21 and 24 days the highest number of 88-89 piglets was obtained in the group of sows with the service period of 45 days and more. At the same time, the lowest number of piglets was obtained in groups of sows with a service period of 1-7 days, i.e. when inseminating sows in the first
heat. An analysis of the data for all sows averaged over the weaning period suggests that skipping one heat had a positive effect on their fertility. The difference in multiple births of sows with a service period of 21-28 days and 45 days or more compared to the group of sows without skipping one heat was 2.34 and 2.39 animals, respectively (P<0.001). The difference in prolificacy in the group of sows with one and two skipped heat was insignificant and was only 0.05 animal.

The farrowing index, which indicates the average number of farrows per sow in a year of production, is of great importance in pig reproduction practice. The higher the farrowing index, the more efficiently the sow is used for reproduction. The farrowing index ranged from 1.99 to 2.63 in the sow groups. Taking the farrowing index into account, the greatest number of piglets was obtained in groups of sows with the service period of 21-28 days - from 33.35 to 34.70 animals. In groups of sows with the service period of one to seven days it was from 31.25 to 32.88 animals. In groups of sows with the service period of 45 days or more, from 28.42 to 30.22 animals. Thus, the highest number of piglets per year of productive use of sows was when one heat was skipped, despite the lowering of the farrowing index.

The survival of suckling pigs in the group of sows with a service period of 1-7 days was 89.3% and in the group of sows with a service period of 21-28 days it reached 90.0%, which was higher by 0.7% compared to the group of sows with a service period of one-seven days. In the group of sows with a service period of 45 days and more, the survival rate increased to 91.5%, which was 2.2% higher than in the group of sows with a service period of one to seven days. Thus, with an increase in the service period of the sows, there is an increase in the survival rate of the piglets. On the whole, a rather high survival rate of the piglets can be noted - 90.5% in all groups of sows.

Reducing the mortality of piglets during the suckling period, as well as reducing the stillbirths of piglets, mummification of fetuses (death of embryos during embryogenesis), crushing the piglets by the sow, is one of the priority tasks of modern pig production. Given that the potential of reproductive qualities of sows is used with maximum efficiency and the load on the physiological functions of reproductive qualities is intensive, it is necessary to create such technological conditions of sow keeping that would contribute to the reduction of losses of piglets both during embryogenesis, farrowing and the course of keeping the piglets together with the sow.

The studies noted that on average the stillbirth rate was 0.85 pigs per nest. Slight variations of this indicator from 0.79 to 0.95 have been noted depending on the service-period of the sows. The highest rate of stillbirths depending on the farrowing order number was observed in the first and sixth farrows - 0.94 and 1.05 piglets respectively. The lowest percentage of stillbirths was observed in the second and third farrowings - 0.66 and 0.70 respectively. Apparently, at the first farrowing, young sows with a relatively physiologically incompletely formed reproductive system have a higher stillbirth rate. The increase in stillbirths in the sixth farrowing period can be explained by an age-related decrease in the physiological qualities of the sows, including the reproductive system.

Piglet crushing, which occurs in the first days after farrowing when the piglets are not yet sufficiently active, causes considerable damage to the pig industry. Crushing is the second cause of piglet mortality during the suckling period. It depends on many factors: individual characteristics of the sow, design of the pen, age of the piglets, etc. [13].

Indicators of piglet crushing by sows on average at all weaning times are shown in Table 1.

**Table 1.** Average piglet crushing rates in sow nests at 18, 21, 24 days of lactation, X±m.

| Farrowing | Service-period of sows, days | 1-7 days | 21-28 days | 45 days and more | On average |
|-----------|-----------------------------|----------|------------|-----------------|-----------|
| 1         |                             | 0.82±0.33| 0.83±0.24  | 0.88±0.30       | 0.84±0.28 |
| 2         |                             | 0.74±0.25| 1.04±0.27  | 0.82±0.23       | 0.87±0.21 |
| 3         |                             | 0.88±0.55| 0.62±0.21  | 0.89±0.44       | 0.80±0.38 |
| 4         |                             | 0.72±0.22| 0.57±0.22  | 0.66±0.21       | 0.65±0.18 |
| 5         |                             | 1.03±0.22| 0.58±0.21  | 0.66±0.19       | 0.76±0.17 |
| 6         |                             | 0.53±0.18| 0.74±0.37  | 0.56±0.26       | 0.61±0.24 |
| On average per farrow, animals | | 0.79±0.27 | 0.73±0.22 | 0.75±0.26 | 0.76±0.23 |
Table 1 shows that the average crush rate was 0.76 heads per nest. Slight variations from 0.73 to 0.79 were observed depending on the service-period of the sows. The highest crushing rate of piglets depending on the number of farrowing was observed in the first, second and third farrowings, which ranged from 0.80 to 0.87 pigs per nest, in the fourth, fifth and sixth farrowings: 0.61 to 0.76 pigs respectively. In the first three farrowings, the maternal qualities of the sows had not yet fully emerged and therefore a higher crushing of the piglets by the sows was noted.

The indices of mummified fetuses of the experimental sows on average for all weaning dates are presented in Table 2. The table shows that the average number of mummified fetuses was 0.37 per nest. It is noted that the number of mummified fetuses tends to increase with increasing service period.

Table 2. Average indicators of mummified fetuses of sows at lactation of 18, 21, 24 days, \( \bar{X} \pm m \).

| Farrowing | 1-7 days | 21-28 days | 45 days and more | On average |
|-----------|----------|------------|------------------|-----------|
| 1         | 0.13±0.08| 0.45±0.23  | 0.55±0.20        | 0.39±0.18 |
| 2         | 0.15±0.09| 0.15±0.11  | 0.40±0.21        | 0.13±0.14 |
| 3         | 0.32±0.15| 0.22±0.13  | 0.25±0.12        | 0.26±0.13 |
| 4         | 0.30±0.12| 0.50±0.21  | 0.52±0.19        | 0.44±0.17 |
| 5         | 0.36±0.14| 0.28±0.14  | 1.07±0.40        | 0.53±0.22 |
| 6         | 0.37±0.21| 0.49±0.20  | 0.18±0.11        | 0.35±0.17 |
| On average| 0.27±0.13| 0.35±0.17  | 0.45±0.19        | 0.37±0.17 |

The highest rates of mummified fetuses depending on farrowing number were found in the third, fourth and sixth farrows. The average was 0.44 fetuses, while in the first and third farrowings, the number of mummified fetuses was 0.29. When analyzing the number of mummified fetuses it can be noted that this indicator increases when the number of sows with multiple births increases, which was observed in groups of sows with a service period of 21-28 days and 45 days or more.

The live weight of piglets at weaning from sows is of great importance in reproduction, which determines the growth potential of piglets in growing and fattening.

Table 3 shows the average live weight of piglets of the experimental groups in all service-periods studied.

When weaning technology is used at the age of 18 days, there is an increase in weaning live weight of piglets up to the 5th farrowing period. When using weaning technology at 21 days of age, there was noted an increase in weaning live weight until the third or fourth farrowing periods. A noticeable decrease in weaning weight in these sow groups was observed at the 5th and 6th farrowings.

Table 3. Average live weight of piglets of the experimental groups of sows for all service periods, \( \bar{X} \pm m \).

| Farrowing | Sow groups at weaning, days | Number of piglets, animals | On average |
|-----------|----------------------------|-----------------------------|-----------|
|           | 18                         | 21                          | 24        | 550        | 5.83±0.13 |
|           | 2                          | 5.46±0.11                   | 5.89±0.10 | 6.53±0.12 | 559        | 5.96±0.11 |
|           | 3                          | 5.49±0.11                   | 5.97±0.09 | 6.43±0.11 | 555        | 5.96±0.10 |
|           | 4                          | 5.50±0.10                   | 5.94±0.12 | 6.51±0.10 | 553        | 5.98±0.11 |
|           | 5                          | 5.51±0.11                   | 5.70±0.12 | 6.19±0.11 | 561        | 5.80±0.11 |
|           | 6                          | 5.39±0.11                   | 5.63±0.12 | 6.24±0.13 | 423        | 5.75±0.12 |
| On average| 5.43±0.11                   | 5.82±0.11                   | 6.39±0.12 | 3323       | 5.88±0.11 |

And when weaning technology was used at 24 days of age, the increase in weaning live weight occurred up to the fourth farrowing. It seems that the most significant effect of sow farrowing number on weaning live weight or maternal body influence is related to the duration of lactation. The shorter the lactation period, the greater the effect. As the lactation period increases, the influence of the maternal body decreases and the individual characteristics of the young pigs increase. The live weight of piglets
when weaned at 18 days of age was 5.43 kg, and when weaned at 21 days of age it was 0.39 kg more (P<0.05). At weaning at 24 days of age it was 6.39 kg, which was 0.96 kg more than at 18 days of age (P<0.001).

4. Conclusion
Thus, the results of the studies show that the duration of service-period and lactation of sows influences their prolificacy, survival of suckling pigs, as well as stillbirths, crushed piglets and mummified fetuses. It was revealed that inseminating sows in the second heat after weaning has a positive effect on their fertility, large birth rate and preservation of piglets.

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