

## CORRELATIONS BETWEEN PIG REPRODUCTIVE PERFORMANCE AND SOME ENVIRONMENTAL AND FEEDING FACTORS

HUSZAR JANOS<sup>1</sup>, DOBOS DORINA<sup>2</sup>, BODNAR KAROLY<sup>1</sup>

<sup>1</sup>*Hungarian University of Agriculture and Life Sciences, Szarvas, Hungary*

<sup>2</sup>*FirstFarms Hungary Kft, Telekgerendas, Hungary*

\*Corresponding author's e-mail: bodnar.karoly.lajos@uni-mate.hu

*Abstract: In recent decades, market competition has become decisive for many animal products, and their role in the food supply has been determined by their competitiveness. The environment in pig farms is not natural, but artificial, created by man. The environment is a determining factor, because on industrially operating small and large pig farms, approximately two-thirds of production depends on it. The beneficial properties of high-performance meat pigs can only be fully realized if, in addition to proper feeding, they are also provided with housing that meets their needs. The goal was to collect fresh research results in preparation for a planned study.*

**Key words:** *pig reproduction, housing conditions, content of concentrates, farm management, heat stress*

### INTRODUCTION

Pig farming is a significant livestock sector both in Hungary and internationally, as pork remains one of the largest sources of animal protein for human nutrition [9]. The efficiency of production depends on many factors, but reproductive biological indicators play a particularly important role - for example, pregnancy rate, litter size, number of piglets weaned, the interval between two farrowing of a sow, etc. Improving reproductive performance is not only a breeding issue, but also a crucial economic one.

The aim of this literature review is to summarize how environmental factors (husbandry technology, microclimate, stress, etc.) and feeding factors (energy and protein supply, microelements, etc.) affect the reproductive performance of pigs, including breeding sows and breeding boars, and to base our planned research on this information.

### MATERIALS AND METHODS

A narrative literature review was chosen as the method, where existing theories and results on the topic are collected. The presented material will form part of a student thesis. The material was selected using the Google Scholar search engine, where the search words were terms related to pigs, reproduction and feeding. The aim was to compile a collection that would provide a sufficient basis for our subsequent investigations.

### RESEARCH RESULTS

Several indicators are used to measure reproductive success. The most important ones are: the proportion of sows conceived at first insemination, the pregnancy rate, the proportion of sows farrowed, the litter size (number of piglets born alive and weaned), the weaning weight, and the length of the sow's "weaning-to-oestrus" period. Maximum performance can only be expected from breeding sows if their needs are met in every phase in a manner and to an extent appropriate to the given period. The different phases of reproduction differ significantly in terms of the nutritional needs of the animals.

The success of each pregnancy cycle is largely determined by the events of the preceding lactation and post-weaning period. During lactation, the sow loses body weight, since the demands of milk production cannot be met even with the most concentrated feeding [21]. This is acceptable if the body weight loss remains moderate, not exceeding

20 kg, and according to some recent opinions, 10 kg. Reproduction just like any other life process is energy-dependent, and reproduction especially oestrus and follicle development is a process with high energy requirements. For the period of re-oestrus after weaning, energetic processes must be set in a positive direction. This is all the easier, the better we can reduce the loss of body weight of the sow during lactation.

The amount and ratio of each nutrient in the feed is very important. If there is a deficiency of any important nutrient, it can be limiting in terms of the utilization of the others. However, the role of energy should be emphasized in this regard, because energy deficiency has an absolutely limiting effect even if all other nutrients are optimally provided.

During lactation, efforts should be made to ensure that sows can consume maximum feed and energy. In Hungarian practice, this maximum feed intake is 4.5–6 kg, which is very little. The twice-daily feeding in the farrowing pen, which is most commonly used in practice, tends to do this. It is not possible to feed a larger amount with twice-daily feeding. Not even if the sows were previously “stomach-fed” in the last stage of pregnancy, i.e. fed only once a day. In English literature, there is the so-called Stotfold method, according to which the sow is given 2.5 kg of feed on the day of farrowing, and then the ration is increased by 0.5 kg per day for 10 days. Thus, by the 11th day, 7.5 kg of feed intake per animal can be achieved. Then the sows are fed individually according to the number of piglets suckled, and in the case of a litter of 13, the daily feed consumption at the peak of lactation is 10.5 kg.

A domestic practice also can be mentioned. At one of the farms 1500 sows are fed four times a day in the farrowing pen at 6, 10, 14 and 18 hours and they can achieve a feed intake of 7.5–8 kg. The result is a balanced farrowing of 80% and an average of 10.7 live piglets born. The seasonal decrease in yield did not exceed 5% [20].

The feed for lactating sows must have the following main content values: energy DE 14.5 MJ, crude protein 17–18%, lysine 1.1%, Ca 1.1%, P 0.7–0.8%. The feed composition and feed intake are particularly important in the case of sows that have just given birth – gilts – as they are still in an intensive growth phase after the pregnancy, in addition to raising piglets, and may be more susceptible to energy deficit [19].

After weaning, sows are usually fasted for 24 hours to facilitate lactation and avoid mastitis. This is applicable, but not absolutely necessary, since lactation is not caused by a lack of feed, but by the negative pressure of unsucked milk. As a basic principle, we must accept that the best reproduction occurs in improving condition. We must change the catabolic state during lactation into an anabolic one. We must strive for maximum energy intake from weaning to oestrus, since, as already mentioned, reproduction is a high-energy-demanding process, and sows start their cyclical sexual function after weaning. The energy fed at this time is directly proportional to the ovulation rate, and thus the potential litter size, within certain limits. Therefore, during this period, normally 4–7 days, we should feed lactating sow feed, on the one hand, due to its higher energy and nutrient content, and on the other hand, to avoid feed changes. Pigs are enzymatically digesting animals, and any change in feed causes a decrease in digestibility for a few days [10].

The next critical phase is the week after insemination. Continuous high energy intake during this period increases the rate of early foetal death. Therefore, from the day of insemination, switch to pregnant sow feed and feed a maintenance amount of feed for one week – approx. 2 kg feed/day/animal. The most important content components of pregnant sow feed: energy DE 13.5 MJ, crude protein 12–13%, lysine 0.7, Ca 1.0%, P 0.7% [15]. The amount of protein must be significantly reduced, as high protein content causes reproductive biological disorders – e.g. cyst formation – and N excretion due to excessive

protein feeding results in significant energy consumption. During the first 80 days of pregnancy, foetuses and foetal appendages do not have any particular quantitative nutrient requirements, because at this time their development, not their growth, dominates [6].

For the 7th to 30th day after insemination, sows should be fed 10% above the maintenance level, and any condition problems can be corrected at this time. In general, the daily ration of sows is 2.6–3 kg of gestating feed. The energy intake slightly above the maintenance level is necessary because at this time the sow needs to be “made aware” that she does not have to worry about food shortages after farrowing.

Between the 30th and 80th day of pregnancy, the feeding is based on a maintenance level of pregnant sow feed. This means approx. 2 kg of feed per day - plus or minus 10% depending on the condition. Feeding larger feed rations should be avoided, as sows can become fat during this period. Fat sows, on the other hand, can cause many problems in terms of the weight of the piglets born, the balance of the litter, and milk production [13].

The intensive growth of the foetuses takes place in the last third of pregnancy (at this time they double their previous weight). Therefore, during the last month, the ration given to pregnant sows should be 1.5–2 times the amount of feed required for maintenance. It is advisable to feed the sow with lactating feed during this period. The sow should not be fattened at this time!

If possible, from the time of introduction to the farrowing pen until farrowing, it is advisable to feed the sows so-called farrowing feed in an amount of about 2.5 kg per day. The special feature of this feed is that it has high fibre content (8–10%) and contains an acidifier. The acidifier's role is to prevent urinary tract infections. The high fibre content causes more intense intestinal peristalsis. Thus, on the one hand, it prevents intestinal colic around farrowing, and on the other hand, it makes uterine contractions more intense during farrowing [7]. The uterus always functions with the same intensity as the intestine. Farrowing can be accelerated and MMA (Mastitis-Metritis-Agalactia) syndrome can be prevented [13].

### **Sensitivity and some stress reactions in pigs**

Pigs are psychologically sensitive animals, which mean they get scared easily, which triggers a stress reaction. Intensive pig breeds (e.g. pietrain) are characterized by a small heart mass and load capacity relative to their body weight, as well as a low thermoregulatory capacity. As a result, cardiovascular disorders are more common and they have difficulty coping with stress and other stresses associated with housing and transportation [11].

Temperature requirements of pigs. Each category has its own thermo neutral zone:

- Suckling piglets: 30-38°C;
- Selected piglets: 25-30°C;
- Fatteners: 16-18°C;
- Sows and boars: 16-18°C.

Temperatures below this can lead to hypothermia, and temperatures above this can lead to heat stroke. The farrowing shed is particularly challenging, where two different climates must be maintained: “cool the sow – warm the piglet” [8; 14].

Similar to other farm animals, pigs also experience a decrease in feed intake in extreme heat: according to some estimates, by 1.5% per degree above 20°C. In the case of lactating sows, the daily feed intake is 0.5 kg less above 25°C, which can lead to further problems [17].

The biggest problem is the decrease in body weight gain and the deteriorating reproductive biological condition of the animals, and in the case of lactating sows, the decreasing milk production, which in extreme cases can lead to a complete shutdown. During heat stress, it can generally be said that the health status of the herd deteriorates, and at the same time the risk of developing diseases increases [1].

The stress caused by high temperatures causes the body temperature of the animals to increase, which increases the metabolic intensity (it can be 20-30% in the case of a 1°C temperature increase), which in turn leads to an increased energy requirement. Together, these result in an increase in the respiratory rate. At 30°C it can reach 150/min (20-30/min is the average).

At high temperatures, pigs drink more water. Excessive water consumption leads to diarrhoea and increased urine output. This is a problem because the animal also loses electrolytes in larger quantities through urine.

Despite all efforts, animals are exposed to various stress factors due to the housing technology, which negatively affect their well-being. Such factors can include, among others, an environment lacking in stimuli, excessive stocking density, insufficient trough length, limited access to water, flooring quality, air quality, inadequate temperature and humidity, heat stress and drafts [22]. The direct negative effects of the listed factors are further enhanced by the fact that the increased stress level makes the herd more susceptible to various pathogens and diseases, and increased stress can also lead to the development of tail biting.

The aforementioned stress factors can be present in all age groups depending on the technology, but in the case of high-value breeding animals, we must pay particular attention to mitigating these factors. The rearing and feeding of breeding sows in order to ensure the renewal of the breeding stock therefore requires precise management [3]. The most important principle is to provide sufficient space [5]. The optimal placement for animals weighing between 50-100 kg is 1.0 m<sup>2</sup>/animal, while for animals weighing over 100 kg it is 1.5-2.0 m<sup>2</sup>/animal.

Continuous exchange of the air in the stable reduces the harmful effects of greenhouse gases on health. The irritation of the mucous membranes caused by ammonia-laden air is sufficient to disturb the animals' peace and rest even at lower concentrations. As little as 5-6 ppm NH<sub>3</sub> concentration results increased mucous membrane irritation. The discomfort that develops in polluted air throughout the day can lead to increased aggression and easily abnormal behavioural manifestations. In this regard, the ammonia load of livestock buildings has become a common practice and one of the conditions for assessing animal welfare subsidies [2; 16]. The fact that we can also expect deterioration in reproductive biological indicators in a polluted environment can also be mostly associated with the increased stress effect.

The adverse effect on the functioning of the respiratory organs initially only results in increased mucus production, but this already limits the intake of oxygen, which is essential for the intermediate processes that underpin intensive production. The deterioration of production indicators can be a source of significant losses even in the continuous presence of lower concentrations. At >10 ppm, daily body weight gain decreases and the amount of feed required to produce 1 kg of meat deteriorates. This in itself can be a source of significant losses.

The exceptional case when boars also receive more attention is the period of summer heat stress...at this time; sperm must usually be taken from more boars in order to fertilize the sow population, because both the quantity of ejaculates and their quality deteriorate [4]. The libido of sires also decreases, which further complicates the

organization of breeding work. Heat stress and the reduction in male fertility caused by it are biological facts – that is, their effects cannot be prevented, but their damage can be reduced with appropriate preparation.

***What happens in the body of a sire who has suffered heat stress?***

In general, we can say that the internal temperature of the body increases and the electrolyte balance is upset due to the excessively high temperature [18]. In pigs, this usually occurs when the room temperature reaches 27°C. In such cases, the reproductive performance of both sows and boars deteriorates. Most farms focus on “recovering” sows and do not take into account that boars are much more sensitive to heat stress damage, as high temperatures destroy mature sperm stored in the epididymis [12]. This explains why male fertility decline usually occurs 10-14 days after the onset of heat stress – and the biological processes of spermatogenesis explain why it takes up to 50-60 days for male fertility to “recover”, depending on the frequency of semen collection.

The first sign that a sire is experiencing heat stress is an increase in respiratory rate – the animal’s number of breaths per minute exceeds 50. Instead of the cumbersome respiratory rate check, we can also check the surface temperature of the testicles more simply – if we experience a temperature value higher than 33.5°C on the surface of the testicles of the male, measured with an infrared thermometer, we should expect deterioration in the quality of the semen to occur soon. The deterioration in quality can last for several weeks.

***What can we do to prevent heat stress?***

Do not overcrowd our animals; ensure adequate natural ventilation in the stables.

If natural ventilation is not possible or not enough, use artificial air conditioning equipment. We can also improve the comfort of our animals with cooling and humidifying equipment, and we can prevent the negative effects of heat stress caused by high temperatures with properly insulated stables.

## CONCLUSIONS

Precise composition of sow feed, depending on the condition of the sow, is important for the number and viability of piglets born.

However, a significant decrease in the condition of sows or excessive obesity can cause damage to the development of fetuses, and animal health problems may occur in sows during and after farrowing.

Lactating sows are particularly sensitive to energy and mineral deficiencies (Ca, P) during the period of intensive milk production.

The thermoneutral zone of pigs varies depending on their age, but in all cases, it is within relatively narrow limits. This is accompanied by a limited ability of their thermoregulation to adapt to the ambient temperature. In a warmer than optimal environment, they have difficulty getting rid of the heat that accumulates in their bodies, and in cold weather, they cannot always produce enough energy even by consuming extra feed.

In the summer heat, if there is no way to cool the building sufficiently, not only is the well-being of the boars at risk, but their fertility may also deteriorate significantly. Unfortunately, due to the length of spermatogenesis, the breeder will only notice these weeks after the heat.

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