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The use of oxytocin in liquid semen doses to reduce seasonal fluctuations in the reproductive performance of sows and improve litter parameters—a 2-year study

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ABSTRACT

The objective of the present research was to eliminate seasonal fluctuations in year-round reproductive performance of sows and to improve litter parameters by administration of oxytocin into liquid semen insemination doses. A 2-year experiment was performed on crossbreed sows, Polish Large White × Polish Landrace, which were partitioned into two groups: control, insemination without any modification with 100 mL semen doses and oxytocin, insemination with 100 mL semen doses to which 5 IU of oxytocin was added just before insemination. A total of 10,486 inseminations were made. The farrowing rate and obtained litter parameters, including the effect of season, were analyzed. For each litter, the following factors were defined: average litter size, percentage of fetal death and mummified piglets, average piglet birth weight, percentage of piglet mortality, fecundity index, average number of piglets weaned, weaned piglet weight, and daily gain. Sows presented a positive reaction to the experimental factor. A statistically higher farrowing rate for oxytocin group in summer and autumn seasons was confirmed ($P \leq 0.01$). Regardless of the season, a higher average litter size was observed in the oxytocin group with the most evident differences for winter, spring ($P \leq 0.01$), and summer ($P \leq 0.05$). The effect of oxytocin on the percentage of fetal death and mummified piglets born was not confirmed statistically except for winter. Analyzing the fecundity index, higher values were obtained for the oxytocin group in all seasons ($P \leq 0.01$), including the lowest difference between groups for winter (51.43) and the highest for summer (100.61). A higher average birth piglet weight and weaned piglet weight were recorded for the oxytocin group in all seasons. The highest differences in birth piglet weight between groups were noted for spring (0.22 kg; $P \leq 0.01$) and winter (0.17 kg; $P \leq 0.05$) and in weaned piglet weight for winter and spring (0.58 kg and 0.52 kg; for both, $P \leq 0.01$). The greatest daily gains were observed in the winter season ($P \leq 0.05$) in favor of oxytocin. On the basis of the presented results, it should be noted that the use of oxytocin into insemination doses improves the farrowing rate and other parameters of the reproductive performance of sows. In the absence of negative effects, year-round insemination with oxytocin addition into seminal doses is recommended, which effectively improves the production performance and reduces the problem of seasonality in reproduction.

1. Introduction

Porcine production still incurs huge losses because of seasonal variations in the reproductive performance of sows. The seasonality of pig reproduction is largely

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dependent on the photoperiod [1,2], temperature, humidity or temperature-humidity complex [3], and food availability, which is related to the physiology of the ancestor of modern breeds, the European wild boar [4]. Season remains one of the least controllable elements affecting production, because its relative importance and the strength of the determinants are elusive [5]. It is now recognized that the most important factor is the photoperiod and other environmental factors only exacerbate or alleviate the results in reproduction [6] because this problem concerns sows kept indoors (most studies) and outdoors [7].

One of the most commonly observed syndromes is summer infertility syndrome occurring during long days and high temperatures. Manifestation of summer infertility mainly relates to various parameters of reproductive performance: farrowing rate [4], length of the period from weaning to estrus [3], repeat of estrus [8], abortions [9], and litter sizes [10]. This phenomenon has become a major obstacle to maintain the continuity of production because it affects the most important reproductive indicators, and govern economic viability. The achievement of high results in modern pig farms is also supported by the use of artificial insemination.

It is estimated that over 50% of the world population of pigs is inseminated and this number is increasing, and in some European countries the figure is more than 80% [11]. Reduced number of sperm in insemination doses (compared with natural mating) may cause a reduced number of sperm in the oviductal reservoir at 24 hours before ovulation. It is partially associated with decreased activity of the uterine muscle, which is liable for sperm transport [12]. Loss of sperm in the reproductive tract of sows is mainly observed by semen backflow during insemination (30%–40%), trap and die in cervical folds (5%–10%), phagocytosis in the uterus (60%) [11]. Since the earlier diagnosis of the seasonality problem [13], many steps against it over the years until today have been taken.

Among a range of solutions, the application of proactive substances (progestagens, gonadotropins, prostaglandin, and its derivatives) directly into the organism of sows, or as a component of semen has also been used. One of such substances is oxytocin. Its administration into insemination doses was intended to improve reproductive performance also during periods of infertility [14–17]. Oxytocin is a peptide hormone, which was claimed to be liable to standing reflex, fertilization, and stimulation of myometrium [18], thanks to the contraction of the smooth muscle during copulation. Natural mating stimulates hypothalamus binding oxytocin receptors by movements of the penis in the vagina and cervix. Artificial insemination excludes proper stimulation of mechanoreceptors located in the vagina, which results in the release of oxytocin; thus, it is reasonable to administer this substance at the time of insemination. The genetic improvement of pigs, and modification of production systems and management conditions have progressed very fast over the years. Genetically new animals and other environmental conditions justify the need to verify the effectiveness of some methods developed much earlier, especially in temperate climates.

It should be noted that a temperate climate is characterized by high variability during the four main seasons. One reason is the high correlation between photoperiod and temperature in this climate [19]. Therefore, high correlation between photoperiod and temperature becomes an important aspect of pig reproduction physiology not only during infertility period (late summer to early autumn) but whole year. Unfortunately, there have been no long-term experiments with a large number of observations on contemporary pig material, which have focused on the elimination of seasonal problems in commercial systems, taking into account not only the late summer to early autumn season but also the whole year.

In the present study, oxytocin was administrated in insemination doses to eliminate seasonal fluctuations in the reproductive performance of sows throughout the year and to improve litter performance in terms of industrial pig production.

2. Materials and methods

2.1. Experiment location and design

The experiment was carried out at Ferma-Pol Zalesie, an industrial pig farm located in Poland in Opole province, and lasted for 2 years. The farm was located in a temperate climate zone, which is distinguished by the four seasons, easily recognizable and determined, for example, by temperature and sunshine hours (Fig. 1). Average temperatures and sunshine hours in each season around the farm originated from the database of the meteorological station (Institute of Meteorology and Water Management, National Research Institute) situated in the region near the farm. On this basis, the inseminated sows were divided into four experimental season subgroups: winter (January to March), spring (April to June), summer (July to September), and autumn (October to December).

2.2. Experimental animals and treatments

The experiment was conducted using Polish Large White × Polish Landrace (PLW × PL) crossbreed sows. The

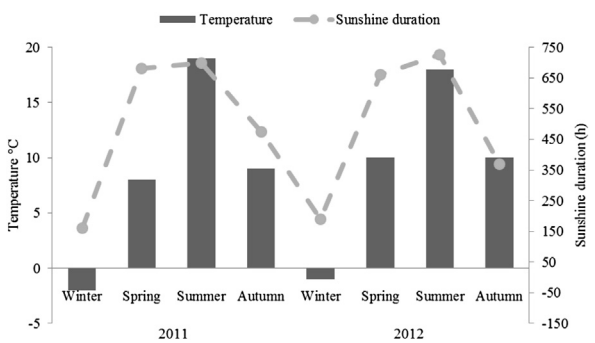

Fig. 1. Characteristics of external weather conditions in the area of the farm, detailing seasons during the experiment period (2011 and 2012).