IMPACTO CIENTÍFICO EDITORA

AGE AND WEIGHT AT FIRST SERVICE OF THE GILT TO IMPROVE HER LIFETIME PERFORMANCE

IDADE E PESO NO MOMENTO DA COBERTURA DA LEITOA PARA MELHORAR SEU DESEMPENHO AO LONGO DA VIDA

EDAD Y PESO AL SERVICIO DE LA CERDA PRIMERIZA PARA MEJORAR SU DESEMPEÑO DE POR VIDA

https://doi.org/10.56238/edimpacto2025.073-002

Laura Francisca Espinoza Aguirre[1], Juan Manuel Romo Valdez[2], Ulises López Arroyo[3], Ana Mireya Romo Valdez[4], Jesús José Portillo Loera[5], Javier Alonso Romo Rubio[6]

ABSTRACT

Swine farms show greater reproductive efficiency due to improvements in ovulation rate and litter size; however, they require a constant supply of replacement gilts because of the persistently high culling rates (40 to 50%) of sows in the breeding herd. It is recommended that gilts be selected from third-parity litters, with birth weights above 1.2 kg, achieving growth rates of 600 g/day at 140 days of age and 650 to 750 g/day at the time of first service. From 140 days of age onward, stimulation with a mature boar should begin for 15 to 20 minutes in the morning and afternoon to induce puberty between 150 and 180 days of age. Gilts should be first serviced when they reach a body weight of 135 to 150 kg, with at least 13 mm of backfat thickness (BFT), generally at the second or third estrus, around 210 to 240 days of age. Servicing gilts at a body weight between 135 and 150 kg allows them to reach approximately 180 kg at first farrowing and to have a short weaning-to-estrus interval (WEI) of 3 to 6 days, with sufficient body reserves (15–18 mm BFT) to achieve a high ovulation rate, sustain pregnancy, and produce a large litter at the second farrowing. Gilts that are too old (>250 days) and overweight at first service are at increased risk of premature culling. Premature culling is mainly due to reproductive failures and locomotor problems, although an increase in mortality rate has also been recently reported. Sows with extended reproductive longevity are often characterized by producing large litters in their first two parities. To determine the economically optimal parity at culling, the cumulative number of piglets born

[1] Doctoral student in Agricultural Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: lauraespinoza448@gmail.com Orcid: 0000-0002-7300-7364
[2] Dr. in Agricultural Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: romo_14@hotmail.com Orcid: 0000-0002-0520-9968
[3] Master's student in Agricultural Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: uliseslopezarroyo@gmail.com Orcid: 0009-0003-0459-0626
[4] Dr. in Agricultural Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: e.ana.romo@uas.edu.mx Orcid: 0000-0002-9424-3235
[5] Dr. in Livestock Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: portillo6422@uas.edu.mx Orcid: 0000-0002-5990-7841
[6] Dr. in Livestock Sciences. Universidad Autónoma de Sinaloa (FMVZ.UAS).
E-mail: romo60@uas.edu.mx Orcid: 0000-0002-2364-2554

and weaned during the sow's productive life in the breeding herd and the future productive potential of a replacement gilt should be considered. For a gilt to be economically profitable, she needs to achieve three to four parities, with at least 12 piglets weaned per litter.

Keywords: Body Weight. Age at Service. Gilt. Reproductive Performance.

RESUMO

As granjas suínas apresentam maior eficiência reprodutiva graças à melhoria na taxa de ovulação e no tamanho da leitegada, porém necessitam de um fornecimento constante de leitoas de reposição devido às taxas persistentemente elevadas de descarte (40 a 50%) das matrizes do plantel reprodutivo. Recomenda-se que as leitoas sejam selecionadas de leitegadas do terceiro parto, com peso ao nascimento superior a 1,2 kg, que alcancem taxas de crescimento de 600 g/dia aos 140 dias de idade e de 650 a 750 g/dia no momento do primeiro serviço. A partir dos 140 dias de idade, deve-se iniciar a estimulação com um reprodutor maduro, durante 15 a 20 minutos pela manhã e à tarde, para que atinjam a puberdade entre 150 e 180 dias de idade e sejam servidas pela primeira vez ao alcançar um peso corporal de 135 a 150 kg, com pelo menos 13 mm de espessura de gordura dorsal (EGD), geralmente no segundo ou terceiro cio, por volta dos 210 a 240 dias de idade. Servir as leitoas com peso entre 135 e 150 kg permite atingir um peso corporal ao primeiro parto em torno de 180 kg e possibilita que a matriz apresente um intervalo desmame-cio (IDC) curto (3 a 6 dias), com reservas corporais suficientes (15–18 mm de EGD) para obter uma elevada taxa ovulatória, sustentar a gestação e produzir uma leitegada numerosa no segundo parto. Leitoas que são muito velhas (>250 dias) e apresentam excesso de peso no momento do primeiro serviço correm maior risco de descarte precoce. O descarte prematuro ocorre principalmente devido a falhas reprodutivas e problemas locomotores, embora recentemente também tenha sido relatado aumento na taxa de mortalidade. Matrizes com maior longevidade reprodutiva geralmente se caracterizam por parir leitegadas numerosas nos dois primeiros partos. Para determinar o número de partos economicamente viável no momento do descarte, deve-se considerar o número acumulado de leitões nascidos e desmamados ao longo da vida produtiva no plantel reprodutivo e o potencial produtivo futuro de uma leitoa de reposição. Para que uma leitoa seja economicamente rentável, é necessário que alcance entre três e quatro partos, com pelo menos 12 leitões desmamados por parto.

Palavras-chave: Peso Corporal. Idade ao Serviço. Leitoa. Desempenho Reprodutivo.

RESUMEN

Las granjas porcinas presentan una mayor eficiencia reproductiva gracias a la mejora en la tasa de ovulación y el tamaño de la camada, pero requieren un suministro constante de primerizas de reemplazo debido a las tasas persistentemente altas de desecho (40 a 50%) de las cerdas del hato reproductor. Se recomienda que las cerdas primerizas sean seleccionadas de camadas de la tercera parición, con peso al nacimiento superior a 1.2 kg, que logren tasas de crecimiento de 600 g/d a los 140 d de edad, y de 650 a 750 g/d al momento del primer servicio. A partir de los 140 d de edad se debe iniciar la estimulación con un semental maduro, durante 15 a 20 minutos por la mañana y tarde, para que presenten la pubertad entre los 150 y 180 días de edad y se sirvan por primera vez al alcanzar un peso corporal de 135 a 150 kg, con al menos 13 mm de espesor de grasa dorsal (EGD), generalmente en su segundo o tercer celo, alrededor de los 210 a 240 días de edad. Servir a las cerdas primerizas con un peso entre 135 a 150 kg, permite lograr un peso corporal al primer parto alrededor de los 180 kg y que la cerda pueda tener un intervalo destete-celo (IDC) corto (3 a 6 d), con las suficientes reservas corporales (15-18 mm de EGD) para tener una tasa ovulatoria elevada, pueda sostener la gestación y logre una camada numerosa en su segundo parto. Las primerizas que son demasiado mayores (>250 d) y presentan

sobrepeso al momento del primer servicio corren el riesgo de ser desechadas prematuramente. El desecho prematuro se debe principalmente a fallas reproductivas y problemas locomotores, aunque recientemente también se ha reportado aumento en la tasa de mortalidad. Las cerdas con una longevidad reproductiva prolongada a menudo se caracterizan por parir camadas numerosas en sus dos primeros partos. Para determinar el número de partos rentable al momento del desecho, se debe considerar el número acumulado de lechones nacidos y destetados durante su vida productiva en el hato reproductor y la productividad futura potencial de una primeriza de reemplazo. Para que una hembra primeriza sea rentable necesita lograr entre tres a cuatro partos, con al menos 12 lechones destetados por parto.

Palabras clave: Peso Corporal. Edad al Servicio. Cerda Primeriza. Desempeño Reproductivo.

1 INTRODUCTION

Improving the performance and longevity of breeding herd sows maximizes the productivity and profitability of commercial swine production units. In recent decades, improvements in sow productivity have led to increased replacement rates on pig farms. The chosen replacement rate significantly affects the structure of the breeding herd, which, in turn, influences production indicators. Typically, lower replacement rates increase the maximum herd parity, while higher rates raise the number of gilts. Currently, approximately 50% of sows in breeding herds are replaced before reaching the target number of farrowings to be profitable. Consequently, the number of gilts required increases, which is associated with lower productivity and a greater likelihood of affecting herd health. In addition, about 20% of the premature discarding of females from the breeding herd occurs at parity 0, and 65% of these discards are attributed to reproductive disorders or failures. Gilts represent the most numerous category (18-20%) of females in a breeding herd. The development of management practices that produce gilts with the highest yield potential over their lifetime is crucial for the productivity of conventional production systems. There are several factors that affect the productivity of the sow throughout its life, such as genetics, selection criteria, management of gilt development and its health, among others. However, one of the main factors influencing the productivity of the sow throughout her life is when or at what age the gilt enters the breeding herd and begins her productive life. The optimal age for gilt sows' first service depends on factors such as age at puberty, number of estrus presented and their regularity, growth rate (PRI), and body weight. However, it is difficult to find this optimal time, as these variables are associated with each other, constantly changing, and in most cases, reached at different times. Under field conditions, the CT amplitude and age at first mating of gilts are significantly higher than the recommendations of genetic companies; Therefore, recording the age and body weight of gilts at the first service is an important practice, and easy to implement, which will give information on productive performance and retention rate until the third farrowing.

The fact that gilts entering the breeding herd do not produce at least three or even five litters represents a financial loss for the producer. It has been reported that between 38.5 and 51.1% of gilts are eliminated from the breeding herd, with a high incidence of sows that only produce one litter. In addition, a significant proportion (10 to 30%) of gilts entering the breeding herd never give birth to a litter. In practice, 40 to 50% of the sows in the breeding herd are slaughtered annually and replaced by gilts; therefore, the reproductive performance of gilts greatly influences the performance of the breeding herd. The management and proper selection of gilts to reduce the number of gilts, which never give birth to a litter, and are

completely unproductive, is essential to retain at least 75% of gilts until the third farrowing; a key aspect in the productivity of the pig production unit. Therefore, the ability to identify gilts with the highest potential for lifetime performance is crucial to the productivity of conventional production systems, and the boar stimulation response effectively identifies the most productive gilts. It has been observed that there is a positive relationship between CT, body weight and age at first service of gilts and their subsequent reproductive performance.

2 REPRODUCTIVE DEVELOPMENT OF THE GILT

From before birth, piglets already have enough oocytes, in the primordial follicles of their ovaries, to sustain all subsequent reproductive cycles that may occur throughout their lives. The primordial follicles predominate in the ovaries until almost 90 days after birth; However, although most primordial follicles remain dormant, some become active around 70 d before birth and differentiate into primary follicles; These will progress to secondary (preantral) follicles or suffer from atresia. As birth approaches, secondary follicles can be seen on the ovarian surface. Also, during the prenatal period, the number of hypothalamic neurons capable of secreting gonadotropin-releasing hormone (GnRH) is already established, but their functionality is not yet fully developed due to their high sensitivity to the estrogen-mediated negative feedback mechanism. In prepubertal sows that are between 60 and 90 d old, their ovaries begin to respond to gonadotropins and tertiary antral follicles are formed. However, before puberty, antral follicles are limited, do not progress to the ovulatory stage, and suffer from atresia. This is due to an unfavorable endocrine environment, as neurons in the tonic center of the hypothalamus show limited ability to respond to stimuli through connections with presynaptic neurons, while GnRH neurons in the spawning center of the hypothalamus remain inactive. Since the release of GnRH occurs in low-frequency, high-amplitude pulses during the prepubertal period, its circulating concentration is not high enough to stimulate the release of gonadotropins.

Puberty approaches as the sensitivity of hypothalamic neurons to estradiol-mediated negative feedback gradually decreases. Consequently, stimuli from environmental signals and metabolic signallers (such as leptin), with increasing circulating concentrations, are processed more efficiently through interactions between GnRH-secreting neurons and presynaptic neurons. As the responsiveness of hypothalamic neurons increases, GnRH pulses become more frequent and of lower amplitude, resulting in increased release of LH from the pituitary gland, which stimulates the secretion of estradiol by the ovarian follicles. The higher circulating concentration of estradiol (along with the metabolic signal of leptin) stimulates the hypothalamic neurons of kisspeptin; This hormone stimulates the GnRH

neurons of the wave center, which previously did not respond during the prepubertal period, which promotes an increase in the release of GnRH, which, in turn, amplifies the release of gonadotropins by the pituitary gland and estradiol by the ovaries, implying a positive feedback mechanism.

3 INFLUENCE OF BIRTH WEIGHT ON GILT PERFORMANCE

The selection of sows for a higher ovulation rate is associated with the delivery of large and heterogeneous litters. The latter, as a result of the restriction of intrauterine growth of piglets and its effect on low birth weight; which occurs more frequently in litters of primiparous sows, and can be repeated in different farrowings. Therefore, gilts born to primiparous mothers may be lighter and have a lower TC compared to those born to multiparous mothers; In addition, they may be high in backfat at the time of selection as a replacement sow (at almost 24 weeks of age), indicating less muscle mass deposition compared to fat deposition. Low birth and puberty weight and high backfat content at puberty are undesirable, as they carry an increased risk of reproductive failure and premature shedding, as well as reduced litter size in later gestations. Studies on the influence of birth weight on age at puberty are controversial; however, gilts with low birth weight may have poor ovarian follicular development. These findings suggest that gilts from litters farrowed by primiparous mothers may not be the optimal choice for selecting breeding herd replacement sows compared to gilts born to multiparous sows.

In the case of the need to select sows for replacement of primiparous mothers, CT before weaning, rather than birth weight, may be a more accurate predictor of age at puberty, which may have a positive effect on gilt sow retention rates; since, lactating piglets with an inadequate intake of colostrum (<250 g) would not be the best option for future replacement, since they would present a reduced subsequent performance. Low birth weight and pre-weaning growth may occur in progeny of primiparous mothers, because gilts selected by their CT and early puberty only complete maturation between the first and second parturition. Therefore, if replacement sows are selected from gilts, it would be more appropriate to do so from the litters of the second and third farrowing.

Some physical traits of gilts' reproductive organs are potentially associated with their future reproductive performance. It has been observed that vaginal length is greater in gilts with higher birth and first service weight than in lighter gilts; although, no associations have been observed with the development of the entire genital tract. A vulvar width score, measured around 15 weeks of age, identified morphometric variations between proestrus and estrus, especially 24 hours before the onset of estrus. In addition, high vulvar scores may

be associated with early estrus expression and total litter size. However, since these associations are marginal, vulvar score is not considered a reliable predictor of reproductive performance, especially since there is currently no information on its possible heritability. However, gilts may respond positively to selection for reproductive tract development. Young sows selected for their uterine capacity over several generations show an improvement in live litter size and piglet prenatal survival, despite a slight reduction in ovulation rate. Therefore, gilts selected for their uterine capacity would likely give birth and wean large litters over their lifetime.

4 INFLUENCE OF GILT SOW AGE AT PUBERTY ON NON-PRODUCTIVE DAYS OF THE BREEDING HERD

The age of the gilt's first estrus, or onset of puberty, has a positive predictive value for future reproductive performance within the breeding herd. Therefore, this phenotype may be associated with the sow's lifetime productivity, or the number of quality pigs a sow produces from the time it enters the breeding herd to the time it is discarded.

The gilt sow entry interval is an important factor contributing to the total non-productive days (NPD) in the breeding herd. The reduction of DNPs and, consequently, the reduction of production costs can be obtained by achieving gilts with an earlier age at puberty. However, gilt sows' body reserves at first mating can affect gilt sows' timing and discard pattern. Therefore, the efficiency of the breeding herd can be improved if gilts are introduced with a minimum total DNP, provided that a minimum weight and body condition (135 kg and 13 mm EGD) are guaranteed in the first service, to maintain performance and longevity. It has been observed that gilts that exhibit their first behavioral heat at an early age (<153 d) compared to older ages (154 to 180 d) have less DNP in the breeding herd; In addition, gilts that exhibit estrus after 180 D of age have a lower service rate than gilts whose first estrus is detected before 180 D of age. This observation has also been corroborated, in the sense that gilts that reach their first heat at a younger age have a higher probability of producing a third farrowing.

5 AGE TO START PUBERTY STIMULATION WITH THE PRESENCE OF THE BOAR

Contact with the boar at an appropriate age exerts a great influence and plays a critical role in inducing puberty heat. The exposure of the gilt to the boar at an earlier age corresponds to an age younger than puberty, but requires more days of stimulation; In contrast, gilts older at the start of boar exposure are usually older at puberty, but require fewer days of stimulation. The timing and timing of puberty seem to have better responses if gilts are over 180 d old. However, it has been observed that more than 75% of gilts go into heat

up to 40 days after stimulation, if exposure to the boar begins around 140 days of age, which makes it possible to have gilts with early puberty presentation. If heat stimulation is initiated at this age, gilts to be selected will be those with puberty no later than 180 d of age. Gilts can be classified into three categories, based on the age at which they present the first heat: 1) Early puberty (<153 d), 2) Intermediate puberty (154-167 d), and, 3) Late puberty (168 to <180 d). In addition, it is necessary to ensure a CT between 600 and 750 g/d at the first service with ages between 210 and 240 d. Sows that do not show their first heat before 180 d of age should be considered non-selectable.

First-time sows with faster growth rates at the time of boar exposure have been shown to reach puberty earlier than slower-growing counterparts; which suggests that rapid growth allows the goal body weight to be achieved at an early age. In fact, if mating takes place between 185 and 209 d of age, with a minimum weight of 135 kg body weight, rather than after 210 d, the farrowing rate, the mowing rate and the total number of piglets born, produced in three farrowings, are not negatively affected in gilts with a CT of more than 700 g/d. Therefore, low CT and unnecessary delays in pubertal heat stimulation are important factors contributing to reproductive herd DNPs.

6 AGE AND BODY WEIGHT FOR GILT SOW MATING

Many factors, such as breed, body condition, parity, semen quality, nutritional management, and environment, can influence reproductive success. In particular, the age and body condition of the gilt sow (body weight, backfat thickness and back muscle depth) are critical to optimize the number of piglets born alive, subsequent reproductive success and consequently to reduce early culling rates of hyperprolific sows. However, under field conditions, the age and body weight range of gilts at first service may be too wide.

7 AGE AT FIRST SERVICE

Age at first service is a management decision and can therefore be improved, to some extent, by an appropriate feeding regimen during the gilt's developmental period and a puberty stimulation program; for example, a CT scan at 160 days of age of at least 600 g/day (but less than 790 g/d) is crucial to reach an optimal age at first heat (150 at 180 d) and at the first service (210 to 250 d), while an average daily gain below this threshold would be considered limiting for future reproductive performance.

A minimum age at first service between 210 and 250 d of age is generally recommended; however, the optimal economic age is between 200 and 220 days. This age is recommended to allow gilts to reach the maturity of their reproductive organs, a target body

weight (135 to 150 kg) and accumulate the necessary body fat (18 to 22 mm) at the end of gestation, in order to maximize the number of piglets born alive throughout their lives. An earlier age at first service is associated with higher expected longevity, as sows have a higher chance of reaching fourth parity. Serving for the first time the gilt with an age of around 220 d and a body weight between 135 and 150 kg guarantees a body mass greater than 180 kg after the first farrowing, which protects her against the detrimental effects of fat and lean tissue loss during the first lactation on subsequent reproductive performance, if you have a weight gain of 35 to 40 kg during pregnancy.

A late age at first service has been associated with a higher rate of return to estrus, likely due to decreased functions of the ovaries and corpus luteums, as well as lower progesterone concentrations, which increases the risk of shedding from reproductive failure. First-time sows that receive the first service at an early age have higher conception and farrowing rates; fewer unproductive days, produce more litters and more piglets born alive throughout their lives and, consequently, lower initial costs. Conversely, although gilts with a first-serve age greater than 260 d have a higher number of piglets born alive in their first litter, a late first-serve age is not recommended, as these gilts have lower fertility, a longer wean-first service interval, fewer piglets born alive throughout their lives, and, consequently, lower reproductive efficiency, which increases their risk of disposal. In addition, lower reproductive performance in gilts late at first service is related to the risk of overweight at the time of breeding.

It has been observed that gilts that receive the first service between 233 and 253 days of age are more productive, either in the total number of piglets born throughout their lives or with a lower risk of being discarded due to reproductive failure, compared to those less than 233 d of age; In other studies, gilts mated after 260 D of age have been reported to have poor subsequent reproductive performance and reduced longevity. Thus, gilts mated at an older age have a shorter reproductive life and a higher risk of being culled due to infertility problems. In addition, gilts exhibiting the first permanent estrus between 180 and 200 d of age have a larger litter size in the first three parturitions than those that expressed the first estrus between 201 and 220 d of age. These findings indicate the importance of gilt sow management, as well as the first mating decision for their subsequent reproductive performance. Also, sows mating for the first time at 278 d of age have fewer piglets born alive than those mating at a younger age (229 d). The variation in the results observed in the different studies may be due to the genetic line studied and the environmental conditions in which they were raised, among other factors, mentioned above. However, it is clear that age at first service in gilts influences their subsequent reproductive performance and longevity; in

addition, unnecessary delay in age to first mating increases DNPs from entry to conception and influences their subsequent reproductive performance.

8 BODY WEIGHT AT FIRST SERVE

It has been observed that sows with a higher TC from birth to first service (771 to 870 g/d), with an average body weight of 173 kg and an EGD greater than 17 mm, have a higher percentage of stillborn piglets and more piglets with a birth weight of less than 1.0 kg, as well as a higher coefficient of variation in birth weight than in gilts with a TC of less than 701 g/d. Also, relatively light gilts at first service (124 ±0.5 kg body weight and 230 ±0.6 d in age) have a lower reproductive performance at their second farrowing (lower gestation rate and litter size). In addition, it has been reported that gilts served weighing less than 135 kg have fewer piglets born in three farrowings than gilts served weighing more than 135 kg.

Other studies indicate that gilts with a TC ≥700 g/d at the time of the first service have a higher number of total piglets born at the first farrowing, but the cumulative piglet production over three cycles is not affected in sows with a TC less than 700 and greater than 700 g/d at the first service. It has also been reported that gilts that achieve a CT >770 g/day at the first service have a larger litter size at first farrowing, but with a higher percentage of stillborn piglets, compared to gilts with a lower CT, which shows the risk of a higher rate of stillbirth in overweight females. It has already been indicated that sows between 210 and 250 d, which have already presented heat and have reached 135 kg are eligible to be inseminated without affecting the total number of piglets born until the third farrowing.

The effect of CT on farrowing rate is less consistent than its effect on litter size at first farrowing. Even with a large variation in CT (397 to 883 g/d) from birth to first service, the rate of deliveries to the third calving was not affected.

Age should not be used as the only criterion to determine the time of first mating, it could be risky, especially if gilts do not reach a minimum weight of 135 kg. One of the risks is that gilts tend to consume less feed during the lactation phase, which leads to greater weight loss afterwards. A logical consequence of this physiological condition is an inadequate development and maturation of the oocytes, which directly affects the size of the litter in subsequent births and increases the probability of reproductive failure in the following cycle. In this regard, it has been reported that CT from first service to farrowing, the number of piglets born at first farrowing, and weight at first weaning, affected the rate of discarding, more than age or weight at first mating. Also, the lack of energy reserves and an inadequate body weight in sows with feed restriction cause gilts to be more sensitive to the detrimental effects of a negative energy balance on reproduction, which affects the development of oocytes, as

previously indicated. The reproductive performance of the sow decreases if the losses, during lactation, exceed 10 to 12% of the initial body weight, which is more evident in primiparous sows, as they are still growing. Ensuring good body condition in gilts could optimise production at second farrowing and beyond.

First-time sows with a higher weight (150 to 170 kg) at the first service have a lower farrowing rate at the second farrowing and a higher risk of discarding and locomotion problems at three farrowings. The available information indicates that gilts should be served at an age between 210 and 250 d with a body weight between 135 and 150 kg, with a minimum backfat thickness of 13 mm.

During the final selection of the gilt, in addition to taking into account age, body weight, EGD and the number of regular estrous cycles, it is necessary to consider the number of teats. Current (hyperprolific) replacement sows should have at least eight pairs of teats.

9 AGE AND WEIGHT IN THE REPRODUCTIVE PERFORMANCE OF THE PRIMIPAROUS SOW

First-time sows that reach puberty at an early age will also become mothers at young ages. The achievement of puberty requires multifactorial stimuli until a physiological balance is reached between physical and reproductive development. During the prepubertal period, metabolic intake prioritizes physical development. Subsequently, basal metabolic demand is oriented towards maintaining physical fitness, while a surplus of energy is stored in the form of adipose tissue, which can serve as a source of various metabolites and hormones, such as fatty acids, glucose, and leptin. In gilts with adequate fat deposition, this is transmitted to presynaptic hypothalamic neurons by increased leptin secretion by adipose tissue, which drives GnRH synthesis and release. In this regard, in cyclic females, a greater presence of leptin and its receptor has been detected in the growing follicles and newly formed corpus luteums. However, consumer demand for low-fat animal protein has oriented modern swine genetics selection programs toward lower voluntary feed intake and better feed conversion, resulting in animals with a higher lean tissue mass and lower fat deposition. Therefore, fast-growing gilts that reach puberty at very young ages may have a reduced adipose tissue reserve; Therefore, today's primiparous sows may have a reduced ability to raise their first litter and overcome the metabolic challenge of the first lactation, as they maintain their growth to maturity. The impact of second litter syndrome can be mitigated by optimising sow weight gain from first mating to weaning and by avoiding strong selection pressure on first farrowing litter size.

Primiparous females that give birth to a large first litter and do not perform poorly at second parturition will generally have larger-than-average litters at their subsequent parturitions. Therefore, the litter size of the offspring born alive in the first two births could be an indicator of subsequent reproductive performance due to its relatively high heritability and its positive association with retention rates and productivity throughout life.

Reproductive failures are the main cause of debris in breeding herd sows, and are especially relevant among gilts and primiparous sows. This has not changed over the years, despite improvements in ovulation rate, litter size, and heat rate. Among the risk factors that contribute to the discarding due to reproductive failure, late age at first service is considered the most relevant. First-time sows that receive the first service at a late age usually return to estrus after long or irregular intervals; Even with successful reproduction and full-term gestation, gilts mated at an older age may have a prolonged weaning-estrus interval. Therefore, gilts with a late first mating are more likely to be discarded early.

Common health conditions, such as limb and hoof injuries, can lead to severe locomotor problems and lameness, significantly affecting the well-being of females. Locomotion problems and lameness are the most frequent reasons for the displacement of high-parity sows, often exacerbated by their high body weight. However, these culling reasons are also prevalent in gilts and primiparous sows on commercial farms. Lame females tend to have a low litter size at weaning and a long weaning-estrus interval, which further increases the risk of later shedding. Since gilts with delayed puberty are older at the time of first mating, they are also prone to overweight and may continue to be overweight later, which can lead to lameness problems and their rapid discarding of the breeding herd.

Recent observational data have reported an increase in female mortality rates, which impacts reproductive longevity. Although the risk of mortality increases with parity, it can be high in gilts and primiparous sows. Sudden deaths constitute almost one-third of all female deaths in large production systems, often attributed to acute health conditions that can occur at all parities. However, the risk of sudden death from heart failure is increased in sows with a body condition greater than 3.5 (obese), which may be common in overweight gilts.

10 INFLUENCE OF PHYSIOLOGICAL AGE AND BODY WEIGHT OF GILT GILTS ON PRODUCTIVITY THROUGHOUT LIFE

More important than chronological age at the time of mating is physiological age (number of estrous cycles). Early stimulation of gilts allows producers to take advantage of the increased productivity of gilts inseminated in the second or third estrus. Generally, delaying mating from the first to the second estrus results in an increase of 0.7 piglets in the

size of the first litter. Conversely, delaying mating from the second to third estrus only increases litter size by 0.2 piglets for the same additional cost. Therefore, mating should only be delayed until the third estrus to achieve acceptable reproductive weights. Also, the body condition of gilts at first mating has a significant effect on their lifetime performance. Gilts that do not have an adequate body condition when selected and introduced to the breeding herd generally do not achieve a reasonable number of farrowings (≥ 3). Experimental data and cost-benefit analysis clearly indicate that weight-based parenting and recording of first heat is the most cost-effective strategy. Thus, sows that do not have puberty before 180 days of age and do not achieve a minimum of 135 kg of body weight between 210 and 240 days of age, must be sold for slaughter.

The reproductive performance of sows throughout their lives is a key component for the productive efficiency and profitability of the farm. Sows that stay longer in the breeding herd produce more litters and piglets born alive, helping to recover the initial costs of replacement sows and improve the overall financial performance of the farm. There are several indicators to evaluate the performance of sows throughout their lives; Among these are the productive life (number of days from the first calving to the date of disposal), parity at the time of withdrawal, the number of piglets born alive and the number of pigs produced. Factors associated with sow productivity throughout her life include: age at puberty and first farrowing, body composition, weight at puberty and first service, number of piglets born alive in the first three farrowings, number of services within a given farrowing, and weaning-service interval at first farrowing.

However, annual reproductive efficiency, expressed by the number of piglets weaned/sow/year, is determined by the fertility, prolificacy and longevity of the sow in the breeding herd. Therefore, sows must be kept productive for longer in the breeding herd to optimize their productivity throughout life. One of the most critical factors driving sow longevity and herd reproductive performance is gilt development and management. Successful introduction of selected gilts is usually associated with better retention of high-value replacement sows in the breeding herd.

Longevity is also maximized in females who receive the first service at a younger age. Gilts that are first served at late ages are less efficient, produce fewer piglets born alive throughout their lives, are slaughtered prematurely and show negative economic profitability throughout their lives. In general, most sow removals occur at the lowest parities (between 3.1 and 4.6), are unplanned and are mainly due to reproductive failures and secondly to lameness or locomotor problems.

It has been observed that reproductive problems contribute to 47% of the reasons why gilts are removed from the breeding herd; Common reproductive problems include anestrus, repeated insemination, failure to become pregnant, abnormal vaginal discharge, miscarriage, and childbirth problems. In addition, high replacement rates of one- and two-flock sows have skewed the distribution of parities in most North American breeding farms towards gilts; This has caused the overall productivity of the breeding herd to be limited due to sows being slaughtered before they reach their peak reproductive performance periods. Minimizing the gilt detriment rate due to reproductive failure is critical to optimizing reproductive efficiency throughout life.

Stable herds outperform those with high fluctuations in the parity structure. In these, there are more pigs weaned per year, fewer DPNs, higher farrowing rates, fewer gilts in inventory, lower replacement rates and greater parity at the time of disposal.

Improving sow longevity, herd stability and maximising sow performance over the life of the breeding herd is a major challenge that is best addressed by having a well-managed gilt development unit to maintain a constant supply of high-quality gilts to the breeding herd. Achieving and maintaining reproductive objectives is the main objective of the gilt development unit. However, there are two key risk factors that, if not addressed through proper management, will negatively affect lifetime productivity and overall profitability: 1) Selection of gilts with the highest reproductive potential, and 2) Inadequate management to achieve body condition at sexual maturity.

The objectives of the gilt development unit include that 86% of the selected gilts reach the first farrowing and no more than 10% of these die in each subsequent farrowing; thus, reproductive management practices should be aimed at reducing the accumulation of DNPs in the first reproductive cycles, which could be achieved through the implementation of better management practices in the gilt development unit.

Clearly, a key area for improving breeding herd performance is from gilt entry to third litter delivery, with special attention to gilts that never give birth to a litter and are 100% unproductive throughout their lives.

Additional benefits of increased sow retention in the breeding herd would be a greater opportunity to recover the initial costs of developing replacement sows, increased acquired immunity to disease, increased salvage value of removed sows, and lower replacement costs.

11 CONCLUSIONS

The gilt is the basis of the breeding of the pig production units. Their proper selection and management during the developmental stage can contribute to increasing retention rate, longevity and lifetime performance. Reducing the rate of discarding, and consequently of replacement sows, allows stabilizing the distribution of parities in the breeding herd and immunity in the population of the production unit; it decreases production costs and increases the profitability of the company, as a result of lower expenditure in the production of replacement sows, reduction of non-productive days and increase in the reproductive performance of the herd. This implies that gilts are selected from third farrowing litters, with birth weight greater than 1.2 kg, which achieve growth rates of 600 g/d at 140 d of age, and 650 to 750 g/d at the time of the first service. From 140 days of age they are stimulated with a mature stallion, so that they present puberty between 150 and 180 days of age and are served for the first time if they reach a target body weight of 135 to 150 kg, with at least 13 mm of EGD, in their second or third heat, around 210 to 240 days of age.

REFERENCES

Almeida, F. R. C. L., Alvarenga Dias, A. L. N., Moreira, L. P., Fiúza, A. T. L., Chiarini-Garcia, H. (2017). Ovarian follicle development and genital tract characteristics in different birthweight gilts at 150 days of age. Reproduction in Domestics Animals, 52(5), 756-762. http://doi.org/10.1111/rda.12976

Alvarenga, A. L. N., Chiarini-Garcia, H., Cardeal, P. C., Moreira, L. P., Foxcroft, G. R., Fontes, D. O., Almeida, F. R. C. L. (2013). Intra uterine growth retardation affects birth weight and postnatal development in pigs, impairing muscle accretion, duodenal mucosa morphology and carcass traits. Reproduction, Fertility and Development, 25(2), 387-395. http://doi.org/10.1071/RD12021

Carrión-López, M. J., Orengo, J., Madrid, J., Vargas, A., Martínez-Miró, S. (2022). Effect of Sow Body Weight at First Service on Body Status and Performance during First Parity and Lifetime. Animals,12, 3399. https://doi.org/10.3390/ani12233399

Craig, J. R., Collins, C. L., Bunter, K. L., Cottrell, J. J., Dunshea, F. R., Pluske, J. R. (2017). Poorer lifetime growth performance of gilt progeny compared with sow progeny is largely due to weight differences at birth and reduced growth in the preweaning period and is not improved by progeny segregation after weaning. Journal of Animal Science, 95(11), 4904-4916. http://doi.org/10.2527/jas2017.1868

de la Cruz-Vigo, P., Rodriguez-Boñal, A., Rodriguez-Bonilla, A., Córdova-Izquierdo, A., Pérez Garnelo, S. S., Gómez-Fidalgo, E., Martín-Lluch. M., Sánchez-Sánchez, R. (2022). Morphometric changes on the vulva from proestrus to oestrus of nulliparous and multiparous hyperprolific sows. Reproduction in Domestics Animals, 57(Suppl 5, Suppl 5), 94-97. http://doi.org/10.1111/rda.14178

Declerck, I., Dewulf, J., Sarrazin, S., Maes, D. (2016). Long-term effects of colostrum intake in piglet mortality and performance. Journal of Animal Science, 94(4),1633-1643. http://doi.org/10.2527/jas.2015-9564

Faccin, J. E. G., Laskoski, F., Lesskiu, P. E., Lopes P. A. F., André Luis Mallmann A. L., Bernardi M. L., Gonçalves M. A. P., Ivo Wentz I., Bortolozzo F. P.1. (2017). Reproductive Performance, Retention Rate, and Age at the Third Parity According to Growth Rate and Age at First Mating. Acta Scientiae Veterinariae, 45, 1452. https://doi.org/10.22456/1679-9216.80034

Freyer, G. (2018). Maximum number of total born piglets in a parity and individual ranges in litter size expressed as specific characteristics of sows. Journal of Animal Science and Technology. 60(1),13. http://doi.org/10.1186/s40781-018-0172-x

Graves, K. L., Mordhorst, B. M., Wright, E. C., Hale, B. J., Stalder, K. J., Keating, A. F., Ross, J. W. (2019). Identification of measures predictive of age of puberty onset in gilts. Translational Animal Science, 4(1), 285-92. http://doi.org/10.1093/tas/txz173

Gruhot, T. R., Calderón Díaz, J. A, Baas T. J., Stalder, K. J. (2017). Using first and second parity number born alive information to estimate later reproductive performance in sows. Livestock Science, 196, 22-27. http://doi.org/10.1016/j.livsci.2016.12.009

Iida, R., Koketsu, Y. (2015). Number of pigs born alive in parity 1 sows associated with lifetime performance and removal hazard in high- or low-performing herds in Japan. Preventive Veterinary Medicine, 121(1-2), 108-114. http://doi.org/10.1016/j.prevetmed.2015.06.012

Koketsu Y., Iida, R. (2020). Farm data analysis for lifetime performance components of sows and their predictors in breeding herds. Porcine Health Management, 6 (24), 1-12. https://doi.org/10.1186/s40813-020-00163-1

Lents, C. A., Lindo, N. A., Hileman, S. M., Nonneman, D. J. (2020). Physiological and genomic insight into neuroendocrine regulation of puberty in gilts. Domestic Animal Endocrinology, 73, 106446. http://doi.org/10.1016/j.domaniend.2020.106446

Magnabosco, D., Bernardi, M. L., Wentz, I., Cunha, E. C. P., Bortolozzo, F. P. (2016). Low birth weight affects lifetime productive performance and longevity of female swine. Livestock Science, 184, 119-25. http://doi.org/10.1016/j.livsci.2015.12.008

Mills, K. M., Schinckel, A. P., Stevens, J. G., Casey, T. M., Stewart, K. R. (2020). Evaluation of on-farm indicators of gilt reproductive performance potential at 21 days of age. Translational Animal Science, 4(4),1-8. http://doi.org/10.1093/tas/txaa210

Monteiro, M. S., Matias, D. N., Poor, A. P., Dutra, M. C., Moreno, L. Z., Parra, B. M., Silva, A. P. S. P., Matajira, C. E. C., Gomes, V. T. M., Barbosa, M. R. F., Sato, M. I. Z., Moreno, A. M. (2022). Causes of sow mortality and risks to post-mortem findings in a Brazilian intensive swine production system. Animals. 12(14), 1804. http://doi.org/10.3390/ani12141804

Ocepek, M., Andersen-Ranberg, I., Edwards, S. A., Fredriksen, B., Framstad, T., Andersen, I. L. (2016). Can a super sow be a robust sow? Consequences of litter investment in purebred and crossbred sows of different parities. Journal of Animal Science. 94(8), 3550-3560. http://doi.org/10.2527/jas.2016-0386

Paiva, R. C., Moura, C. A., Thomas, P., Haberl, B., Greiner, L., Rademacher, C. J., Silva, A. P. S.P., Trevisan, G., Linhares, D. C. L., Silva, G. S. (2023). Risk factors associated with sow mortality in breeding herds under one production system in the Midwestern United States. Preventive Veterinary Medicine, 213, 105883. http://doi.org/10.1016/j.prevetmed.2023.105883

Patterson, J. L., Bernardi, M. L., Allerson, M., Hanson, A., Holden, N., Bruner, L., Pinilla, J. C., Foxcroft, G. (2020). Associations among individual gilt birth weight, litter birth weight

phenotype, and the efficiency of replacement gilt production. Journal of Animal Science, 98(11), 1-13. http://doi.org/10.1093/jas/skaa331

Romoser, M. R., Hale, B. J., Seibert, J. T., Gall, T., Rademacher, C. J., Stalder, K. J., Baumgard, L. H., Keating, A. F., Ross, J. W. (2019). Methods for reproductive tract scoring as a tool for improving sow productivity. Translational Animal Science, 4(1), 275-284. http://doi.org/10.1093/tas/txz160

Segura-Correa, J. C., Ek-Mex, J. E., Muñoz-Osorio, G., Santos-Ricalde R., Sarmiento-Franco, L., Calderón-Diaz, J. A. (2023). Associations between first parity wean-to-service Interval and sow lifetime productivity traits. Agroecosistemas tropicales y subtropicales, 26, 1-8. http://dx.doi.org/10.56369/tsaes.4678

Wijesiriwardana, U. A., Craig, J. R., Cottrell, J. J., Dunshea, F. R., Pluske, J. R. (2022). Factors affecting the early growth and development of gilt progeny compared to sow progeny. Animal, 16(8),100596. http://doi.org/10.1016/j.animal.2022.1