The use of progestogens and gonadotropins in gilts

The scheduled and controlled administration of these drugs allows gilts to go into heat and improves the productive results of the farm.

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Images provided by the author

The sow replacement rate on pig farms is between 30 and 55% per year (Gordon, 1997), and so the selection of future breeders is an especially important component of the reproductive efficiency of farms. Normally we work with large groups of gilts that are stimulated to go into heat to maintain a continuous flow of matings without altering the farm census. Reproductive efficiency could be improved if there were an effective means to synchronize estrus in replacement sows.


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Synchronizing estrus in future breeders would optimize the use of gestation facilities and greatly increase the efficiency of monitoring at the time of weaning (Estienne et al., 2018).

Remember...

Domestic pigs are a continuous polyestrous species whose female sexual cycle repeats every 21 days (18 to 24 days; Brinkley, 1981) except in non-productive or anestrus periods. Spontaneous multiple ovulation occurs (with 8–30 oocytes in each heat) and the ovarian cycle is biphasic, with a follicular phase in which estrogens predominate and a luteal phase during which progesterone (P4) is dominant.

Stimulation of the estrous cycle

Success in stimulating estrous cycles in gilts is determined by several factors. To simultaneously obtain many synchronized gilts, exposure to a heat-induction boar is recommended when most of them reach puberty, between 155 and 170 days (Patterson *et al.*, 2010; *figure 1*). However, we must consider that the earlier the heat stimulation is carried out, the more days the gilts will require to express heat (*figure 2*). This practice should be monitored and recorded to control the number of heats gilts have before mating.

Early stimulation allows a smaller number of gilts to be maintained on the farm and permits more exhaustive control of mating age (around 8 months) and use at an optimal weight (145–160 kg), implying the early elimination of animals that do not present these characteristics and which thus, may later have fertility problems (Buxadé *et al.*, 2007).

Often, it is either not possible to carry out early stimulation in nulliparous, or the season of the year means that the animals suffer heat stress leading to silent heats or anestrus. This makes it difficult to maintain the continuous cycle of gilts joining the farm system, meaning that hormonal treatments are frequently used to compensate for this problem.

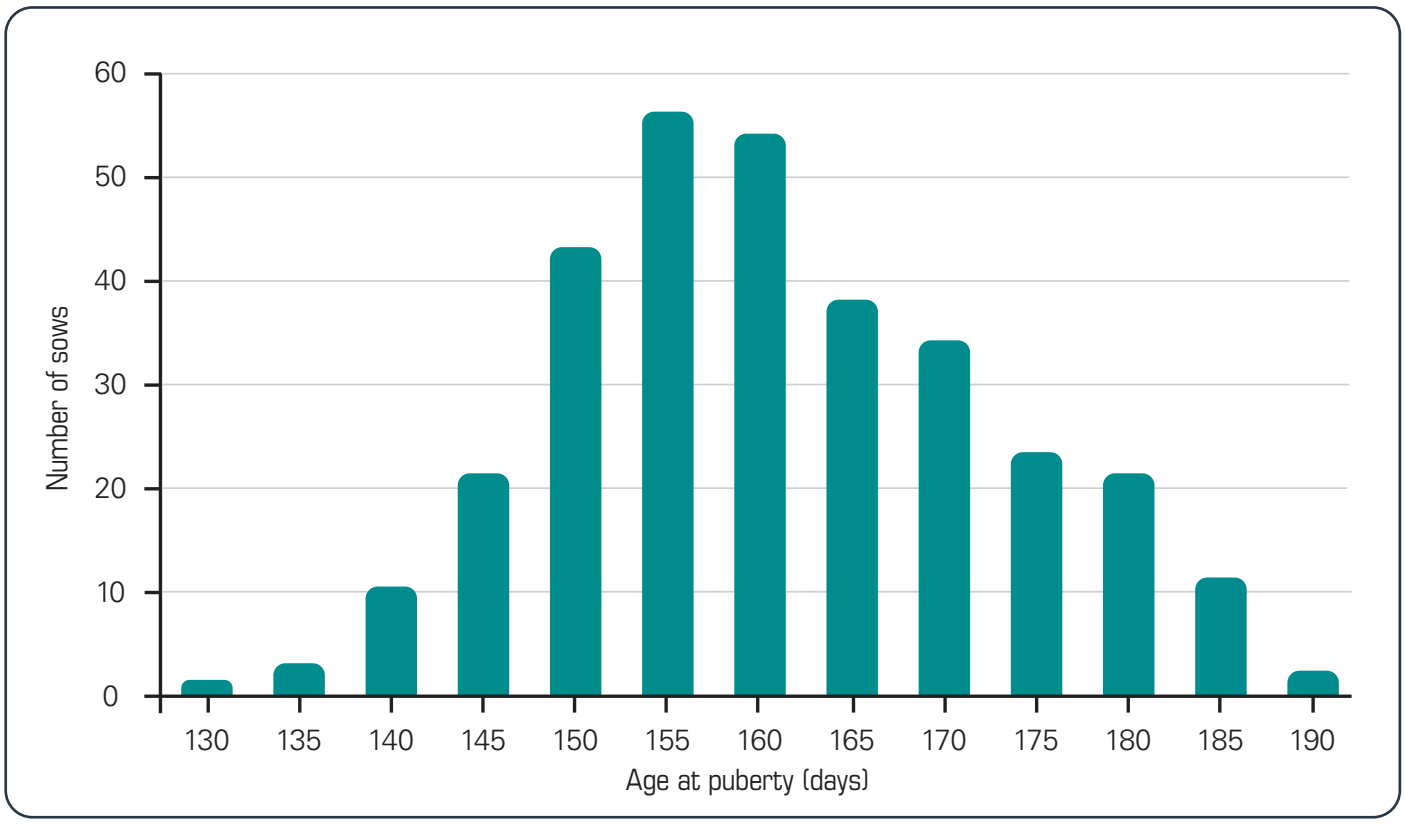

Figure 1. Age of onset of puberty. Source: Paterson *et al.*, 2010.

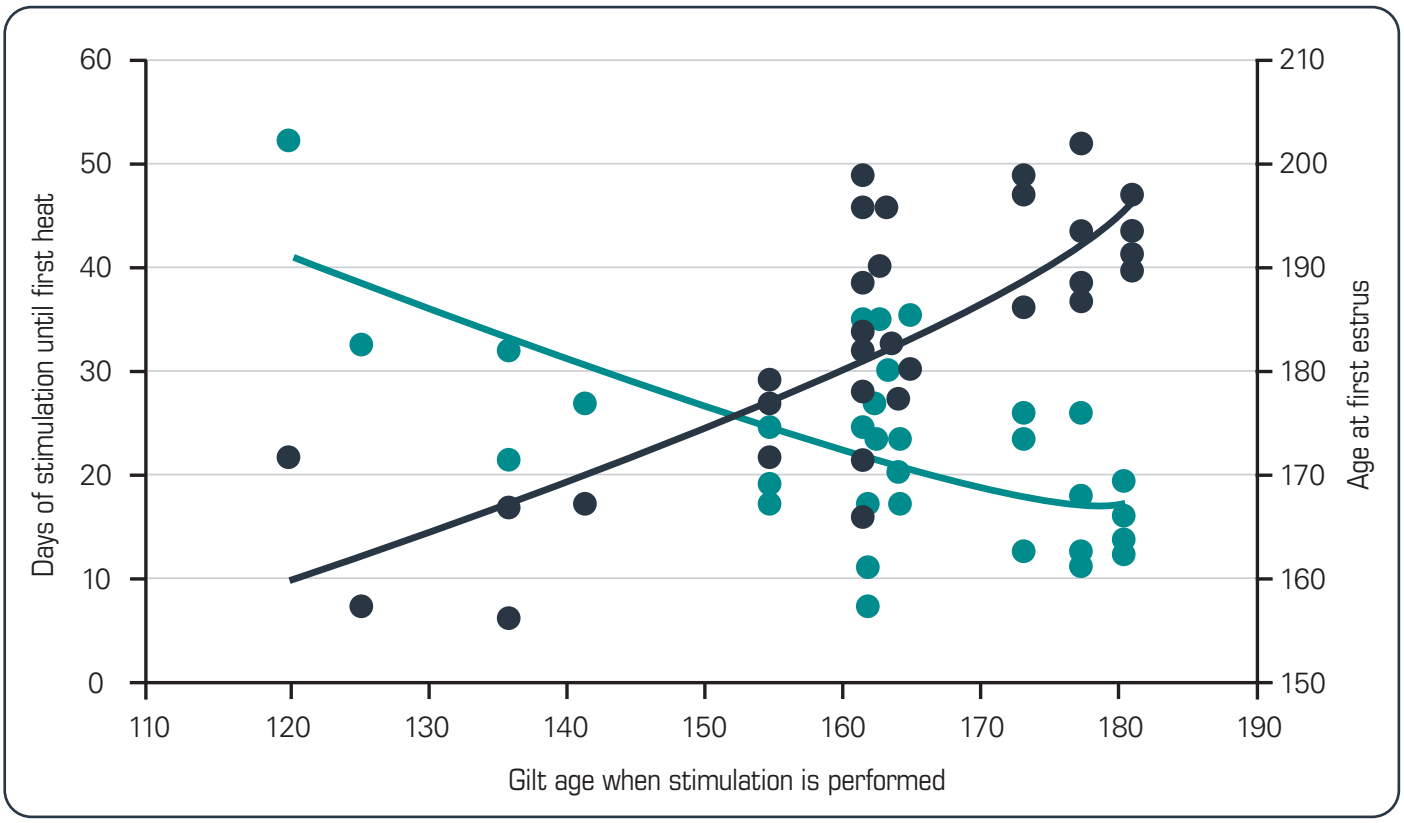

Figure 2. Relationship between the age at stimulation, the days required for the first heat to appear, and age of the nulliparous at the first estrus. Source: *La cerda reproductora: claves de su optimización productiva*. Buxadé *et al.*, 2007. Ediciones Euroganadería.

Hormonal dynamics during the estrous cycle

Before carrying out any hormonal synchronization treatments, the reproductive physiology of the animals must first be understood.

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1. Follicular phase

During the initial follicular phase, pituitary luteinizing hormone (LH) secretion is low, while follicle-stimulating hormone (FSH) is high. This FSH will cause increased progesterone production by granulosa cells, while LH will participate in the production of androgens. Importantly, progesterone and androgens are used as substrates to produce estrogens (*figure 3*; Falceto, 2015). Similarly, granulosa cells have prolactin receptors, which modulate the steroidogenesis of small and medium-sized follicles.

2. Luteal phase

The luteal phase is characterized by the secretion of progesterone by the corpora lutea (CL). The functions of the CL include inducing proliferation of the endometrium required for the implantation and survival of embryos and blocking the follicles by preventing production of the gonadotropic hormones FSH and LH by the pituitary gland.

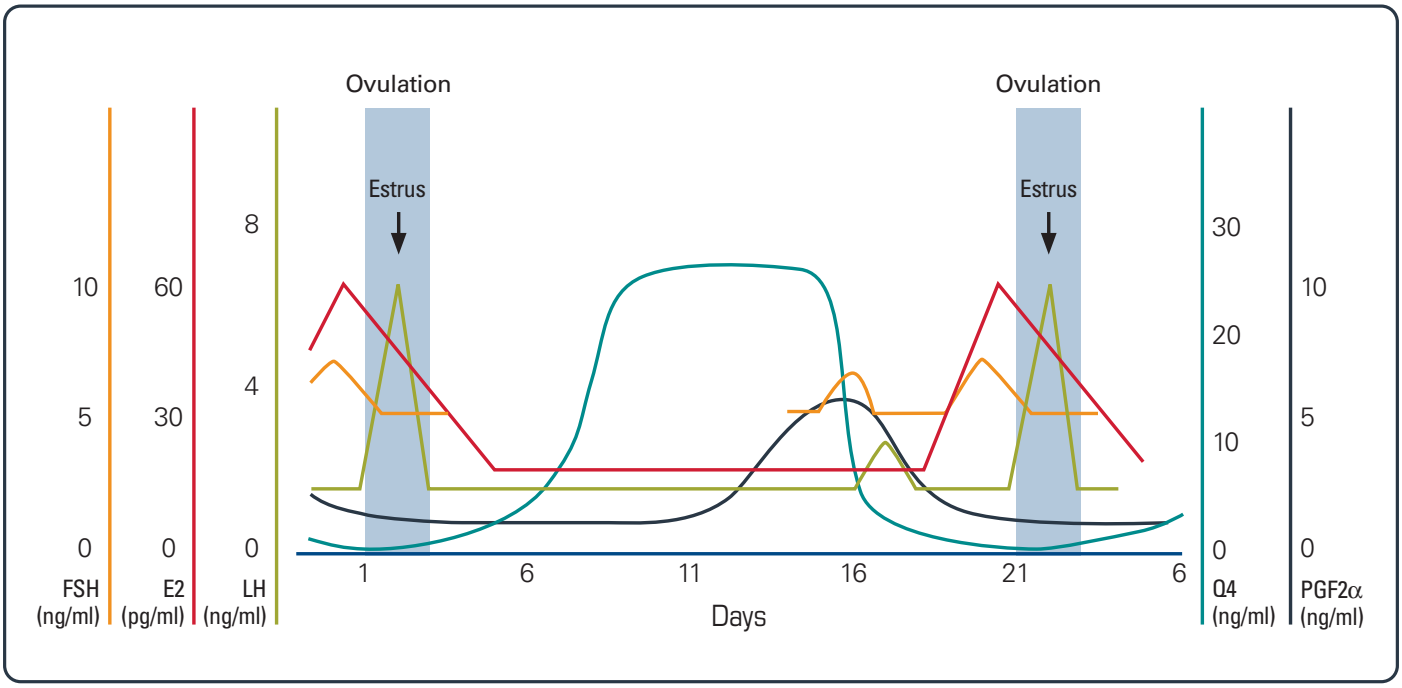

Figure 3. Blood hormone concentrations during the estrous cycle of sows (adapted from Laing *et al.*, 1991).

Hormonal synchronization of gilts

Several hormones are available for gilt synchronization which act both individually and in association to allow stimulation and the onset of estrus in gilts. However, the implementation of hormonal treatments must be meticulous, with regulated application times, because otherwise, we are unlikely to get the results expected.

1. Use of progestogens

One of the methods most used for gilt synchronization on farms is the application of synthetic progestogens (Regumate®, MSD Animal Health). Regumate is used continuously in the animals for 18 days. Remember, it must not be mixed with water because this can inactivate the product. Thus, the best form of administration is orally, in management blocks, using specialized syringes. The administration must be rigorous since one of the main problems is application failure. This protocol can be carried out only if there is sufficient space on the farm to keep at least 2 batches of gilts in the mating area while waiting for their insertion into production.

Plasma drug levels and their effect on the estrous cycle

Plasma drug levels remain high throughout the application process and exert negative feedback on the hypothalamus and anterior pituitary gland, thereby blocking cyclical gonadotropin (FSH and LH) production and preventing the return to estrous in these animals. When treatment is stopped, the hypothalamus starts secreting gonadotropin-releasing hormone (GnRH) again. This stimulates the secretion of FSH and LH by the anterior pituitary gland, leading to estrus and ovulation. However, we must consider that failure to properly apply these drugs would allow the hypothalamus to function normally and so, the desired synchronization effect would not be achieved.

Moreover, this treatment can only be administered to sows that have cycled at least once and so it is not entirely effective on farms which have not maintained an exhaustive heat record.

Oral administration of a synthetic progestogen (Regumate®, MSD Animal Health) in doses of 12.5 to 15 mg/day for 18 days allowed heat synchronization in gilts (Gordon, 1997; Estienne *et al.*, 2018).

2. Use of gonadotropins

In most cases, there is insufficient space on farms to be able to continuously administer altrenogest and so, other types of hormonal treatments must be used.

Thus, a single injection of the combination of pregnant mare serum gonadotropin (PMSG, 400 IU) and human chorionic gonadotropin (HCG, 200 IU) in the form of PG600® (MSD Animal Health) induces fertile estrus in prepubertal sows (Britt *et al.,* 1989). However, we must bear in mind that ovarian physiology is unknown on farms and so, ovulation often occurs without the expression of heat during the luteal phase of the estrous cycle in nulliparous (Tanabe *et al.*, 1949; Estienne *et al.*, 2018) or can result in a smaller litter size when these animals are inseminated after the first estrus synchronization (Ziecik *et al.,* 1996).

Injecting PG600® in sows after their first weaning reduces the weaning–mating interval, which is usually longer in second-cycle sows (Kikwood *et al.,*1998). Also of note, treatment with PG600® can induce estrus in problem sows that do not come into heat 3–7 days after weaning (even in summer), thereby helping to control the estrus cycles typically seen during the summer months (Kosork *et al.,* 2011). It is a common practice in Iberian pig farming to inject sows after weaning to avoid the anestrus associated with summer seasonality.

After the gonadotropin injection, ovulation will occur after approximately 72 hours.

3. The association between progestogens and gonadotropins

Lastly, it would be useful to discuss the association between the two previous protocols. This procedure is very widespread on Iberian pig farms during the summer season, although it is also commonly used on white-coat pig farms. 24 hours after completing the 18-day altrenogest protocol, future breeders are injected with PG600® so that they will go into heat 7 or more days later.

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Since the injection of PMSG and HCG can stimulate precocious puberty (Patterson, 1982), using these hormones together on farms could allow many gilts to go into heat. Thus, even if they may have never previously cycled, if their body condition characteristics are appropriate, they can be cycled together with their sisters from the same batch, thus avoiding the loss of animals because of reproductive failures.

Economic advantages of heat synchronization

It should be noted that heat synchronization can be extremely useful on genetic selection farms because it reduces the number of seminal doses required per sow, resulting in economic savings on the farm.

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After the combined treatment with progestogens and PG600® in nulliparous (Knox and Tudor, 1999; Estienne *et al.*, 2018), an improved farrowing rate (*table 1*; Cassar *et al.*, 2005; By Rensis *et al.*, 2016) and litter size (*table 2*; Estienne *et al.*, 2018) was evident on farms as the result of good synchronization and heat detection.

Adequate stimulation of heat in gilts will determine the maintenance of a constant flow of matings and economic losses resulting from the early elimination of these animals.

	Induced	Control
From Rensis *et al.* 2016		
Number of sows	88	140
Farrowing rate	94.8	78.5
Cassar *et al.* 2005		
Number of sows	198	370
Farrowing rate	90.0	75.7
Cassar *et al.* 2005		
Number of sows	110	131
Farrowing rate	84.2	68.7

Source: Rensis *et al.*, 2016.

Table 1. Effect of hormonal induction with altrenogest and the combination of PMSG and HCG on the farrowing rate.

	PG600®	Control	SD	*p*-value
Number of sows	22	23	-	-
Ovarian characteristics				
• **Mean ovarian weight (g)**	• 9.7	• 9.3	• 0.5	• 0.46
• **Mean follicular fluid weight (g)**	• 2.6	• 2.8	• 0.1	• 0.21
• **Corpora lutea**	• 26.2	• 18.1	• 1.8	• <0.01
• **Mean corpus luteum weight (g)**	• 0.43	• 0.49	• 0.01	• 0.01
Progesterone (ng/ml in serum)				
• **Day 7**	• 41.2	• 27.1	• 3.8	• 0.02
• **Day 28**	• 31.6	• 31.8	• 2.9	• 0.96
Embryonic characteristics				
• **Total number of embryos**	• 16.1	• 14.7	• 1.3	• 0.46
• **Live embryos**	• 15.6	• 14.2	• 1.2	• 0.40
• **Embryo survival (%)**	• 64.3	• 78.0	• 0.04	• 0.03
• **Mean embryonic weight**	• 2.08	• 2.04	• 0.06	• 0.72
• **Crown–rump length (mm)**	• 29.3	• 29.8	• 0.4	• 0.39

The values shown are the least squares means; *SD*: Standard deviation. Source: Estienne *et al.*, 2018.

Table 2. Reproductive characteristics of sows pretreated with Regumate® (15 mg/day for 18 days) that came into heat less than 7 days after intramuscular administration either of PG600® (400 IU of PMSG and 200 IU of HCG) or deionized water (controls) that were pregnant 30 days post-mating.

Embryo collection

Both synchronization of estrus and superovulation are equally important to obtain a high number of embryos (Kapelanski *et al.*, 2002) and so, to maximize their responses, resulting in the ovulation of a large number of follicles (Ziecik *et al.*, 2002) the yearlings must be monitored rigorously to ensure that the future breeders are at least 150 to 170 days old when heat is induced with a boar (Hughes *et al.*, 1989; *figure 4*).

In addition, after taking advantage of the association between these two hormones (*table 2*), more embryos were collected and overall, these were of better quality than those from animals not injected with PG600®. The injected animals showed a much higher increase in serum progesterone on day 7 post-injection, indicating good rupture of the corpora lutea and a better ovulation rate.

Although embryos are not often collected on farms, this practice is very widespread in the field of physiological research.

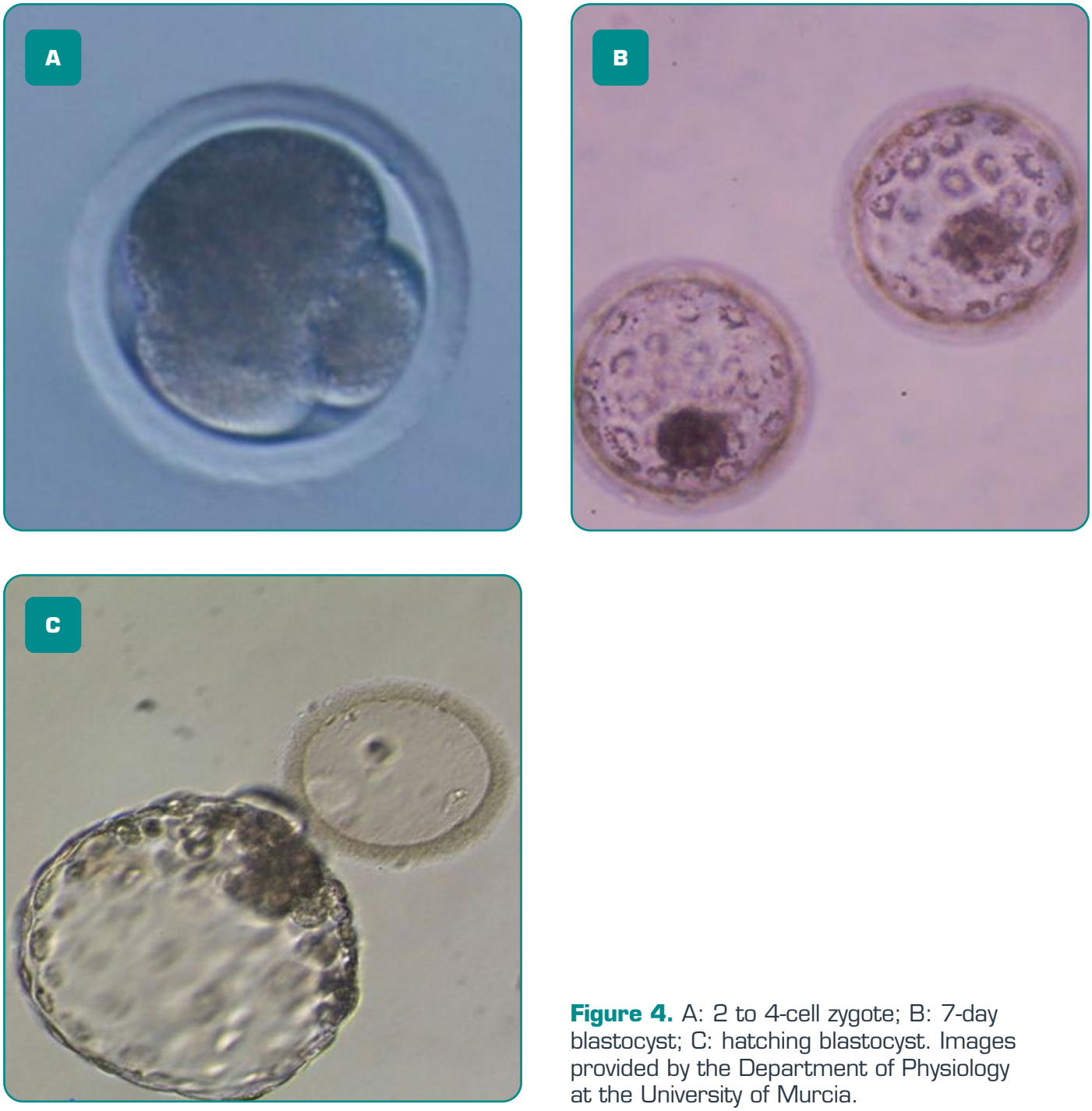

Figure 4. A: 2 to 4-cell zygote; B: 7-day blastocyst; C: hatching blastocyst. Images provided by the Department of Physiology at the University of Murcia.

Conclusion

The use of progestogens and gonadotropins is effective in achieving a return to heat in gilts and optimizes both the use of the facilities and the number of gilts required on the farm. However, these hormones must be used at specific times and with rigorous control to achieve maximum effectiveness.

Bibliography

- Gordon I. 1997. Controlled reproduction in pigs. CAB International, Wallington,oxon, UK.
- Estienne M.J, Harper A.F, Horsley B.R., Estienne C.E., and knight J.W. 2018. Effects of P.G 600 on the onset of estrus and ovulation rate in gilts treated with Regumate. Animal and poultry Sciences Department, Virginia Polytechnic Institute and State University, Blacksburg.
- Patterson, A.E. 1982. The controlled induction of puberty. In D. J: A. Cole and G. R. Foxcroft (ed.) Control of Pig Reproduction. pp 139-159. Butterworths, London.
- Buxade Carbó C-I, Marco Granell E., Lopez Montes D.2007. La Cerda reproductora: claves para su optimización productiva. Pfzier Editorial Euroganadería.
- Falceto M.V., Duque C., Alfonso J., Ciudad M.J., Espinosa E. Variaciones fisiológicas de la funcionalidad ovárica de la cerda. Dpto. Patología animal. Facultad de veterinaria de Zaragoza. España.
- Ziecik A.J., Dybala J., Martin Rillo S., Kapelanski W., Blegniewski S., De Alba C., Gajewski A., 1996. Induction of fertile estrus in prepubertal gilts and weaned sows. Reprod Dom Anim; 31: 469-472.
- Tanabe T. D., Warnick A.C., Casida L. E. and Grummer R. H.1949. The effects of gonadotrophins administered to sows and gilts during different stages of the estrual cycle. J. Anim. Sci. 8:550-557
- Kirkwood R. N., Aherne , F. X. , Foxcroft ,G. R. 1998. Effect of gonadotropin at weaning on reproductive performance of primiparous sows. Swine Health Prod. 6:51-55.
- Kosork S., Kastelic M.2011. Systematic use of PG600 on primiparous sows on a well-managed farm. Acta veterinaria (Beograd), Vol 61 NO. 5-6, 643-652.
- Knox R. V., Tudor, K. W.1999. Influence of norgestomet in combination with gonadotropins on introduction of estrus and ovulation in prepubertal gilts. J. Anim. Sci. 52:831-835.
- Falceto Recio M.V. 2014.Fisiopatología ovárica en la cerda. MSD Animal Health.
- Cassar G., Kirkwood R. N., Poljak, K. Bennett-Steward, Friendship R. M. 2005. Effect of single or double insemination on fertility sows bred at an induced estrus and ovulation. J. Swine Health Prod. 13: 254-258.
- D Rensis F., Kirkwood R.N.2016.Control of estrus and ovulation: Fertility to timed insemination of gilts and sows. Theriogenology 86; 1460-1466.
- Kapelanski W., Ziecik A.J., Daybala J., Kapelanska J.2002. Effect of diet and gonadotrophic stimulation of sexual maturity on sow performance. Medycyna Wet; 58 (10): 803-806 (in Polish).
- Hughes P. E.1989. Mating management and artificial insemination. In: Barnett J. L., Hennessy D. P. (eds), Manipulating Pig Production II. Australia: APSA; 277-280.
- Zieck A. J., Kapelanski W., Zaleska M., Rioperez J. 2002. Effect of glucose supplemented diet on natural and gonadotropin induced puberty attainment in gilts. J Anim Feed Sci 2002; 11: 461-469.