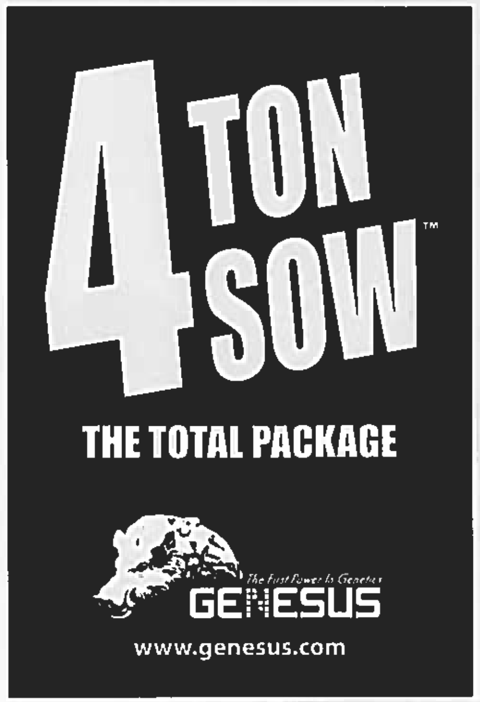
BREAKOUT SESSION 5: Breeding Technologies

By Geoff Geddes



Part one: Current strategies and technologies for reproductive management of gilts and sows

Though not all aspects of pig production are universal, reproduction is kind of a given. Still, technologies to increase the precision of pig reproduction are becoming more widely available and vital to the economic viability of producers. Drawing on his expertise as Director of Reproduction Research and Development for JBS United Inc, Stephen Webel took a closer look at these technologies and what they mean for the industry.

Estrus Synchronization by Controlling the Luteal Phase of the Estrous Cycle

Commercial PGF (prostaglandin) products are not as effective for inducing a short cycle and synchronizing estrus in gilts and sows as they are for cows and mares. Therefore, the predominant approach to estrus synchronization in the gilt is to administer a synthetic progestin (altrenogest), which suppresses pituitary secretion of the gonadotropins, follicle stimulating hormone (FSH) and luteinizing hormone (LH) for 14 to 20 days. During this time the corpus luteum (CL) degenerates while the growth of new follicles and ovulation is suppressed. Upon withdrawal of altrenogest, pituitary gland secretion of FSH and LH resumes simultaneously.

Altrenogest is generally available worldwide and is marketed as Matrix or Regumate as well as several generic formulations. Altrenogest is also used to synchronize estrus in sows to facilitate batch scheduling. Accurate daily dosing of altrenogest is extremely important, with gilts receiving at least 15 mg/day and sows 20 mg/per day for 14 to 18 days. Insufficient dose levels, failure to deliver the dose each day and at the same time each day or failure of animals to ingest the entire dose leads to increased incidence of cystic follicles and failure of animals to return to estrus. Inaccurate administration of altrenogest is a consistent problem that reduces the precision of estrus synchronization.

Stimulating or Controlling Follicular Development

Precise stimulation of follicle growth requires treatment with a correct ratio of FSH to LH. However, frequent injection or continuous infusions of these purified hormones are required. Likewise, gonadotropin releasing hormones (GnRH) for follicle stimulation have failed to produce consistent results. Pregnant mare serum gonadotropin (PMSG or eCG) contains the appropriate ratio of FSH and LH-like activities to stimulate follicle growth. Doses ranging from 500 to 1000 IU are generally effective.

Although PMSG is widely available in many countries, the only commercially available preparation for inducing estrus and ovulation in pigs in the United States is P.G. 600.

Induction of Puberty in Gilts

PMSG or P.G. 600 induces estrus and ovulation in 50–90% of prepubertal and peripubertal gilts within five days. The maximum response occurs when gilts are within 20–30 days of natural puberty. However, up to 30% of treated gilts do not display estrus, but many of these ovulate. As well, up to

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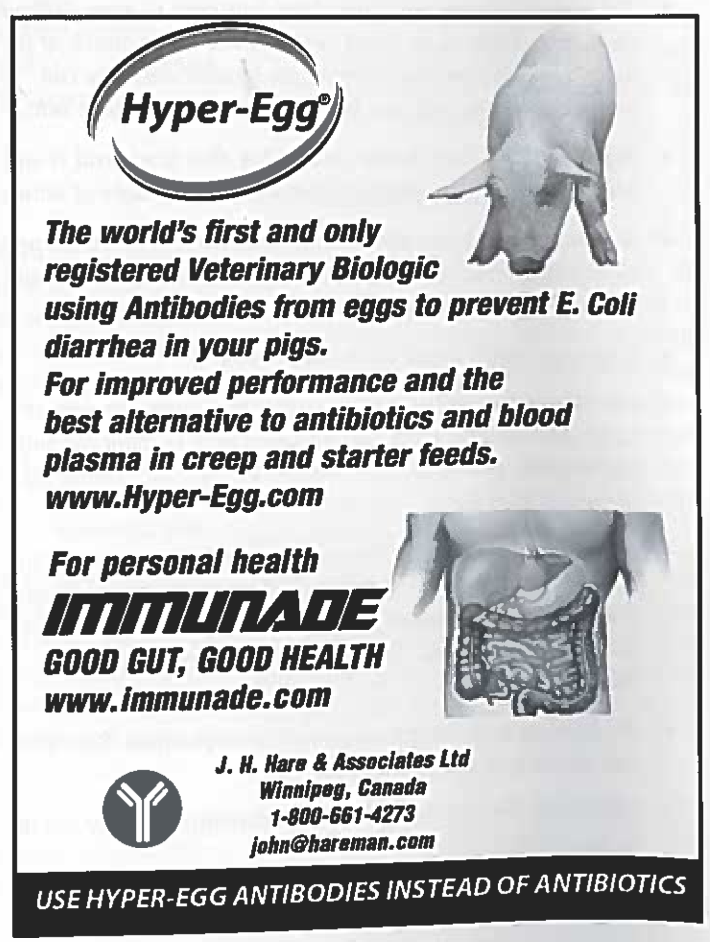

30% of those exhibiting estrus have an irregular return to a subsequent estrus.

Development of improved methods of inducing estrus in prepubertal and peripubertal gilts would increase the precision of breeding this group of gilts.

Follicle Stimulation after Estrus Synchronization with Altrenogest in Gilts

Inevitably in commercial swine operations, groups of gilts will include cycling and prepubertal animals, or the sexual maturity of a group of gilts may be unknown. A regime of altrenogest for 14 days followed by a follicle stimulator, such as PMSG or P.G. 600 24 hours after the last feeding of altrenogest, synchronizes estrus in these gilts.

Follicle Stimulation in Weaned Sows

Weaning a group of sows typically results in wean-to-estrus intervals of 3–6 days. Yet greater variation occurs in parity one and two sows and in the hot summer months. Variation in the weaning-to-estrus and ovulation intervals in sows is due to variation in stages of follicular development at weaning. Simultaneously triggering follicle growth with PMSG or P.G. 600 at weaning results in a more uniform population of follicles and increases the percentage of sows in estrus within five days.

Seasonal Anestrus

Puberty is frequently delayed in summer months. Weaning-to-estrus interval is longer and ovulation rate, conception rate and litter size are lower among both primiparous and multiparous sows weaned during summer and early fall. Parity one sows are more susceptible than older sows. An injection of 500 to 1,000 IU of PMSG, or treatment with P.G. 600 promotes a synchronized estrus in gilts following altrenogest and in weaned sows injected the day of weaning or 24 hours later during late summer and autumn.

Induction of Ovulation

Ovulation induction is an important tool to more precisely synchronize the time of ovulation. Mature follicles are simultaneously induced to ovulate with a gonadotropin of predominately LH activity, such as porcine LH (pLH) or hCG. A GnRH analogue can also synchronize ovulation by inducing an endogenous preovulatory LH surge from the pituitary gland.

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Control of Farrowing

Generally, farrowing within a group of sows is spread over several days. Due to an increased focus on biosecurity and piglet health, there is renewed interest in batch farrowing and all-in-all-out production. Properly timed induction of farrowing increases the proportion of sows farrowing during normal working hours. It's important to note that successful induction requires treatment within two days of the expected normal farrowing date.

Available technologies for precise control of reproduction have been implemented in part or in whole by early adopters. These technologies are not therapies for reproductive problems the way antibiotics are for disease, but are designed to enhance production efficiency.

At present, the primary impediment to more universal application of these technologies is critical training of all personnel regarding the importance of proper and precise implementation. Careful timing of treatments and correct dosing of products are primary issues that limit the precision of these technologies. These are issues worth addressing, as pig reproduction is like proposing to your future spouse: There's no way around it, so you might as well do it right.

Part two: Application of sexed sperm in pig production

The use of sexed sperm has been primarily synonymous with cattle, but why should they have all the fun? Significant investment in research and development has made this technology available to other commodity groups including pigs. Commercial application of sexed sperm is expected to increase as the level of fertility approaches that of conventional AI and as the sorting capacity improves. So the timing was right for Kilby Willenburg of Fast Genetics to explain the processes of flow cytometric sperm sorting and how this technology can be applied to the swine industry.

Flow Sorting of X and Y Bearing Sperm

The effects of sorting, particularly on the sperm membrane, are well characterized and include several stressors and potential dangers to the gamete resulting in reduced viability, storage capacity and fertilization. Sperm are exposed to Hoechst staining, high dilution rates, laser exposure, high pressure, electrical charging, changes in media composition and centrifugation, which are collectively thought to reduce the lifespan of the sorted sperm.

Kilby Willenburg of Fast Genetics

Interestingly, inter and intra-boar variation exists for sperm to withstand flow cytometric sorting as it was reported that 15 per cent of boars did not exhibit a well-defined distinction between the X- and Y-bearing peaks in a histogram plot. Hence there is value in determining which boars can withstand the sorting process to ensure sufficient post-sort motility and viability to accommodate a greater distance between the sows and sorting lab.

Fertility of Sexed Sorted Sperm

The application of sexed sorted sperm in the swine industry must overcome some challenges before this technology can be used commercially. Flow cytometric sperm sorting speeds are a limitation, especially for an industry that inseminates 2.5-3.0 billion sperm in 75-100 mL of extender. Although sorting speeds have improved to around 20 million cells per hour, one A.I. dose would require about 100 hours of sorting time. To overcome this obstacle, new insemination techniques have been used to reduce the number of sperm and deposit the sperm closer to the site of fertilization.

One such technique is Laparoscopic insemination (LAI), which appears a plausible alternative to inseminate pigs from a sorting perspective. It could be a realistic model for sexed sperm on nucleus or multiplier herds since one gender is generally preferred and fertility could be reduced if additional animals from the desired gender are produced. This technique is still relatively new in terms of use with sexed sperm but has shown promising results.

Deep uterine insemination (DUI) is another option for inseminating reduced numbers of sexed sperm, particularly on a commercial farm. A DUI catheter longer than 1.5 m has to bypass the cervical folds and manipulate the length and coiled nature of the uterine horn prior to depositing cells in one of the horns.

Collectively, LAI and DUI enable the swine industry to reduce the number of sperm inseminated and further leverage a particular boar across multiple females, which is not realistic for inseminations that require billions of sperm per female.

For example, a boar that is used for cervical inseminations at 3 billion cells can produce almost 8,000 pigs a year, while that same boar can produce almost 8 million pigs when used in a laparoscopic model, assuming all sperm cells are used for insemination (and you thought you were overworked). A more realistic model for commercial farms would be an insemination dose of 500 million cells and 45,000 slaughter pigs produced per year.

At present it's unclear when sexed sperm will be ready for commercialization. Sorting speeds are a popular area of concern, especially for an industry that relies on billions of sperm for one insemination dose. Speeds have increased from 200-600 cells/second in the earlier years to 8,000-10,000 cells/second from improved digital technology and partial automation. For an industry that relies on 6-9 billion cells per breeding female, however, inseminating 50-500 million sperm might be a difficult transition. Sorting speeds will continue to improve but a reduction in sperm cells is needed for inseminations similar to what the dairy industry experienced in the earlier years of the implementation of sexed sperm.

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