

VIII International Conference on Pig Reproduction: report and research recommendations

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The VIII International Conference on Pig Reproduction was held at Banff, Alberta between the 1st and 3rd June 2009, and was attended by approximately 200 delegates from around the world. The conference included a number of reviews describing a wide number of areas of extreme importance to breeding herd performance, these ranged from factors involved in determining semen quality and boar fertility through to management of the breeding gilt and lactating sow. The most novel, interesting and relevant information presented at this conference, either as part of a review or as an abstract, is summarised below.

The report is divided into four broad sections: developments towards improving semen quality and boar fertility; the impact of lactation on embryo/foetal development; practical strategies to improve reproductive performance post-lactation; and the impact of gilt management on lifetime productivity. The final section of this report, contains recommendations for future research and investment by the CRC.

1. Towards improving semen quality and boar fertility

The ability to reduce the size of the semen dose required for artificial insemination (AI) procedures continues to form the focus of a considerable amount of research. Researchers from the Netherlands, Germany and USA, in particular, presented abstracts describing their efforts towards reducing the size of the semen dose used without negatively affecting fertilisation outcomes and litter size, and towards identifying boars with higher fertility. Some of the more interesting points regarding semen quality and dose size are described below:

- Inseminating with seminal plasma, or giving a V-boar mating, leads to an increase in female progesterone levels, possibly by altering ovulation time, rather than luteal activity. Considering the positive association between more rapid increases in progesterone post-mating and embryo survival / litter size, it is possible that V-boar matings or inseminations with additional seminal plasma may represent a strategy to improve pregnancy outcomes during periods of low fertility, such as summer. This may be a strategy worth investigating as part of the seasonal infertility sub-program
- Sex-sorted sperm give a lower farrowing rate unless they are deposited close to the fertilisation site and in the immediate pre-ovulatory period. It is, therefore, suggested that development, and commercial application, of sex-sorted semen should occur in conjunction with the development of an effective strategy for deep-intra uterine insemination as well as an accurate and effective method for predicting time of ovulation (i.e. exogenous hormone protocols which enable accurate prediction of ovulation time).
- The first 10 ml of the sperm rich fraction of an ejaculate is superior, primarily due to the proteins present in the seminal plasma component. Although, it is interesting that sperm cells are a better stimulant of uterine cytokine release than seminal plasma
- Interestingly, the semen of a proportion of boars performs well even when frozen.

- Getting a good litter size from an AI boar can depend on the dose, with some boars needing 7 - 9 billion sperm to maximise litter size while others require only 1 billion sperm.

2. *The impact of lactation on embryo / foetal development*

In French and Canadian herds, the effect of lactation feed restriction on subsequent fertility and fecundity is manifested as a reduction in embryo survival, with little, or no, demonstrable impact on weaning-to-oestrus interval (WOI) or ovulation rate. This is a stark contrast to Australian genotypes which commonly experience extended WOI and low second litter sizes when lactation feed intake is low. This differential response likely reflects differences between the genotype typical of Australia's closed herd and that created as a result of the larger gene pool available to the rest of the world.

The factors causing this increase in embryo mortality likely relate to the impact of insufficient LH support and/or negative energy balance on the growth and development of the follicle-oocyte complex. Specifically, the oocytes shed at the first oestrus post-weaning are maturing within an inappropriate endocrine and metabolic environment, and are therefore less able to survive implantation or cope with the stresses associated with embryo / foetal crowding. Crowding and its effects on placental size and efficiency are driven by the number and synchrony of elongated blastocysts present at day 12, with the more conceptuses present in the uterus the faster their amniotic sacs come into contact, thus halting their elongation and limiting placental size. Foetal crowding has been associated with phenotypic alterations in the progeny, with the embryos produced by lactation-restricted sows more sensitive to the negative effects of embryo crowding. Studies presented by Dr George Foxcroft demonstrate incidences of entire litters of pigs being altered phenotypically as a result of uterine crowding. Dr Foxcroft also indicated that the number of still borns and mummified foetuses could be used as a measure of uterine crowding, and suggested that sow lines should be selected on figures for born alive, rather than total litter size. Another, interesting outcome Dr Foxcroft's studies is the finding that low birth weight piglets possess severely compromised immune statuses, and work is now underway to investigate the cause of this. In light of these developments, I would suggest that the issue of crowding in utero and its impact on post-natal growth and development of the progeny is worth investigating within the Australian breeding herd. Especially, considering Australian sows appear to experience a reduction in ovulation rate in response to lactation restriction, and the impact of uterine crowding may therefore be less severe.

Interestingly, a pair of abstracts presented at the conference reported that first parity sows experiencing a severe loss of liveweight during lactation, but able to ovulate and conceive, continued to experience sub-optimal reproductive output in subsequent parities. This may be related to impaired growth of these animals, and the lack of an opportunity to ever recover metabolically from the rigours of the first lactation. Specifically, this problem likely reflects the failure of management system to take the impaired physiological state of these animals into account when feeding them through the subsequent gestation. This apparent continuation of sub-optimal reproductive performance may well be responsible for the premature decline in fertility observed in parity 4 plus sows within Australian breeding herds, and is an area worth investigating.

3. Practical strategies to improve reproductive performance post-lactation

A number of strategies to alleviate the impact of lactation on subsequent reproductive performance were described during the course of the conference, and these are summarised below:

- It has been demonstrated, repeatedly, that split weaning can reduce WOI. With the removal of the heaviest piglets 3 - 7 days prior to weaning likely reducing the suckling-induced inhibition of LH frequency and increasing the size of the follicles present at weaning. The size of the follicles present at weaning is positively correlated to WOI. It is worth noting that an increase in LH may promote follicle growth, but may not improve oocyte developmental competence. With an increase in LH not necessarily associated with an improvement in metabolic status and therefore nutrient availability to the ovary.
- Intermittent suckling elicits an increase in LH pulse frequency, but only when the sow is removed from the pen rather than just separating the litter and sow using a board. It would be useful to know if it is the separation from the piglets alone that triggers the change in LH, or if a similar response would occur if both sow and piglets were moved to another pen and then the piglets separated using a board. Equally, the practical application of intermittent suckling would be improved if it were possible to achieve the increased LH pulse frequency without moving the sow, or piglets, from the pen. To achieve this understanding, it would be necessary to identify volatile olfactory, visual or auditory cues from the piglets are responsible for the failure of LH pulsing to increase when the piglets are separated from the sow but not removed from the pen.
- Using artificial progesterone (i.e. regumate, altrenogest) during the peri- and post-weaning period represents a practical and easily implemented strategy to improve oocyte developmental competence and thus decrease the impact of embryo crowding on both placental size and embryo development. The theory being that during progesterone treatment after weaning, follicles approach maturity and develop the ability to undergo recruitment and selection in a more appropriate metabolic environment, and thus the oocytes they contain will be more competent. Equally, progesterone treatment ensures atresia of those follicles which reached the later stages of folliculogenesis during lactation. The use of artificial, exogenous progesterone to enable the follicular recovery of first, or indeed second, parity sows is worthy of further investigation within the Australian system

4. The impact of gilt management on lifetime productivity

Two reviews were presented pertaining to gilt management, and the most interesting information was as follows:

- Gilts mated at less than 135kg have lower lifetimes performance although mating weight per se has no effect on litter size in the first 3 litters
- Heavier gilts tend to have lower farrowing rates when mated at 2nd heat and a lower herd retention rate, possible relating to structural problems
- There appears to be a degree of androgen sharing in utero, and a possible androgenisation of some female piglets cannot be discounted. Such an effect would result in an alteration in sexual development, and the effect

of sex ratio in utero on gilt reproductive performance is worthy of further investigation.

Recommendations for future CRC funded research and investment opportunities

Based on the information presented at ICPR, a number of areas stand out as providing the potential to improve the productivity of Australia's breeding herd.

- The impact of lactation on growth of the ovarian follicle - oocyte complex is an area of extreme importance to the pig industry. Recent data coming out of George Foxcroft's group in Alberta, indicate that low lactation feed intakes significantly reduce not only the ability of the oocyte to survive through to the foetal stage but also the phenotype of the resultant piglet and possibly its immune status. It is, therefore, of extreme importance to investigate this effect within Australian genotypes, and also to develop strategies to ensure the oocytes shed after weaning mature in an appropriate endocrine and metabolic environment. Research should focus on the role of nutrition, particularly during the last week of lactation, on oocyte quality, embryo survival and progeny phenotype. Equally important, the benefits of using exogenous progesterone (i.e. regumate, altrenogest) to delay ovulation post-weaning such that the oocytes shed are those which mature in a more favourable metabolic environment should be investigated. Considering the obvious research synergies between this proposed work and that currently being conducted by George Foxcroft's group in Alberta a collaborative approach is recommended. However, considering the obvious differences between the Canadian / European genotypes and the Australian genotype, stand alone research must be conducted in Australia.
- Research should be conducted to determine the benefits of using a V-boar mating or infusions of seminal plasma to improve sow fertility during the summer / autumn period when fertility is impaired. More specifically, both V-boar mating and seminal plasma have been shown to increase sow progesterone levels. An alteration in progesterone release is a probable cause of impaired sow fertility during summer, and therefore research should be conducted to see if a V-boar mating or seminal plasma infusion can improve progesterone release and pregnancy outcomes during the summer period. A small-scale study focussing on progesterone release and embryo survival/viability would make the best starting point.
- Research towards developing an effective exogenous hormone protocol which enables accurate prediction of ovulation and the use of only one AI should continue. One of the most promising, recent technologies for controlling time of ovulation is the GnRH agonist triptorelin (Ovugel™) which is administered intravaginally, and should be tested in Australian commercial conditions. However, the incorporation of boar contact in such a system should also be investigated. If an effective and accurate system could be developed the potential benefits of using sex-sorted sperm could be taken advantage of, especially if the effectiveness of intra-uterine insemination could be improved.