Evaluation and Economic Impact of Boar Fertility

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Introduction

The concept of evaluating commercial boars for fertility is a rather novel idea in the North American swine industry. The majority of commercial systems are content with pooling semen from a population of boars with unknown fertility. With this approach come two points to consider. First, given the number of boars in the pool and the ability of the stud to properly manage indices, the best boars in terms of genetic merit may not be influencing the maximum number of progeny going to the marketplace. Secondly, boars may be used in pools that may never sire a pig and, therefore, the boar stud is committing resources with a poor return on investment. The question then becomes, should commercial boars be evaluated for fertility and what is the ultimate economic value to be gained?

Commercial Evaluation of Boar Fertility

Estimates for the number of poor fertility boars in a commercial population are limited in NA because of the use of pools. Data from the field suggests that up to 13-17% of boars may be subfertile when evaluated using 1.5 billion viable sperm and conventional AI (T. Gall, personal communication). Since data is limited, research is needed to evaluate the use of single sire matings with reduced semen concentration in a commercial population and identify the economic outcome.

A trial is being conducted within a 40,000 sow commercial production system with two internal boar studs (Holden Farms, Northfield, MN) in order to evaluate boar fertility using single sire matings with reduced semen concentration in a commercial population and identify the economic outcome.
concentration. During the first phase of the project, sire line boar ejaculates were processed at a concentration of 2.0 billion viable sperm cells per dose. Only boar ejaculates with >75% motility and >60% normal sperm cells were processed. Each boar was evaluated using 50 single sire matings in commercial sow farms and semen was used within 5 days of collection. Sows with weaning-to-estrus intervals of 3 to 6 days were randomly allocated to be bred using conventional AI. Data was monitored to ensure parity distribution within boar. No sows that were returns or had abortions were used. Once boars completed 50 matings, semen from those boars were pooled at the stud’s standard concentration until pregnancy rate (PR), farrowing rate (FR), total born (TB) and born alive (BA) results were available. During the second phase of the project boars were evaluated using post-cervical artificial insemination (PCAI). Initially, semen concentration remained at 2.0 billion to ensure performance using PCAI was maintained before reducing further.

As expected, variability in fertility parameters existed and not all boars performed equally in the first phase of the trial. The range for PR was 37 to 100 with an average of 93.1 ± 8.1%. A difference of 8.2 pigs per litter existed between the lowest and highest boar in terms of total born with an average of 13.2 ± 1.0.

Figure 1: Pregnancy rate and total born for boars evaluated using 2 billion viable sperm per AI dose.
Culling decisions were made between the two phases, so not every boar evaluated at 2.0 billion went on to be evaluated using PCAI. Boars were culled for reasons including: low conception rate, poor litter size, poor health, unacceptable semen quality, poor feet/legs and genetic index. The culling rate for boars with poor fertility was 10% and total culled was 43%. It is important to note that before boars were removed for fertility, the index of the boar was also taken into consideration by creating a value that encompassed index and pigs produced per 100 sows.

**Economic Impact**

With the reduction in semen concentration, it is assumed that fewer boars with a greater average index are needed to produce progeny. The removal of poor fertility boars from this population equated to an initial improvement of an average of 5 index points and improved overall fertility of the system. The value per pig can be calculated simplistically by using the value per index point times the improvement in index. In this situation the system has the capacity to realize a $0.35 per pig increase in value. The sustainability of this improvement though, must be analyzed. It cannot be assumed that in every situation the poorest fertility boar is also the boar with the lowest genetic merit. Research has indicated that semen quality traits, that are a measure of the boar’s fertility, are negatively correlated with certain performance traits such as average daily gain and muscle depth (Safranski, 2008). While boars can be removed based on fertility, an increase in the average index cannot be guaranteed each time.

One of the concerns of production systems in evaluating boars using single sire matings is the perception that performance will be sacrificed during the evaluation period and ultimately impact the bottom line. While subfertile boars will certainly be exposed, there will also be boars with higher than expected fertility. Data is limited but research suggests that different scenarios exist when boars of varying fertility are pooled. One potential outcome is that neither the greatest potential nor the poorest potential is realized, creating an average of the boars in the pool. A second outcome suggests that the pool performs at the highest or at the lowest fertility possible given the potential of the boars individually (unpublished, PIC). Although the reason for the variability in results is unknown, it could be hypothesized that sperm competition within the pool is a determinant of performance. More research is needed to make a sound conclusion. Within Holden Farms, the system’s average performance was maintained or slightly improved during the trial using the single sire matings at a reduced concentration than when only pooled doses were used. Since a decided limit for the number of matings was used, subfertile boars could only influence a certain number of sows before being removed, limiting the potentially detrimental effect.
The use of pools creates efficiencies in the boar stud and makes the logistics at the sow farm easier. North American boar studs typically use 4 to 6 boars in a pool (Knox et al., 2008). It’s been estimated that pooled doses cost $0.10 per dose less to produce than single sire doses (unpublished, PIC). With the use of pools comes the challenge of managing indices in the population. Realistically, there may be a 20 point spread in the pool. It cannot be assumed that the boars in the pool are fertilizing an equal number of eggs, therefore, the number of pigs the boars with the greatest genetic merit are influencing is unknown. The added cost of a single sire dose per pig born alive, assuming 12, is <$0.01, which is rather negligible, given the potential for the highest indexing boars to sire more pigs.

Calculations for the cost per boar should also be considered. Assuming the inventory is reduced by 10%, the stud will decrease variable costs (i.e. feed, health) 5 to 10% on depending on when the culling decision is made. However, labor must still be dedicated to training and collecting these boars during their use, so the savings at the stud by decreasing inventory is debatable.

Genetic Component

A true understanding of the opportunity to increase genetic merit must be established if it is to be used as a reason to use single sire matings with reduced semen concentration. Evaluating boars with single sire matings will identify subfertile boars and using a reduced concentration will allow fewer boars to be utilized. However, if a boar stud is already maintaining a boar inventory at the top 15% of a population in terms of index due to participation in a genetic sourcing and management program targeting higher merit boars (i.e. PIC CBVPlus), the return on investment is limited because the existing inventory is already substantially above the average merit of the population. The improvement at a commercial stud cannot surpass the annual rate of genetic change at the genetic nucleus.

An immediate short term boost may be realized and this increased merit should be maintained into the future but, as emphasized previously, subfertile boars may not be the lowest in index. There are many traits included in a commercial boar’s index in an attempt to reflect the potential of that terminal sire to enhance profitability of the future generation.
Figure 2: Rate of genetic change over time.

- **Conclusion**

The use of single sire matings with reduced concentration can be successfully used to identify and remove subfertile boars to improve overall performance of a production system. Fewer boars are required and the opportunity exists to remove boars with lower genetic merit that would typically be used to meet semen production needs. The improvement and sustainability in average boar index will be dependent on the boar inventory and genetic management program within each production system.

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References