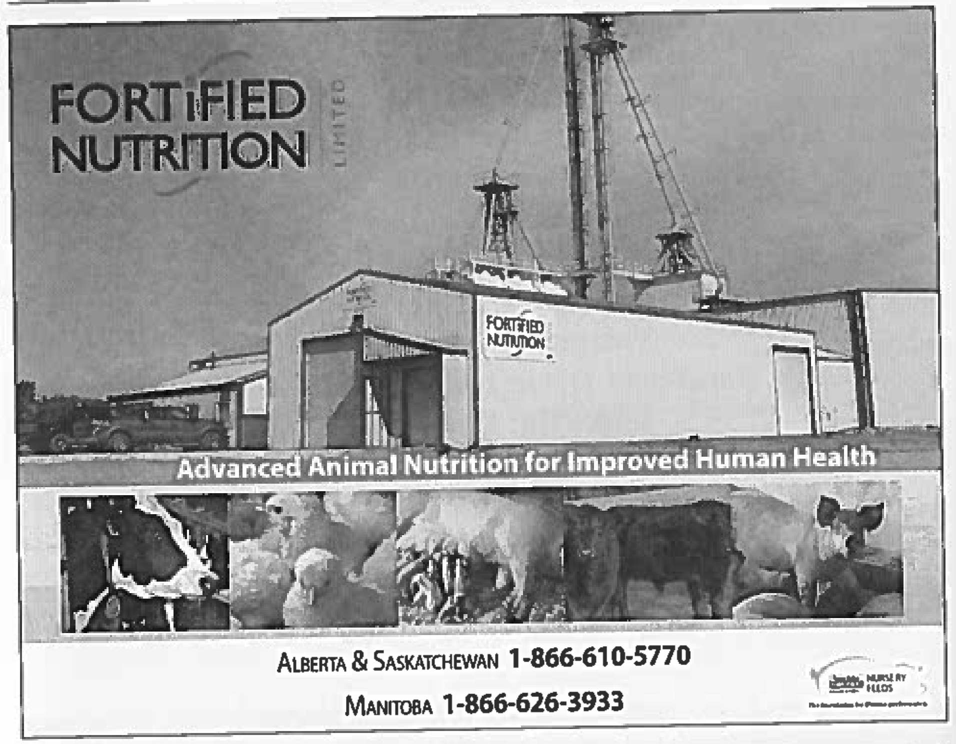

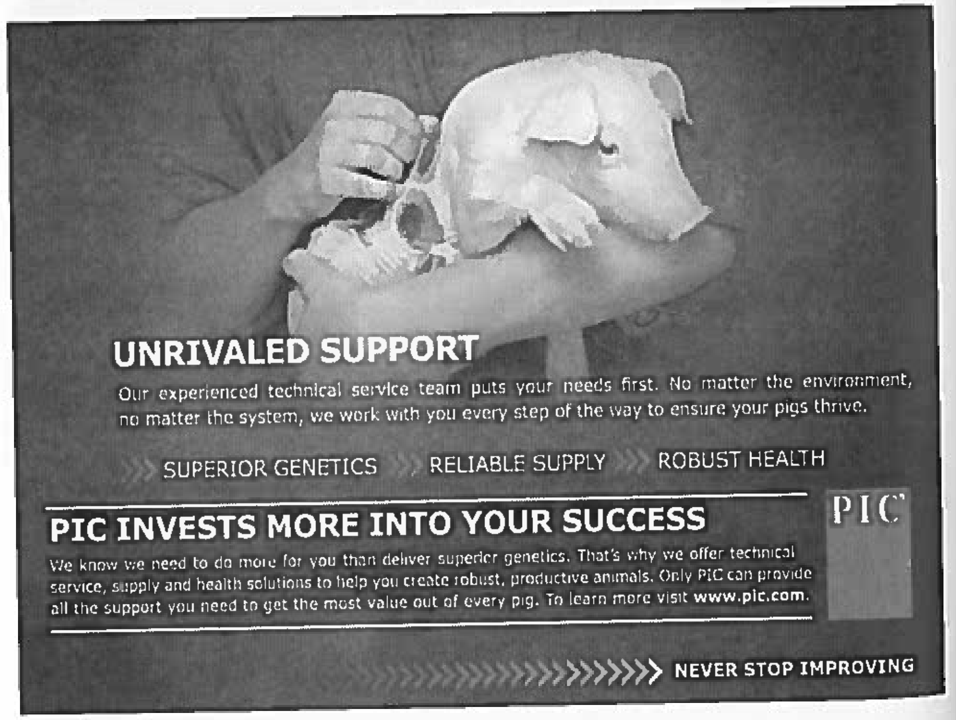

SWINE AI NOW AND IN THE FUTURE: OPPORTUNITIES TO REDUCE THE NUMBER OF BOARS NEEDED FOR BREEDING AND INCREASE THE ACCESS TO SUPERIOR GENETICS

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Introduction

Swine Artificial Insemination (AI) in North America took off in the early 1990s. From a 4% AI rate, the use increased to 95% within 15 years. The introduction of AI in the swine industry reduced the number of boars necessary to breed the sows present with a factor 7. This step had a huge impact on the average genetic index of the boars used for breeding.

Many procedures used in the North American Swine AI were copied from Europe, where AI was established in piglet production since the 1960s and then adjusted to fit the North American situation. Since the 1990s, a few new technologies were introduced in Swine AI in North America. The use of automated packing machines and Computer Assisted Semen Analysis made the volume and quality of insemination doses more consistent, however did not lead to a significant reduction of no. sperm cells per dose as it did in Europe. The approach in North American AI is to avoid risks in fertility results and produce doses at low cost. Reducing the number of cells in the current system will increase risk of fertility loss. The use of Post Cervical AI is a relative new technology that has the potential to reduce the number of cells per dose without the risk of reducing fertility results. Spanish sow producers embraced this technology in order to reduce costs, however in North America it is mainly used to reduce labor and assure the deposition of semen in the uterus, not so much to reduce the cost per dose. Another development in pig production is implementation of genomic selection. This increases the speed of genetic improvement and the accuracy of the breeding value estimation. At the same time breeding companies increase the replacement rates at boar studs to make the better genetics quicker available in the industry. More producers could take advantage of that genetic improvement if the number of doses produced by high indexed boars would increase. It could even be beneficial to lose some fertility but still be more profitable using these high indexed boars for example a reduction of the days until slaughter because of a higher daily gain. In a boar population not all boars have these high indexes and the more boars needed for breeding, the lower the average genetic index. The industry would profit a great deal from reducing the number of boars needed for breeding.

This presentation will focus on opportunities to increase the impact of high indexed boars in the current swine industry through AI.

Economics of efficient boar use

The use of fewer boars to breed sows only gives a slight reduction of cost per insemination dose. Reason is that in order to select boars for AI purposes and to limit the inbreeding percentage, enough genetic variation must be available and minimum population sizes are required. Fewer boars will be selected from these populations and the production cost per AI boar will therefore increase. However, for the same sow population, less insemination doses will be necessary to cover the breeding. In Table 1, a comparison between 4 European countries with the same number of sows as in the USA is shown and compared with Canada as well. Main differences between the European countries and the USA and Canada are: Fewer inseminations per heat cycle (mating) and a lower number of sperm cells per insemination dose.

In the column to the right (Table 1) the comparison is made with a highly efficient system using new technologies such as ovulation synchronization and Post Cervical AI. This can be seen as the opportunity available in the industry to reduce the number of breeding (AI) boars. Although more efficient use of boars will lead to a small reduction in cost per dose and a reduction in the cost per mating, the highest economic benefit will be caused by the increase of the average genetic index of AI boars in the boar studs, which will benefit the producers. Pigs with higher growth rate and better carcass quality will be the result. The economic value of the increase of the average genetic index with 10 points is between $2.00 and $2.50 per slaughter pig. For the US industry that is an additional 150 Million USD, for Canada 34 Million USD annually or 25 USD per sow.

Table 1: Comparing use of boars in different pig producing regions and with the use of new technologies

Country	NL-DK-GER-FRAN	USA	Canada	With new technologies
No. sows	6,000,000	6,000,000	1,300,000	6,000,000
Sow farrowing index	2.48	2.48	2.48	2.48
Inseminations per heat cycle	1.80	2.20	2.00	1.20
Min. total cells/dose (B)	2.00	3.00	3.00	1.00
No. sperm cells ejaculated/week (B)	110	110	110	110
Annual no. doses/boar	2,860	1,907	1,907	5,720
No. doses needed to breed sows	26,784,000	32,736,000	6,448,000	17,856,000
No. boars to breed all sows	9,365	17,169	3,382	3,122
No. boars to breed all sows if highest efficiency	3,122	3,122	676	3,122
No. sows/boar	641	349	384	1922
Boar use relative to European countries		54.5%	60.0%	
Boar use relative to new technology	33.3%	18.2%	20.0%	

*NL=Netherlands; DK=Denmark; GER=Germany; FRAN=France; * Using ovulation synchronization; ** Using Post Cervical AI*

Opportunities to reduce the number of boars needed for breeding at the boar stud

Increase doses output per boar per year

There are several approaches one can think of to increase the doses output per boar per year in boar studs:

1. Reduce the trash rate of ejaculates:

   Trash reasons for ejaculates are mainly due to an increased percentage of abnormal cells, reduced sperm cell motility or a reduced sperm cell survival (shelf life).

   - *Sperm quality* is influenced by factors such as age of the boar, health, vaccinations, treatments, housing conditions, feed quality, ambient temperature or genetic line. Heat stress and fever are well-known factors causing a reduction in sperm quality. Recently (Flowers ea, 1997, 2006, 2008, 2015; Almeida ea, 2009) research was presented that clearly showed "environmental" conditions of boars during gestation, their birth weight, the conditions during the first 3-4 weeks after birth and conditions during puberty affect sperm cell production and sperm quality in the mature boar. Socialization with caretakers had an effect on libido and sperm production as well. An effect of genetic improvements over the years showed that compared to 25-30 years ago, the upper threshold for ambient temperature under which boars produced normal quality semen reduced from 83°F/ to 73°F (Parrish ea, 2015)

   - *Sperm cell survival* is affected by factors such as cold shock (during collection or processing), bacterial contamination, UV-light damage and incorrect transport or storage temperatures. Following proper procedures and the control of these aspects in day to day semen production is important to increase sperm cell survival.

In order to reduce trash rates, boar studs should invest in the quality of housing conditions of boars, temperature/climate control, hygienic collection and processing of semen, proper laboratory design, cleaning and sterilization protocols and controlled semen shipping conditions. This may be more of a challenge in some countries than in others. Hardly any attention has been paid to pre-natal conditions and rearing conditions of boars. This is for sure an opportunity to not only improve the sperm cell output, but the quality as well.

2. Increase of the sperm cell output:

Sperm quantity (output) is influenced by the pre-, peri- and post-natal conditions, the birth weight, the growth and development (rearing conditions), the age of the boar (Figure 1), feed quality and quantity and health status.

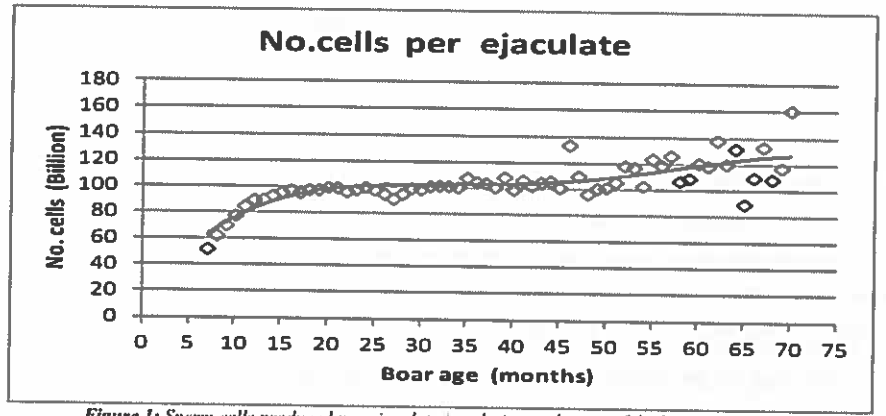

Figure 1: Sperm cells produced per ejaculate in relation to the age of the boars (in months)

Opportunities to increase sperm cell production (spermatogenesis) in the adult boar are, for example, selecting heavier boars at birth (Almeida ea, 2013; Dysart ea, 2015) , selecting boars for increased testis size (Huang and Johnson, 1996), or strategic cross-fostering so boars are reared in litters of ≤6 piglets (Griffin, 2006). Better boar stud management, for example, prevention of heat stress, will prevent germ cell death and indirectly improve the (sound) sperm cell output. Furthermore semen traits are heritable. Using genetic selection is an option to increase sperm output and to improve sperm quality. Table 2 shows the heritability for semen traits as published by several authors. Of course selection for semen traits will decrease the selection intensity in other economic traits, so if implemented it needs to be well balanced.

Table 2: Heritability of boar semen traits from publications

Semen trait	1	2	3	4	5	6	7	8	9	10	11
No. cells	0.44	0.42	0.25	0.22	0.62	0.26	0.16	0.10	0.63		
Motility		0.38	0.05	0.13		0.38	0.54	0.08			0.17
Morphology		0.34				0.59	0.74		0.60		
Volume	0.44	0.58	0.18	0.14	0.51	0.53	0.57	0.20	0.47	0.25	
Concentration	0.09	0.49	0.25	0.26	0.57	0.40	0.37	0.18	0.64	0.23	
No. doses/boar	0.46	0.40									

1. Oh, 2003; 2. Smital ea, 2005; 3. Brandt, 1998; 4. Grandjot, 1998; 5. Grandjot ea, 1997, 6. Huang, 1996; 7. Johnson, 1996; 8. Wolf ea, 2010; 9. Kudel, 1992; 10. Flakenberg ca, 1988; 11. Rotschild and Bidanel, 1998

Figure 2 shows the (normal) distribution of boars over sperm output classes (cells per ejaculate in Billions). Assuming genetic selection on sperm cell output can eliminate boars with a production of less than 40 Billion cells per ejaculate and increase the average production per ejaculate with 30 Billion cells per ejaculate, the boars necessary to produce the required doses will decrease with ±30%, which will lead to an increase of the average genetic index in the boar population.

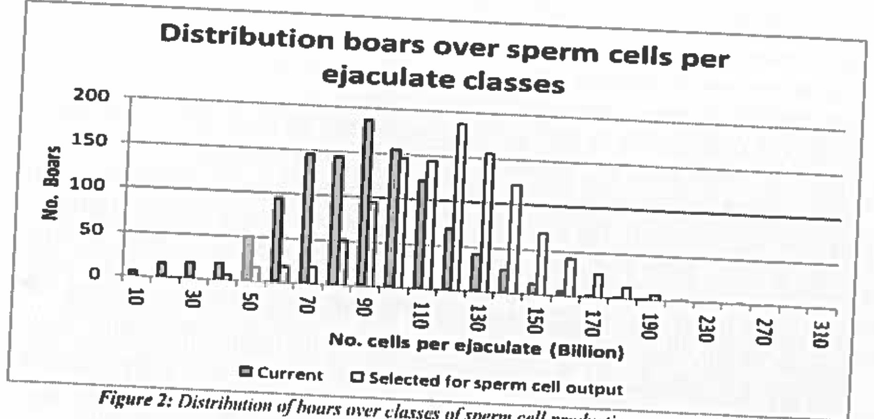

Figure 2: Distribution of boars over classes of sperm cell production per ejaculate

Figure 3 shows the differences in sperm output for several genetic lines at a boar stud.

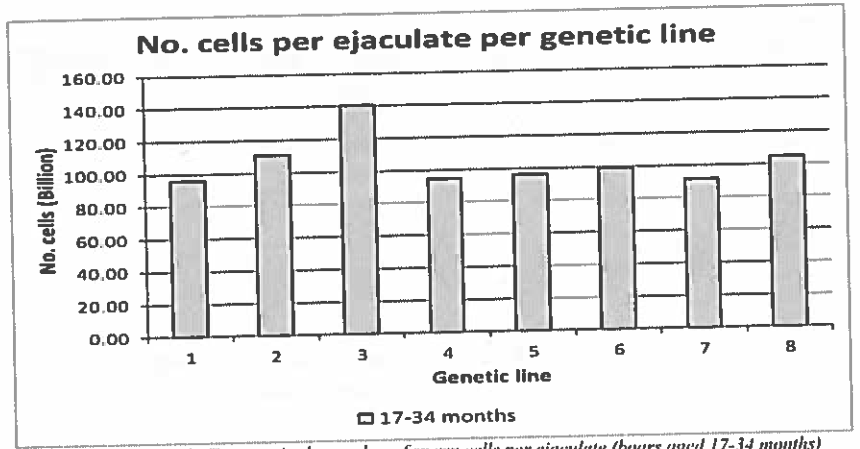

Figure 3: Differences in the number of sperm cells per ejaculate (boars aged 17-34 months) between genetic lines.

3. <u>Reduction of number of cells per dose:</u>

Yet another approach to make more efficient use of boars is to reduce the number of cells per dose. A question often asked is: "How low can you go?" This is not an easy question to answer because there are many factors determining the minimal number of cells leading to optimal fertilisation. Not all these factors are under the control of a boar stud. The quality of heat detection and timing of the insemination relative to ovulation play an even more important role. Besides the number of sperm cells, the insemination volume determines the fertilization result as well. Some published information and field experience show that the minimum volume for traditional, intra cervical AI (ICAI) is 50 ml and for Post Cervical AI (PCAI) this is approximately 40 ml. The thresholds for minimal number of cells vary more globally. The threshold for minimum number of sperm cells per dose is determined by the control a boar stud has over the production quality and the amount of variation. The better the control and the lower the variation, the more the number of cells per dose can be reduced. Another important part of the equation is determined by the quality of the breeding and the insemination technique used at the sow farm (see paragraph 4: Opportunities to reduce the number of boars needed for breeding at sow farm).

Rule of thumb for a PCAI dose seems to be that it should contain at least 50% of the number of cells of a traditional dose and the volume should be at least 40 ml.

4. <u>Identify sub-fertile boars:</u>

Pooled semen is widely used in the North American pig industry. The idea is that by pooling semen, semen from sub-fertile boars will be compensated by other semen. However I believe that in reality there is hardly compensation, but masking of sub-fertility instead. Using sub-fertile boars will have an effect on the fertility result whether you use single sire or pooled semen; it only is less visible in pooled semen. In order to indentify sub-fertile boars, the use of single sire

inseminations is required. It may even be required to reduce the number of sperm cells per dose to make sub-fertility in a boar visible. Some causes of sub-fertility are: poor semen motility, a high percentage of abnormal cells, sperm cell membrane or acrosome damage, fragmentation of DNA or more intrinsic causes such as reciprocal translocation (RT). In the boar stud the sperm motility and morphology are evaluated on a routine base, however the membrane damage, DNA integrity or reciprocal translocation are not routinely evaluated. Some breeding companies have all AI boars tested for RT, others test the nucleus boars. Although the prevalence of sub-fertile boars is estimated at only 1-2% in a population, they can have a big impact on the profitability. An economic calculation for a RT prevalence of 0.5% in a boar stud showed that this costs about $ 1,000 per boar present in the stud on reduced fertility results.

Using low quality ejaculates and sub-fertile boars reduces production efficiency and lowers profit margins for the producer (Foxcroft ea, 2008). When using single sire inseminations and analyzing the farrowing rate and litter sizes using sow records, it is easy to identify sub-fertile boars. Figure 4 shows the conception rate and total number born per boar in a population where single sire insemination was used (raw data). It is interesting to see that there is quite a bit of variation and that you can identify the main population with variation and sub-fertile boars as well.

In different analyses (Feitsma, 2007; Broekhuijse ea, 2011, 2012) it was shown that in general the variation in farm fertility is mainly caused by other factors than the service sire or in the case of AI the semen dose, such as genetic line, the rearing of the sow and the farm of the sow. The service sire effect is relatively small and differs between populations, unless of course the semen dose is of sub-standard quality. In the Dutch population referred to in Broekhuijse's publication, the service sire effect was approximately 6%. Dissecting the service sire effect in underlying factors, the contribution to the variation in fertility caused by service sire effect was mainly by the genetic line of the boar (±20%) or the individual boar (only to be distinguished using CASA, ± 30%). Interestingly the introduction of Computer Assisted Semen Analysis (CASA) systems at the Dutch AI centers increased the contribution of semen quality as part of the service sire effect from 4% to 9-10%. Furthermore the introduction of CASA eliminated the boar stud and lab technician contribution to the service sire effect, illustrating indeed that semen evaluation with CASA is more objective than microscopic semen evaluation (see Table 3).

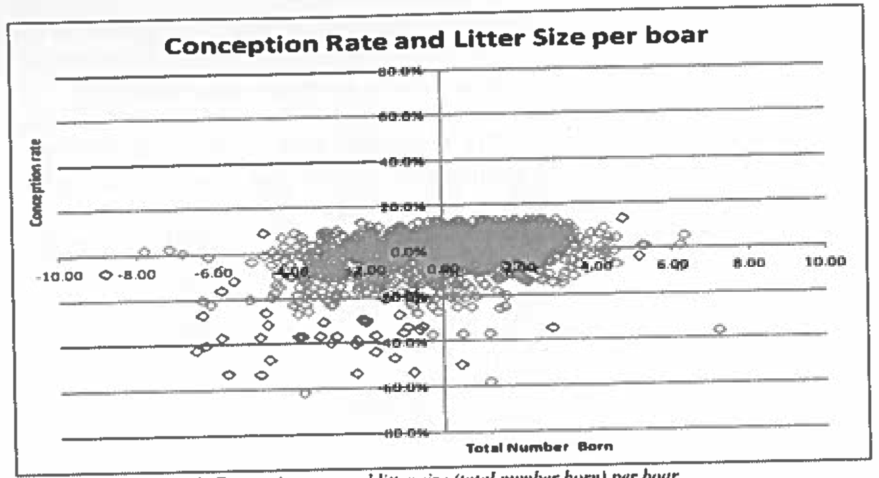

Figure 4: Conception rate and litter size (total number born) per boar

Table 3: Boar (service sire) related sources of variation and their effect on farrowing rate (FR) and total number of piglets born (TNB) comparing this relation before and after the introduction of Computer Assisted Semen Analysis (CASA).

	Microscope (1998-2006)		CASA (2006-2009)	
	FR	TNB	FR	TNB
No. Sows	165,000		33,765	
No. Boars	7,429		2,367	
No. Ejaculates	110,186		45,532	
Service sire effect	5.90%	6.60%	5.30%	5.90%
Individual boar	ns	ns	29%	31%
Genetic line boar	21%	28%	22%	18%
Age boar	3%	8%	0.3%	ns
Ejaculation interval	1%	ns	ns	ns
No. sperm cells/ejaculate	ns	1%	ns	ns
No. sperm cells/dose	ns	ns	ns	ns
Year	9%	13%	ns	ns
Month	11%	5%	ns	ns
Boar stud	7%	7%	ns	ns
Lab technician	11%	ns	ns	ns
% Motile cells	4%	4%	ns	10%
% Progressive Motile cells	ns	ns	9%	ns
Residual	33%	34%	40%	41%

ns: non significant

The contribution of motility and progressive motility as a source of variation was highly significant although the effect was small. Interesting as well was that whereas sperm cell motility explained variation in litter size and not in farrowing rate, progressive motility explained variation in farrowing rate, but not in litter size. In Europe most boar studs use both motility and progressive motility as semen quality evaluation parameters whereas in North America progressive motility is hardly used as such.

In a program developed by the University of Alberta, sub-fertile boars are identified by using 50 single sire matings with a reduced number of sperm cells per dose (2 instead of 3 Billion) at which level it is more likely to find differences in fertility (Foxcroft ea, 2010; Dyck ea, 2012). Although many new (flow cytometric) *in vitro* assays have been described that may have the potential to identify sub fertile boars, these are not used in routine semen quality evaluation. The sperm chromatin structure assay quantifying DNA fragmentation seems an assay that can be used to identify potential sub fertile boars, as well as the membrane integrity and sperm membrane fluidity test. These assays are performed at more sophisticated laboratories and require expensive equipment and highly trained staff and are quite elaborate. Furthermore it is hard to interpret the test results in relation to fertility results. Field validation for these tests needs to be done before boar studs can use these assays to screen boars for fertilizing ability.

Opportunities to increase shelf life in semen transport and storage

Insemination doses age over time and the fertility results will drop when the semen dose is older than 3-4 days. Semen extenders are used to preserve the sperm cells in a dose as good as possible. Some extenders show better *in vitro* preservation capacity than others and therefore typically a longer preservation time is indicated on the label. Suppliers claim having components in the extenders which protect sperm cell membranes against cold shock and temperature fluctuations. So far hardly any field trials have been published to support commercial claims for longer shelf life or cell protection. This is probably because that would require a large number of inseminations, split ejaculate approaches and synchronization of antibiotics in the extenders to make a fair comparison. But the expectation is that field data will be published this year. The newest extenders would be able to protect sperm cell membranes against temperatures lower than 15°C which is typically the temperature where membranes get damaged. It would even make it feasible to store the semen at 5°C, refrigerator temperature, which would have an inhibiting effect on bacterial growth. As a consequence semen doses could then be produced without added antibiotics. At the same time cold chain techniques already available could be used for transportation which would give better control over the transport temperature than the current methods. The same counts for storage temperatures at the farm. Refrigerators are facing fewer problems than storage cabinets that have to be able to cool and heat depending on environmental temperatures. Refrigerators are standard equipment and large storage refrigerators are widely available.

These new developments are very promising and a new concept in AI. It could clearly improve the shelf life and assure less bacterial growth in semen doses without extensive use of antimicrobials. Longer shelf life will reduce the total number of doses needed to be produced currently.

Opportunities to reduce the number of boars needed for breeding at the sow farm

In the beginning days of pig AI, special trained technicians were able to obtain high fertility results with only 1.2 inseminations per heat cycle, illustrating that good heat detection and timing are the key to reproductive success. Nowadays the number of inseminations per heat cycle varies from 1.7 to 2.5.

Many factors affect the breeding outcome on farm level. Whereas the service sire has a limited contribution to that variation (5-6%), the farm, the genetic line of the sow, the rearing of the sow and the year and season contribute for approximately 40% to the variation in fertility (Feitsma, 2007; Broekhuijse ea, 2011, 2012). The body condition of sows, accurate identification of heat, correct timing of insemination relative to ovulation and the quality of the insemination itself all contribute to farm effect. It is interesting to know that the genetic line of the sow only seems to contribute 10% to the variation in fertility and that the farm effect and rearing effect each contribute 10% as well. If the farm effect can be reduced by improving the body condition of sows and the heat detection and breeding skills from technicians, this will reduce the contribution of farm effect and enhance the contribution of genetics to the fertility results. The analysis showed at the same time how important proper rearing of the next generation of breeding animals is. Special rearing programs for breeding gilts pay off, since their lifelong piglet production will be higher than gilts that were raised as finishers and then selected for breeding purposes.

Looking at the breeding procedures in North American sow farms, there are still clear opportunities to achieve a significant reduction in number of boars needed for breeding. This can be achieved by:

1. <u>Reducing the variation in weaning to estrus interval (WEI)</u>

   In most farms, 90-95% of the sows come into heat 4-5 days after weaning. Sows that have lost too much weight during lactation need some more time to recover and typically come into heat at 6-7 days after weaning. A good body condition, depending on the feed regimen, feed quality and the management of lactating and weaned sows is essential for a short WEI. The WEI has changed over the years due to genetic selection for this trait as well. Sows have been selected for better milk production and higher feed efficiency and in general lose less weight. However the increasing litter size is a remaining challenge. Cross fostering strategies can help to balance this in the sow herd. Less variation in WEI means that there is more consistency in estrus duration and thus in moment of ovulation. It will improve the accuracy in timing of the insemination resulting higher farrowing rates and litter sizes.

2. <u>Reducing the number of inseminations per heat cycle by improving heat detection</u>

   The oestrus period can last 1-3 days with ovulation often occurring late on the second day of 'standing heat' (sows at 70% gilts at 80% of estrus duration). Over the years it has become increasingly more difficult to attract experienced staff with an agricultural back ground. Therefore training people to develop the skills needed for farm work is getting more and more important. I have seen the instruction "Breed when the sow stand for the boar" misinterpreted by staff as when the sow stood still for 5 seconds, that was according to the staff the indication that the sow needed to be bred. Training new staff should be a priority on the managers list and needs to be done by an experienced employee/trainer that takes the time to train a new staff member and demonstrates the tasks expected from the trainee. Because of high turnover of farm staff, the training time and quality has been eroded in many cases, which leads to staff misinterpreting protocols leading to poorer fertility results. Typically the lack of proper training is then compensated by using more inseminations per cycle to at least make sure the sow is "covered". In many large systems the given task is to breed every female a minimum of 2 times during the heat cycle. If she still shows a standing reflex 24 hours after that, than a third insemination is required. This particular strategy may get the sows pregnant, but in fact will reduce the fertility results (Nissen ea, 1997; Gotszling ea, 1997; Soede ea, 2005).

   Starting breeding too early in the heat cycle leads to lower farrowing rates. Breeding after ovulation will reduce litter sizes. Accurately identifying the start of first standing heat is essential for good timing and successful insemination.

<u>Heat detection improvement opportunities:</u>

- Heat check twice a day instead of once
- Heat check without the boar first followed by heat check with a boar (you can breed the animals while checking with the boar in this situation)
- Check for some or all of these pre-estrus signs (too early to breed):
  - Back end: swollen, red vulva (more notable in gilts than sows),
  - Watery discharge from vulva, clitoris flat and pale pink, becoming more prominent
  - Activity: restless, climb up gates and walls, mount other females (if in groups) but do not stand themselves, increasing interest in the boar
  - Sounds: high-pitched whining
- Look for signs of being in standing heat (estrus). It is time to breed, but time well (see below). Check for some or all of these signs:
  - Back end: vulva appears normal (swelling and redness subsides), sticky discharge from vulva (mucous), clitoris red and protruding, tail upright whilst standing and flicks up and down
  - Activity: poor appetite, pricked ears, stand with arched back, glazed eyes, trembling, attracted to stockperson, seek boar contact (if allowed), stand rigid if mounted or when technician uses back pressure test or if sows see, smell or hear the boar
  - Sounds: very vocal with repeated grunts or long growls
- Develop a recording system on the sow, on your list and/or on the sow card that helps you find the right time to breed
- See figure 5 for external and internal signs of estrus on the vulva

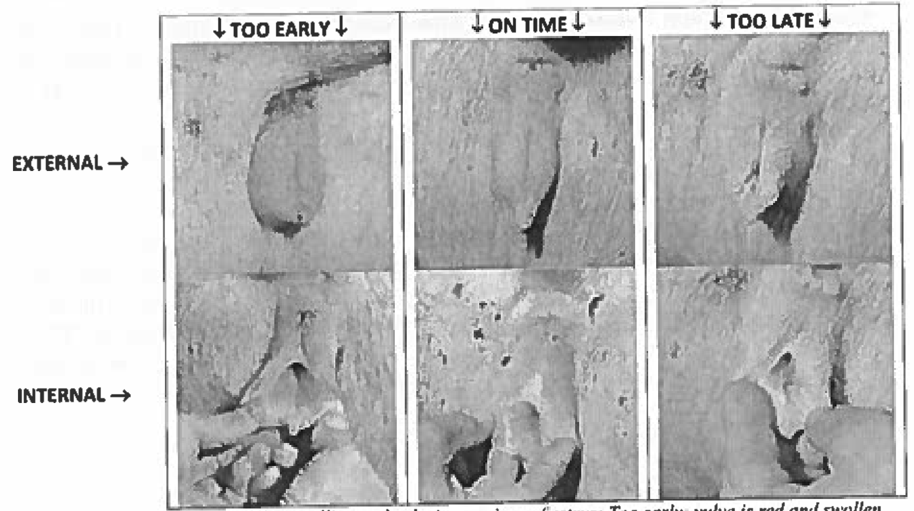

Figure 5: Vulva swelling and coloring as signs of estrus: Too early: vulva is red and swollen, vagina walls are reddish. On time: vulva is elongated and paler, vagina walls are pale. Too late: the vulva shrunk and is pale. The vagina walls are pale and dry.

3. Improving the timing of insemination

There are a few facts that can make the timing of insemination easier. Estrus duration is highly repeatable within a farm but varies between farms (Weitze ea, 1994; Steverink ea, 1999). Although there is variation in oestrus duration, ovulation takes place at approximately 70% of the total estrus duration (80% in gilts). Most breeding staff mark the beginning of estrus but not the end of estrus. Recording the total estrus duration (full period where a sow shows a standing reflex for the boar) for 2 weeks will give insight in the estrus duration on the farm and enables to estimate the time of ovulation. Insemination 24-12 hours before until 4 hours after ovulation gives the best fertility results whereas breeding longer than 24 hours before ovulation will reduce the farrowing rate and breeding more than 4 hours after ovulation will reduce the litter size (Nissen ea, 1997; Gotszling ea, 1997; Soede ea, 2005). This is one of the reasons that just "covering" the whole heat period with insemination doses is a bad idea.

Improved timing of the insemination relative to ovulation opportunities:

- Heat check twice a day
- Two breeding periods a day
- Sows early in heat will have a relative long estrus duration:
  - Stands for the boar on day 4-5, wait 24 hours and if she stands for the technician at day 5-6, breed the sow
  - Still a standing reflex for the technician after 24 hours: breed again

- Sows late in heat will have a relative short estrus duration
  - Stands for the boar on day 6-7, wait 8-16 hours and if she stands for the technician at that time, breed the sow
  - Still a standing reflex for the technician after 24 hours: breed again
- Gilts have a shorter estrus duration and the ovulation is at 80% of the estrus duration. Breeding earlier after the start of standing heat is therefore required.
- Standing heat is when the sow develops a standing reflex. She gets rigid and cannot be moved when pushing her. The sow will "pop" her ears up and backwards. A sow that is at the peak of estrus will get easy in a standing reflex or "lock" while the technician applies pressure on the back. A sow that is in pre-estrus or post-ovulation will not get into a "lock" for the technician, but may lock for the boar. If no heat check is done without the boar, these animals would be bred. Having a heat check without the boar would show that the technician couldn't stimulate the sow into standing heat and therefore it is too late to breed.

New developments

An interesting development is the automation of heat detection. Recently a system has been put on the market where the activity patterns of sows are recorded and sows with deviating patterns are listed for visual inspection. The activities are observed by infrared probes installed on top of the crates of sows in the breeding room/area. Commercial claim is that it can improve the fertility results on farm level, however with how much and if it works on farms with good results is not clear yet. But in a time where it is getting more difficult to find skilled staff, this kind of automation may be a welcome solution. In Europe where group housing of sows is mandatory, sows wear ear tags with chips that identify sows that are visiting the area where the boar is housed. They make contact through a "peep" hole in the wall and every time they visit, this is automatically recorded. These sows will be separated from the herd when they visit the automated feeding station and can then be inspected for heat signs. This works especially good for sows that return back to heat while in the group. Sows that are housed in the breeding area can approach the boar as well in some systems, but not in all systems. Automated heat detection has the potential to improve the accuracy of heat detection, estimate the ovulation better and therefore reduce the number of inseminations per cycle.

Another recent development is the synchronization of ovulation (Bishop ea, 2014). Only 1 insemination is necessary at a fixed time after treatment (Single Fixed Time AI). Results of ovulation synchronization programs show that the percentage weaned sows that is actually bred and become pregnant is higher, whereas the litter size is somewhat lower. With ovulation synchronization all sows are bred, whether they show signs of heat or not. Without treatment some sows will not show heat and will thus not be bred. As a result of a synchronization program, the number of piglets per sow present in the herd will increase. Another advantage of the ovulation synchronization is that the farrowing will be more synchronized as well.

Yet another rather new development is the use of Post Cervical AI (PCAI). With traditional AI (intra cervical), the semen is deposited halfway the cervix of the sow. With PCAI however, the semen is directly deposited in the uterine body, less semen is lost by backflow and the volume and number of cells can therefore be reduced. Another advantage of PCAI is that deposition of the semen in the uterus is assured. With PCAI labor can be saved because the uptake of semen is much quicker. The uterine body is expandable and can thus take up the semen quickly, whereas when deposited in the cervix, uterine contractions have to draw the semen into the uterine body.

There are many different PCAI catheters commercially available. A flexible inner catheter will most likely cause fewer injuries than the more rigid ones, whereas less semen is left back in an inner catheter with a smaller diameter than the ones with a wider diameter. Thickness of the inner catheter's wall determines how easy a kink in the catheter may occur. PCAI in gilts is possible, however the efficacy is depending on catheter and protocol followed. Whereas PCAI in Europe is typically used to be able to reduce the number of sperm cells and have better access to higher indexed boars, in North America the main argument to use this technique is that it safes breeding labor.

Conclusion

There are plenty of opportunities available to reduce the number of inseminations per heat cycle and the number of cells per dose. At the same time the sperm output per boar can be improved by managing the boars and the semen collection and processing professionally. Some systems in North America have chosen to use these opportunities. They pay extra for high indexed boars, have them screened for fertility by performing single sire insemination until the boar is evaluated for fertility. Then the PCAI technique is used to reduce the number of cells per dose and make even more use of the high indexed fertile boars.

In general this will require investment in people, people's skills, boar housing, hygienic conditions in AI laboratories and improving heat detection and timing of insemination on farm level. As a consequence high quality insemination doses will cost more in the future, however that will easily be compensated with the added value per dose and it will benefit the profitability of the industry.

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BATCH FARROWING

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Introduction

Batch Farrowing (BF) is a production practice that allows you to concentrate the farrowings on your farm, which can be helpful in weaning more pigs over a shorter period of time, offer health benefits to your herd and can improve efficiencies at multiple levels. This presentation will evaluate factors to review if BF is right for your production system, the steps and protocols necessary for implementation, and cost factors to consider.

Summary

Batch Farrowing (BF) is a production tool to concentrate the farrowings in specific weeks. It is important to understand the motivations, reasons and implications of adopting this approach. BF can optimize all-in all-out pig flow, and research and production experience has shown that all-in all-out flows can lead to improvements in both health and productivity.

Some of the advantages of BF are:

- better control of the effect of certain pathogens in farrowing, nursery and finisher;
- less medication cost in the wean-to-finish period with the potential of improved daily gain and feed conversion while reduced mortalities in the grow & finish stages; and
- improvements on the efficiency of facility utilization and animal / semen transport.

It is important to review all the potential challenges and variables to have the proper implementation (length of the batch, synthetic progestogen usage in gilts and sows), understanding the facility limits / bottlenecks and particularities of each system.

Some of the disadvantages of batch farrowing are:

- less-flexible breeding targets,
- the management of fall behind piglets, and
- staff difficulties of implementation and execution.