COMMERCIAL EVALUATION OF LACTATIONAL OESTRUS

(1A-112)

Report prepared for the
Co-operative Research Centre for High Integrity Australian Pork

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Executive Summary

Alternative management of sows and piglets in conventional farrowing accommodation in order to uncouple mating from the weaning process has been investigated over recent years in Australia. The main rationale behind this research was to try and improve the weaning process for the piglet without compromising sow productivity. Simply extending weaning age or using techniques such as gradual weaning through intermittent suckling can help piglets better adapt to the weaning process and result in a decrease in the incidence and/or severity of the post wean growth check. However, extending weaning age will decrease the number of litters per sow per year and gradual weaning will result in some sows cycling whist they still lactate, leading to an increase in sow non-productive days, if sows are not mated in lactation. In order to improve the piglet weaning experience but also maintain sow production, mating sows whilst they are still lactating may be a viable option.

This study used criteria developed through various Pork CRC HIAP supported trials to investigate the production outcomes of a lactational oestrus induction protocol (intermittent suckling and boar exposure) employed for a full 12 month period. Outcomes in terms of subsequent reproduction between sows that responded to the induction protocol (mated during lactation) and those that didn't (mated after weaning) were compared. Additionally, the lactational oestrus induction protocol was compared to a convention mating protocol that was run in the previous 12 months at the same site.

Overall, 40% of sows responded to the lactational oestrus induction protocol and were therefore mated in lactation. Production outcomes assessed over the entire year between sows that were mated during lactation (responders) and those mated after weaning (non-responders) resulted in a significantly lower farrowing rate for those sows mated in lactation compared to those mated after weaning (78 vs 88%, respectively). Born alive was also numerically lower for those sows mated in lactation compared to those mated after weaning however the difference was not significant. Season also had an effect with the number of sows which responded to the induction protocol, with the proportion of responders decreasing during the summer period. In addition, sows which were mated whilst lactating during the summer had lower farrowing rates and subsequent born alive compared to both responder sows mated during winter, spring and autumn and non-responder sows mated in summer and winter, spring and autumn.

Sows from the lactational oestrus induction protocol weaned less piglets over the year compared to sows from the conventional mating protocol (23 vs. 22.4, respectively). This was more than likely due to the poorer performance of sows over the summer in LO protocol. Sows from the lactation oestrus protocol mated outside the summer period performed comparatively to those mated in the conventional system.

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1. Introduction

The development and implementation of a mating in lactation protocol (in order to uncouple mating from the weaning process to facilitate more flexible management of sows and piglets (such as increased weaning age and/or gradual weaning of piglets without an increase in sow non-productive days (NPD) has been a strong focus for the Co-operative Research Centre for High Integrity Australian Pork (Pork CRC HIAP). Extending weaning age or gradual weaning of piglets (through intermittent suckling (IS) may allow piglets to better cope with the weaning process and help mitigate the frequently observed post wean growth check.

However, extending lactation lengths in order to increase piglet weaning age will have the undesirable effect of decreasing the number of litters weaned per sow per year. Additionally, as lactation length is extended the incidence of sows having a spontaneous lactational oestrus can be as high as 15% (Downing et al., 2012). Spontaneous lactational oestrus can also reduce the number of litters weaned per sow per year as NPD increases due to an extended wean to remate interval. However, if these sows can be mated whilst they are still lactating, piglets can be weaned at an older age without an increase in sow NPD. Alternatively, gradual weaning of piglets through IS (coupled with an older weaning age, i.e. >25 days) will decrease the suckling pressure exerted on the sow, reducing the inhibition of luteinising hormone release thereby potentially triggering lactational oestrus in a higher proportion of sows than just extended lactation length alone. The added benefit of IS is that the sow is removed as a potential feed source for the piglets and this can encourage them to explore provided solid feeds such as creep feed and result in potentially more piglets actually consuming the creep rather than just ‘playing’ with it. Consumption of creep feed helps to encourage quicker and better adaptation to the weaning process and reduce or eliminate the post wean growth check.

Besides the benefit to a piglet’s ability to adapt readily after the weaning process or simply allowing them to be weaned at an older age with no loss of production from the sow, mating sows during lactation can also reduce the overall time a sow is confined. Sows mated during lactation can essentially be moved directly to their gestation accommodation (which in most production systems in Australia is group housing) eliminating the need for these sows to be housed in mating stalls post-weaning. This can be beneficial in systems where the reduction in sow confinement is a goal.

To date the majority of studies undertaken under the Pork CRC HIAP's Program 1A (Mating and Lactation Innovations*)* have looked at protocols that stimulate oestrus during lactation in conventional farrowing house systems where sows are housed in farrowing crates (Downing *et al.*, 2013 & 2015, Langendijk *et al.*, 2015 and van Wettere *et al.*, 2013 & 2015). The minimum criteria to stimulate oestrus in lactation in at least 85% of sows (that does not negatively affect sow and/or piglet welfare) has been determined, these include:

1) Oestrus stimulation should not commence before day 18 of lactation.
2) Some degree of piglet separation for about 7 days, for at least 8 hours per day.
3) Intense boar stimulation (nose to nose) is required for at least 4 days.

Based on these criteria, this project was developed to assess the implementation of a lactational oestrus stimulation protocol (LO stimulation protocol) in a commercial pig production system over a 12 month period. Unlike previous studies this experiment assessed reproductive outcomes across all seasons (including summer where a reduction in sow fertility is common) and across sows who may be subjected to the induction protocol multiple times throughout the year.

The overall aims of the project were to assess production outcomes of sows mated during lactation compared to those mated after weaning and a comparison of the LO stimulation protocol as a whole with the 'conventional' protocol outcomes achieved on the same farm in the 12 months prior to the implementation of the LO stimulation protocol.

2. Methodology

2.1 Animals and housing

This experiment was conducted between August 2015 and July 2016 in the farrowing house unit of a commercial piggery located in central Victoria, Australia. All animal procedures were conducted with prior institutional ethical approval in accordance with the National Health and Medical Research

Council/Commonwealth Scientific and Industrial Research Organisation/Australian Animal Commission *Code of Practice for the Care and Use of Animals for Scientific Purposes (internal protocol number 15R029C).*

The farrowing unit in which the sows (PrimeGro™ Landrace Genetics, Corowa, NSW) were housed consisted of 48 conventional farrowing crates (1.67m wide x 2.25m long). The shed was naturally ventilated with blinds that were automatically adjusted according to ambient temperature. The farrowing shed also had automatic thermo controlled fans and spray coolers. The farrowing crates contained a creep area using a mat below an overhead heat lamp. After farrowing sows were provided with 3kg of commercial lactation feed (14.8 MJ DE/kg and 16.2% crude protein) in the morning and up to 3 kg in the afternoon (if sow had eaten all of morning feed). By day 4 of lactation, sows were provided with *ad libitum* feed until weaning. Piglets were provided with creep feed from day 10 of lactation up until approximately 1 week post weaning.

2.2 Conventional mating protocol – 2014/2015 production records

At weaning (approximately 28 days after farrowing) sows were moved to the mating shed and housed in group pens of 4-5 sows. On day 3 after weaning boar exposure commenced and sows who displayed standing oestrus were mated both morning and afternoon by artificial insemination (AI) with 2.3×10^9 sperm cells in the presence of a mature boar until no longer standing (2 days on average). After mating sows were moved to group pens of 3 or 4 for the duration of gestation.

2.3 Lactational oestrus stimulation protocol (LO stimulation protocol)

In the 12 month period between August 2015 and August 2016 419 sows (synthetic Landrace based breed) were subjected to a lactational oestrus stimulation protocol (LO stimulation protocol) consisting of sow and piglet separation (placement of a solid board within the farrowing crate that separated the piglets from the sow and partitioned the piglets off into the wide side of the creep) along with fence line boar exposure. Due to lower than expected response rates the piglet and sow separation protocol was modified several times in order to maximize response rates. These differing protocols and the timing of their implementation are outlined below.

6 August 2015 – 5 October 2015

Sows were separated from their piglets from 0700 – 1500 hours for the last 7 days of lactation prior to weaning, thereby reducing the suckling stimulus on the sow for 8 hours per day. Once daily, for the last 4 days of the separation protocol, sows were exposed to a mature boar for stimulation and detection of lactational oestrus. The boar was brought into the farrowing house and placed in a specially modified boar crate and held in front of each sow for 5 mins to ensure nose to nose contact.

6 October 2015 – 27 January 2016 (separation time and boar exposure increased)

Sows were separated from their piglets from 0700 – 1900 hours for the last 7 days of lactation prior to weaning, thereby reducing the suckling stimulus on the sow for 12 hours per day. Once daily, for the last 6 days of the separation protocol, sows were exposed to a mature boar for stimulation and detection of lactational oestrus. The boar was brought into the farrowing house and placed in a specially modified boar crate and held in front of each sow for 5 mins to ensure nose to nose contact.

28 January 2016 – 31 July 2016 (16hr overnight separation)

Sows were separated overnight from their piglets from 1500 – 0700 hours for 3 consecutive nights (starting 7 days before weaning). Once daily, for the last 4 days before weaning, sows were exposed to a mature boar for stimulation and detection of lactational oestrus. The boar was brought into the farrowing house and placed in a specially modified boar crate and held in front of each sow for 5 mins to ensure nose to nose contact.

For all protocols, separation commenced on average at day 22 (range: 16-34) of lactation and sows were weaned at approximately day 29 of lactation (range 23-41). During the period of separation, piglets had *ad-libitum* access to creep feed and water.

All sows were monitored for signs of oestrus and mated in the farrowing crate by AI with 3 x 10^9 sperm cells if they displayed standing oestrus. Sows were inseminated once daily from the first instance of standing oestrus until they no longer stood (2 days on average). At weaning sows that were mated in the farrowing house were moved directly to their gestation accommodation. Those sows that did not respond to the induction protocol were moved to the boar shed and received boar exposure from the first day of entry to the mating shed and were checked for signs of oestrus and subsequently mated by AI according to the same protocol as outlined under section 2.2.

2.4 Piglet growth

For 6 weeks prior to the commencement of the lactational oestrus protocol, piglet weaning and 2 week post weaning weights were recorded for 624 piglets in order to get a baseline measurement of piglet performance on this farm. After the commencement of the 12 hours per day for 7 days separation protocol piglet weaning and 2 week post weaning weights were recorded for 462 piglets in order to compare piglet weaning weights and post wean growth between the systems. Weaning weights from 264 piglets were also recorded for the 16 hr overnight for 3 consecutive days separation protocol.

2.5 Statistical analysis

Data were analysed using GLM analysis or a Chi-square (x^2) test (for farrowing rate) (IBM SPSS, v. 21.0; USA). The sow was the experimental unit and data means were separated by least significant differences (P<0.05). Sow parity was included in the analysis a covariate.

Production outputs such as the proportion of sows responding to oestrus stimulation and being mated before or up to 3 days after weaning (these sows are characterised as having a lactational oestrus) and subsequent pregnancy and farrowing outcomes including litter size were assessed within the system. Additionally, the percentage of sows mated within 7 days of weaning was compared between the LO stimulation protocol and the conventional protocol (previous year's production), as well as piglets weaned per sow per year (PWPSY). The data has been presented on an overall year basis as well as a seasonal basis.

3. Outcomes

3.1 Lactational oestrus stimulation protocol

The overall percentage of sows that had a lactational oestrus was 40%. The figure below shows the percentage of sows that had a lactational oestrus (responders) versus those mated after weaning (non-responders) according to the month they were mated (Fig. 1).

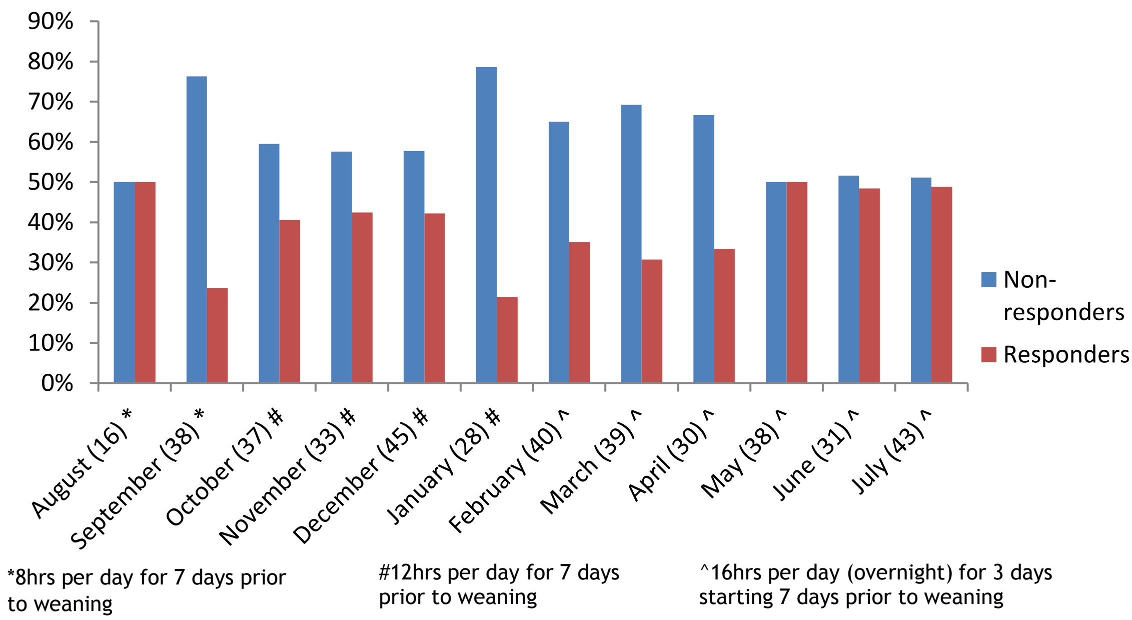

Figure 1. Percentage of sows that had a lactational oestrus (responders) versus those mated after weaning (non-responders) according to the month mated in the 2015/16 year.

Sows mating during lactation (n=166; average parity 2.74 ± 0.09) had a weaning to remate interval of -1.26 ± 0.34 days on average compared to 6.48 ± 0.27 days for those sows mated after weaning (n=253; average parity 3.55 ± 0.11) ($P<0.05$). The farrowing rate for sows mated during lactation was 78% compared to 88% for those mated after weaning (x^2=7.99; $P<0.05$) and subsequent born alive was 10.73 ± 0.46

for sows mated during lactation and 11.21 ± 0.41 for those sows mated after weaning (n.s.).

Season had a significant effect on response rates to lactational oestrus stimulation (Fig. 1), subsequent farrowing rate (Fig. 2) and born alive (Fig. 3) for sows mated during lactation in the summer period (January – April) compared to the rest of the year (August – December and May to July).

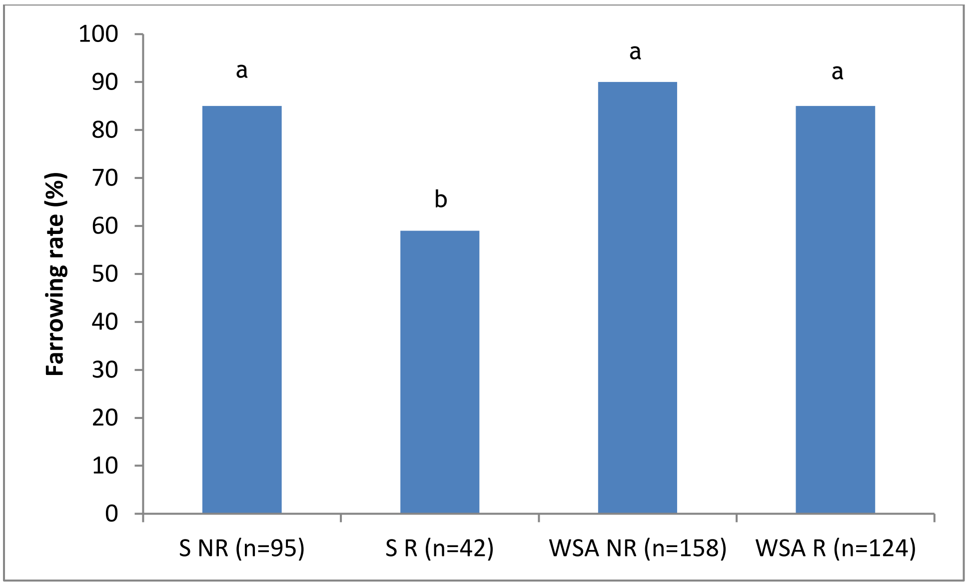

Figure 2. Farrowing rate for non-responders (NR) and responders (R) according to the time of year they were mated. S NR (Non-responder – summer); S R (responder – summer); WSA NR (Non-responder –winter, summer and autumn); WSA R (Responder – winter, summer and autumn). [a,b] **are significantly different from each other (P>0.05).**

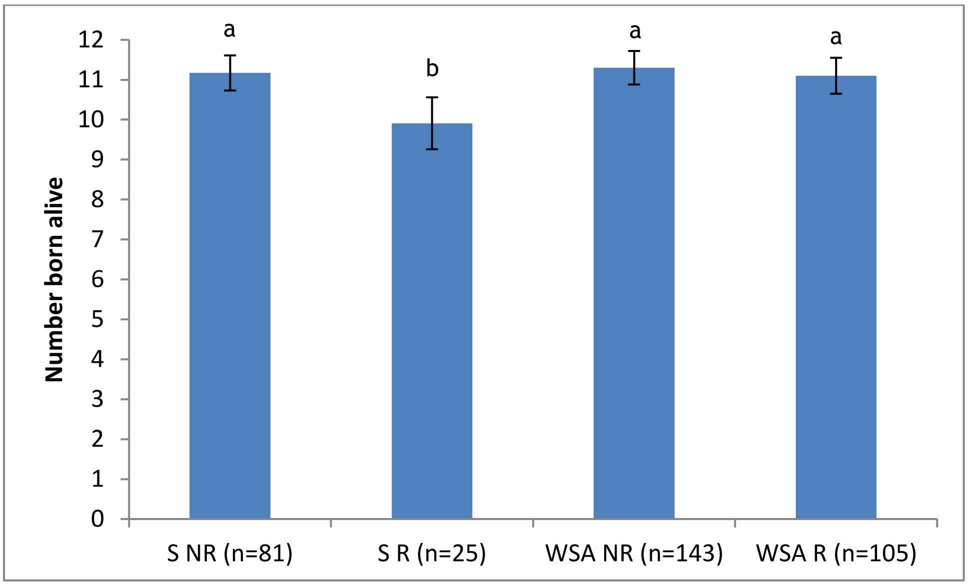

Figure 3. Born alive for non-responders (NR) and responders (R) according to the time of year they were mated. S NR (Non-responder – summer); S R (Responder – summer); WSA NR (Non-responder –winter, summer and autumn); WSA R (Responder – winter, summer and autumn) [a, b] **are significantly different from each other (P<0.05).**

3.2 Production outcomes: Conventional mating protocol versus Lactational oestrus stimulation protocol

Table 1 shows the production outcomes for the LO stimulation protocol (August 2015 to July 2016) compared to the conventional mating protocol (August 2014 to July 2015). Mating data and subsequent reproduction outcomes for all matings (i.e. gilt, return, NIP, lactational oestrus and after weaning) are included so that comparisons that account for all matings between the different systems can be made.

Table 1. Production outcomes from August 2015 to July 2016 matings (lactational oestrus induction protocol) and August 2014 to July 2015 matings (conventional system).

	Conventional Protocol (14/15)	Lactational Oestrus Protocol (15/16)
Total number of matings	569	555
Number of sows farrowed	502	463
Farrowing rate (%)	89[a]	83[b]
Average number born alive per litter	11.08 ± 0.37	11.18 ± 0.36
Average number weaned per litter	9.9 ± 0.14	9.9 ± 0.14
Average wean to remate interval (days)	5.18	3.88
Mated within 7 days of weaning (%)	94.2	95.6
Average sow inventory	218	207
Litters per sow per year^	2.3	2.2
Total number of piglets weaned	5026	4634
Pigs weaned per sow per year*	23.0	22.4

[a,b]Means within a row with different superscripts are significantly different ($P<0.05$).
^Number of sows farrowed/Average sow inventory.
*Number of piglets weaned/Average sow inventory.

Table 2. Production outcomes from August 2014 to July 2015 matings (conventional system) and August 2015 to July 2016 matings (lactational oestrus induction protocol) according to season mated.

	Conventional Protocol (14/15)		Lactational Oestrus Protocol (15/16)	
	Summer[1]	Winter, Spring, Autumn[2]	Summer[1]	Winter, Spring, Autumn[2]
Total number of matings	185	384	191	364
Number of sows farrowed	169	333	152	311
Farrowing rate (%)	91^{a}	87^{a}	80^{b}	86^{a}
Average number born alive per litter	10.93 ± 0.41	11.22 ± 0.38	11.00 ± 0.39	11.32 ± 0.38
Average number weaned per litter	9.70 ± 0.15^{a}	9.95 ± 0.14^{b}	9.83 ± 0.14^{ab}	9.96 ± 0.14^{b}
Average sow inventory	218	218	207	207
Litters per sow per year	2.3^	2.3$	2.2^	2.25$
Number of piglets weaned	1662	3364	1496	3138
Pigs weaned per sow per year*	22.9*	23.1#	21.7*	22.8#

[1]Summer = January, February, March and April; [2]Winter, Spring, Autumn = May, June, July, August, September, October, November, December.
[a,b]Means within a row with different superscripts are significantly different ($P<0.05$).
^Number of sows farrowed/Average sow inventory x 3; $Number of sows farrowed/Average sow inventory x 1.5
*Number of piglets weaned/Average sow inventory x3: # Number of piglets weaned/Average sow inventory x 1.5

3.3 Piglet growth

Average weaning weight for the benchmarking piglets (before LO stimulation protocol commenced) was 8 kg and the average weaning age was 27.5 days. Two week post weaning weights were 11.2 kg. After 12 hour daily separation commenced piglet weaning weights were 7.8 kg and average weaning age was 28 days. Average two week post weaning weights were 11.15 kg. Average weaning weight for those piglets from the 16hr overnight for 3 consecutive nights was 8.05 kg with an average weaning age of 28 days.

3.4 Labour

On average 9 sows and their piglets were subjected to the lactational oestrus induction protocol each week. The 7 day separation protocols took up more time than only the 3 day overnight separation protocol (Table 3). Overall, the running of the overnight separation protocol with 4 days of boar exposure increased labour by up to 5 to 10 minutes per sow per day. For the 7 day separation protocols and 6 day boar exposure this increased up to 10-15 minutes per sow per day. Obviously the more sows that responded to the stimulation protocol in farrowing house less time was needed for their management in the mating shed (they were basically boxed up in gestation accommodation and may have been re-boxed according to size if required when other sows had been mated).

Table 3. Estimated daily labour comparison between conventional weaning and lactational oestrus stimulation protocols.

	Conventional weaning*	3 day (16 hour overnight separation) protocol	7 day separation (8 hour separation) protocol	7 day separation (12 hour separation) protocol
Piglet separation and un-separation	-	15 mins	15 mins	15 mins
Boar exposure and oestrus detection and mating (4 or 6 days)	-	45 mins-1.25 hrs.	45 mins-1.25 hrs.	45 mins-1.25 hrs.
Boar exposure and oestrus detection and mating (boar shed after weaning)	45 mins-1.5 hrs.	20-45 mins	20-45 mins	20-45 mins

*5-7 days boar stimulation and oestrus detection in mating shed post weaning.

4. Conclusion

The application of a lactational oestrus induction protocol in this particular commercial production setting did not achieve the 85% of sows displaying a lactational oestrus which was the original target stipulated as being commercially viable in a conventional farrowing house system. In this particular system an overall response rate of 40% was achieved. This response rate was variable week to week and quite variable between seasons. Production outcomes assessed over the entire year between sows that were mated during lactation (responders) and those mated after weaning (non-responders) resulted in a significantly lower farrowing rate for those sows mated in lactation compared to those mated after weaning (78 vs 88%, respectively). Born alive was also numerically lower for those sows mated in lactation compared to those mated after weaning however the difference was not significant.

When seasonal effects are taken into consideration, sows mated in lactation during the summer period (January to April) had both a lower farrowing rate and subsequent born alive compared to both responder sows mated during winter, spring and autumn and non-responder sows mated in summer and winter, spring and autumn (Figures 2 and 3). It is interesting to note that this was the first study to run a lactational oestrus protocol over a summer period where summer infertility issues can manifest. The farm on which the protocol implemented does not historically have a significant issue with seasonal infertility, but results from this experiment have shown that a mating in lactation protocol exacerbated these issues.

During the summer months the additional labour required to implement LO stimulation protocol (managing boar and piglet separation) in the farrowing house does not seem warranted given the fact that oestrus response rates to the stimulation are markedly lower than during the rest of the year. Those sows that do respond have poorer subsequent reproduction which may be due to a number of factors such the timing of mating relative to ovulation (oestrus can be harder to detect in summer – doubly so in a farrowing house environment) and/or sow condition at mating (sows can be more catabolic after lactating during the summer months which can impair their ability to conceive). This coupled with mating them sooner than would otherwise occur if they were mated after weaning may result in impaired fertility in these sows.

However, during other periods of the year (especially the spring months) mating in lactation may be beneficial to certain production system as up to 15% of sows can have a spontaneous lactational oestrus in the farrowing house (Downing *et al.*, 2012). Identifying these sows whilst they are still lactating and mating them can result in the reduction of non-productive days (NPD) by reducing the number of sows returning to oestrus 15-21 days after weaning. Employing a lactational oestrus stimulation and mating protocol in the farrowing house during these more fertile periods other sows who may not necessarily have had a spontaneous ovulation can be induced to cycle just prior to weaning or earlier after weaning than they normally would, again reducing NPD. Sows mated during lactation outside the summer period have comparable farrowing rates and subsequent reproduction outcomes to sows mated after weaning making the option of mating in lactation more attractive particularly if a system has a significant incidence of spontaneous lactational oestrus.

In this particular system the separation protocol employed whether it be the daily 8 hour separation for 7 days prior to weaning, the daily 12 hour separation for 7 days prior to weaning or the 16 hour overnight separation for 3 consecutive nights starting 7 days prior to weaning had no detrimental effects on weaning or two week post weaning weights (not measured for 16 hour overnight separation for 3 days). The daily 8 hour separation was first employed as this separation strategy was previously found to be the minimum time required to evoke lactational oestrus in up to 65% of sows without detrimental effects on weaning weight of the piglets (separation only occurred for 3 days) (Downing *et al.*, 2015). It was assumed that sow and piglet separation for 8 hours for 7 days would increase this response rate somewhat (closer to the target of 85%) whilst not being detrimental to piglet weights. However, this was not enough in this particular system and the timing was increased to 12 hours daily. Response rates were only slightly improved and as piglet weight was not detrimentally affected (more than likely due to the fact that the piglets were provided creep feed from 10 days of age and were therefore acclimatized to eating some solid food already), 16 hour overnight separation for 3 days (which was previously shown to result in 85% of sows exhibiting a lactational oestrus but was detrimental to piglet weaning weight (Downing *et al., 2015*)) was employed. This protocol was started in the summer months where response rates were quite low but did result in higher response rates during the autumn and winter periods. The 16 hour overnight separation for 3 nights actually resulted in less total time separated from the sow than either the 8 or 12 hour for 7 days separation protocols, but cannot be exactly termed as ‘gradual weaning’ as the piglets do return full time to the sows for last 4 days of lactation. However they are still provided with creep and may be somewhat more encouraged to consume it as they may have previously consumed it whilst separated from the sow.

In conclusion, whilst the target of 85% of sows mated in lactation was not achieved important information on seasonal effects on production outcomes from a LO stimulation protocol was captured. Depending on the purpose of a LO stimulation protocol achieving an 85% mating rate may not be as important to a producer in comparison to reducing NPD during certain periods of the year when incidences of lactational oestrus occur or increase. Additionally, it may be simply used as a management tool to reduce sow confinement, especially as outside the summer period subsequent farrowing rates reproduction are comparable to sows mated after weaning. If increasing piglet weaning age or gradually weaning piglets to improve their transition after weaning, the incidence of lactational oestrus may increase and having a LO stimulation protocol in place will help producers make these type of systems more feasible.

5. Recommendations

It is clear from the results of this study that employing a LO stimulation protocol in summer will yield no benefit for the producer even if there is no prior evidence of significant seasonal infertility issues. However, a LO stimulation protocol could be used as a management tool that is only employed during the other periods of the year outside of summer. This may be particularly beneficial to a system where an increase in stale sows (sows that do not return to oestrus within 7 days of weaning) and thus NPD are seen due to higher incidences of spontaneous lactational oestrus. It may also be beneficial to systems where the motivation is to reduce the overall confinement of the sow as it reduces the number of sows needing to be housed in mating stalls after weaning.

Overall, the benefits of a LO stimulation protocol need to outweigh the economic costs associated with sow and piglet separation and boar exposure in the farrowing house or provide benefit in terms of gradual weaning or reduced sow confinement to be attractive to producers as a mating management protocol.

6. References

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