AUSTRALIAN PORK LIMITED

Best Practice Gilt Management for Fertility and Longevity

September 2019



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Information sources

Much of the information presented in this publication was sourced from the review "Gilt Management for Fertility and Longevity" prepared by Jennifer Patterson and George Foxcroft (published in *animals* 2019, 9, 434) and APL project 2015/044 "Tender to conduct a desk-top study on gilt management" (Paul Hughes, Paul Hughes Consulting).

Furthermore, outcomes from APL funded projects have been used to help inform best practice gilt management under Australian conditions:

2012/2435 - Improvement of sow longevity through identification of early lifetime performance indicators, including the assessment of gonadatrophin response as a suitable selection tool for replacement gilts (Rebecca Athorn, Rivalea Australia)

2012/2436 - Association between gilt structural conformation and implications for lifetime productivity of sows (David Lines, SunPork Solutions)

2013/022 - Key differences underlying top and bottom reproductive performers: analysis of management programme data (Kate Plush, SunPork Solutions)

2015/017 – A new predictor of lifetime reproductive performance and behaviour in pigs (Jemma Seyfang, University of Adelaide)

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Best Practice Gilt Management for Fertility and Longevity

High sow turnover, or replacement rate, is an ongoing issue for Australia's pig industry. High sow turnover within a herd leads to a reduction in sow lifetime performance (calculated as the number of pigs produced per female per day of herd life), especially if the replacement rates of low parity sows are high. High sow turnover rates result in a higher proportion of younger sows in the herd, in particular gilts. This leads to increases in herd feed conversion (defined as feed consumed per unit carcass weight produced) due to a greater proportion of gilt progeny within the herd.

In 2012, the average sow replacement rate in Australia was 56.1% (range 39.8-76.1%) (APL Annual 2012-13). A target annual replacement rate of 50% is considered ideal as this equates to an average herd life of 2 years for breeding females and therefore 4.8 litters/ sow (2 years x approximately 2.4 litters/sow/year). After allowing for sow deaths and early culling due to structural and reproductive failure, together with an imposed culling of parity 6 sows or higher, it is unlikely that a replacement rate of less than 45% is realistically achievable. Conversely, too many females are being lost from the herd prematurely if the annual replacement rate exceeds 55-60%. This suggests that 1) there are structural problems in the herd (early culling for feet, leg or pelvic problems), 2) reproduction is poor – in which case the problem areas need to be identified and attended to, and/or 3) culling is occurring at a too early an age (e.g. after 3 or 4 litters). A sow needs to at least reach her 3rd, or even her 4th, parity before she begins to recover her own cost. Therefore, her removal from the herd prior to parity 3 or 4 also results in financial losses to the producer.

Despite considerable research conducted in this area over the last decade, very little improvement in sow turnover has been made. This may reflect the lack of dedicated gilt development protocols and their implementation on-farm. This manual uses research outcomes to provide best practice gilt development and management recommendations. The adoption of these will help to ensure all potential replacement gilts in Australia are given the best opportunity to have a long and productive life in the breeding herd.

1. Replacement gilt selection and development begins in the farrowing house

When selecting potential replacement gilts, there are a number of important factors to consider which are not just isolated to one time point in a gilt's lifetime (i.e. not just at selection). From the birth of the gilt (and even whilst she is developing *in utero*), her future success as a breeding animal is being influenced. Recently, it has been reported that individual birthweight, sex-ratio of the birth litter, and pre-weaning growth can be used to predict future gilt performance.

1.1 Birthweight

As a consequence of genetic selection for increased litter size, the Australian industry has experienced an associated increase in both within-litter variation in birthweight, and in the proportion of piglets with a low birthweight. Low birthweight gilts (<1.3kg) have increased pre-weaning mortality. Those light birthweight gilts that do survive the pre-weaning phase have poor lifetime growth performance and are also lighter than their higher birthweight littermates at slaughter age. Additionally, a low birthweight can negatively impact reproductive potential as low birthweight gilts have different populations of ovarian follicles and a shorter vaginal length at 150 days of age compared to heavier birthweight gilts. Variation in birthweight is therefore negatively correlated to ovarian and reproductive tract development. Furthermore, studies have shown that gilts weighing <1.0 kg at birth:

- have a higher rate of removal due to anoestrus before first mating;
- produce fewer total pigs born alive at their first farrowing and produce fewer total pigs over 3 parities.

1.2 Colostrum intake

Post-farrowing management is critical to improving the retention and performance of replacement gilts. From a growth standpoint, colostrum intake and birthweight are positively associated with weaning weight.

From a reproductive standpoint, low colostrum intake is associated with increased age at puberty, reduced numbers born alive, and reduced pre-weaning growth rate of piglets during lactation in replacement gilts. Therefore, insufficient colostrum ingestion at birth may impair reproductive and uterine gland development as well as lactation performance of the replacement gilt.

It may be beneficial to implement strategic cross-fostering strategies on all future replacement females to ensure adequate colostrum intake (see APL publication – '*Guidelines for fostering – Getting the "one percenters" right*').

1.2.1 Litter size

Reducing the litter size in which replacement females are raised is one management technique that may increase overall growth, enhance early development of reproductive organs, and increase longevity and performance through reduced competition with littermates for colostrum and milk. Some studies have shown that gilts reared in small litters (<7 piglets) were heavier at both weaning and at 140 days of age, reached puberty earlier, had higher ovulation rates in their first parity, and better retention over six parities when compared to gilts reared in large litters (>10 piglets).

1.3 Litter sex-ratio

The sex ratio of the litter in which a replacement female is born may affect her lifetime performance and behaviour. Generally, gilts born to female-biased litters are better replacement females than gilts from male-biased litters. Gilts born to litters with a high proportion of males are exposed to increased levels of sex hormones (from their male littermates *in utero*) causing gilts to become masculinised. They are more likely to have lower successful inseminations, higher insemination failures, lower mating success, fewer piglets born, and less teats compared to gilts from female-biased litters. Masculinised females are also more likely to display male-like behaviours, including being less fearful and more aggressive than gilts from female-biased litters. This aggression may lead to early removal from the herd and thus reduced sow lifetime performance as well as welfare implications. As such, litter sex-ratio could be considered for use as a selection tool for future replacement gilts.

1.3.1 Anogenital distance

Anogenital distance (measured as the distance between the start of the vulva opening and the anus) can be used as an indicator of female masculinisation in pigs. A number of studies have investigated the relationship between anogenital distance and reproductive performance in replacement gilts. One of these studies reported that gilts originating from a male biased litter (>67% males) had a longer anogenital distance when measured within 4 days of birth compared to gilts from litters with a lower proportion of males.

In a recent Australian study, there was no difference at day 1 of age in anogenital distance in female piglets born in either male-biased (>60% males) or female-biased (>60% females) litters. However, gilts from female-biased litters had a longer anogential distance at 3 and 16 weeks of age. In a second study by the same investigators, anogenital distance was measured at the time of preselection at approximately 170 days of age. Gilts with an anogenital distance longer than 11.55 mm were heavier, achieved puberty earlier, were mated younger and had greater born alive litter size at parity 1 than gilts with an anogenital distance shorter than 11.55 mm.

Taken together, these results indicate that the sex-ratio of the litter into which a potential replacement gilt is born and the anogenital distance at selection could be considered during selection of future replacement females. Although more research is needed, sex ratio at birth and measurements of anogenital distance taken at the time of selection could be used by producers to improve the productivity of the replacement female.

1.4 Pre-weaning growth and weaning age

Pre-weaning growth may be a better predictor of replacement gilt success than individual birthweight and/or weaning weight. In a recent APL study, females with a pre-weaning average daily gain of <125 grams had a lower probability of being selected or mated (displaying oestrus). Increasing weaning age to greater than 25 days also improved the probability of a gilt being selected.

SUMMARY

- Birthweights below 1.3 kg can reduce reproductive potential as a result of negative effects on reproductive tract development.
- Insufficient colostrum intake may impair a replacement gilt's ovarian and uterine development, resulting in increased age at onset of puberty, reduced lifetime reproductive performance, and even poor lactation performance.
- Gilts from male-biased litters are more likely to have lower mating success, smaller litter sizes, and less teats compared to gilts from female-biased litters.
- An average pre-weaning daily gain of >125 grams improves mating and farrowing outcomes in replacement gilts.
- Only gilts with a weaning age greater than 25 days should be considered as potential replacements.

2. Replacement gilt selection and management

Successful gilt selection drives lifetime reproductive performance and longevity in the breeding herd. As stated previously, a sow needs to at least reach her third or fourth parity before she begins to recover her own cost.

Poor reproductive performance during the early parities is a major cause of premature removal. Therefore, the ability to identify gilts with the greatest potential for lifetime performance is crucial.

2.1 Age, weight and P2 backfat depth at selection

Selection of replacement gilts should not occur before gilts are 20 weeks of age – before this age, it is difficult to determine what a gilt's conformation will be when she matures.

At selection, gilts should be of a weight that will allow them to reach between 135 kg and 155 kg at 30-34 weeks of age. More information about this is presented in **Section 3.3**. If gilts are growing at 700g/d, their ideal selection weight at 20 weeks of age should be around 90 kg to achieve a mating weight of 140 kg by 30 weeks of age.

There are no prescriptive fatness targets when it comes to P2 backfat levels of gilts at selection. In a recent APL study, backfat levels at selection varied from 10.8 – 22.2 mm. Higher P2 backfat levels at selection were related to an improvement in farrowing success at parity 1 from 62% (lowest average P2 backfat of 10.8 mm) to 84% (highest average P2 backfat of 22.2 mm). Reduced farrowing outcomes were observed in gilts with an average, mid-population, P2 backfat of 15.1 mm at selection compared to the average fattest P2 backfat of 22.2 mm (73% vs 84%, respectively). In terms of longevity, a linear relationship was found between selection P2 backfat and survival to parity 2 with the percentage of sows being culled by parity 2 decreasing from 59% to 35% between the leanest and fattest average P2 backfat levels.

2.2 Lameness and Conformation

Aside from reproductive failure, lameness is one of the most common reasons for premature removal from the breeding herd. In early parity sows, lameness is usually the result of poor conformation or environment (flooring, penning etc.). Conformation and lameness should be assessed at the time of selection and resultant scores used as part of the overall selection criteria. Findings from an APL funded project showed that of those sows removed for lameness, 75% of these were given a poor locomotion score at selection. This assessment was therefore a valuable indicator for premature removal for lameness. Of these removals, 75% of the sows had rear limb damage. Specific focus on hind leg conformation at selection may also be important as gilts with turned in/out feet and /or sickle-hocked/post legged were more likely to be removed for lameness during their early parities (Figure 1).

Interestingly, in this study, sows which were removed for lameness had lower total born, born alive and increased born dead on average compared to other gilts of the same parity. This suggests a link between lameness and reproduction. Whilst a sow is culled for reproductive failure, poor health or condition from joint issues may be the underlying cause.

Figure 1. Selection criteria – gilt hind leg conformation.

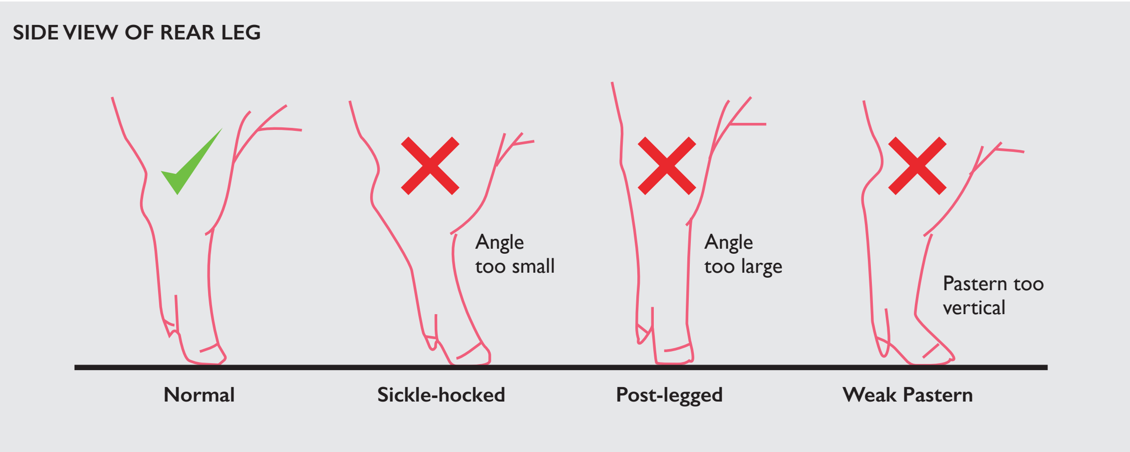

Image source: thepigsite.com

2.3 Puberty stimulation through boar exposure

Several management practices can be used to stimulate puberty. In particular, planned exposure of young gilts to mature boars is conducted so that gilts reach puberty (commence cycling) at a younger age than would otherwise occur. There are practical benefits to be gained by controlling gilt age at puberty. These include achieving younger mating ages, a shorter non-productive period prior to breeding herd entry, and a reduction in rearing costs. Synchronous puberty attainment within gilt cohorts facilitates gilt entry into the breeding herd, increases the efficiency of cull sow replacement and meeting of mating targets.

It has been recognised for nearly 50 years that exposing replacement gilts to a mature boar is an effective method of advancing and synchronising puberty. The efficacy of boar exposure as a stimulus for early puberty attainment, often referred to as the 'boar effect', has been clearly demonstrated.

The key elements that determine the effectiveness of the 'boar effect' are:

- the stimulus value of the boar;
- the responsiveness of the gilt to that stimulation, and;
- the way in which the boar and gilt are placed together, either on opposite sides of a fenceline or with full physical contact, so that the stimuli can be efficiently transferred.

There is some flexibility in implementing a puberty stimulation program and the decision on when to begin puberty stimulation should be based on the time it takes to get 85-90% of gilts cycling by 30 weeks of age. For example - based on your herd's history, if this takes 2-3 weeks, start boar exposure at 27 weeks of age. If it takes 5 weeks, start boar exposure at 25 weeks of age.

2.3.1 Boar age

The 'boar effect' is driven by boar pheromones and physical cues that stimulate puberty in gilts. Concentrations of boar pheromones increase with age. Boars less than ten months of age have a minimal stimulus value due to their inability to produce and secrete sufficient quantities of primer pheromones. Once boars have reached 10 months of age, individual boars still differ considerably in their ability to stimulate early puberty attainment and elicit a standing reflex in oestrus gilts. This variation has been associated with differences in the level of pheromone released as well as the sexual motivation or libido of the boar.

Taken together these data indicate that boars used for gilt puberty stimulation should be at least 10 months of age and have the opportunity to mate regularly. Between 5 to 15% of boars may be of low stimulus value - the only practical way to determine which boars is to record gilt pubertal responses.

2.3.2 Fenceline versus full physical contact

For many years it was assumed that the way in which the boar and gilt were placed together for puberty stimulation was relatively unimportant as sufficient boar to gilt contact was likely to occur. Research has now shown that efficient transfer of the boar stimuli takes time and can be impaired by factors including restricted contact (e.g. through a fence or gate) and large group sizes. As such, fenceline boar contact is now recognised to be much less effective for gilt puberty stimulation than full physical contact where the boar and gilts are in the same pen.

2.3.4 Length of boar contact

Optimum puberty stimulation has been shown to occur in gilts when they are exposed to boars for approximately 15-20 minutes/day. This effect diminishes if the contact is reduced to less than once daily. Conversely, providing boar contact twice daily for 10 minutes per exposure appears to greatly enhance gilt puberty stimulation relative to a single 20 minute period of daily boar contact. Importantly, the efficacy of the 'boar effect' reduces if the number of gilts being exposed to one boar increases beyond 12 at a time.

Image source: W. Singleton, Purdue University

2.3.5 Vasectomised boars

Using vasectomised boars to stimulate gilt puberty is much easier than using fertile 'stock' boars as the periods of exposure do not need to be supervised. In addition, a vasectomised boar being used to stimulate puberty can also be used to mate (infertile mating) the gilt at her first oestrus. This can increase the litter size produced from a fertile mating at her second oestrus by 0.5-1.0 pigs and may raise conception rates by about 5%. Replace the boar at about 15-18 months of age, when he is likely to become too big for the gilts.

2.4 Gilt numbers and culling

Purchase or select approximately 10-15% more gilts than you need. Once 85-90% of these gilts have reached puberty in response to boar contact, cull the remaining gilts. The rationale for this is that in a normal population of gilts, 10-15% will be sub-fertile. These gilts will be the slowest to respond to boar stimulation.

2.5 Feeding

Traditionally, gilts have been fed *ad libitum* from selection to puberty attainment. This was considered ideal as it would optimise gilt response to puberty stimulation and maximise body condition at first farrowing and facilitate lactation without compromising subsequent reproduction.

Feed restriction in the pre-pubertal period was shown in many early studies to delay puberty attainment, and that both the timing and severity of feed restriction affect gilt age at puberty. Many recent reports, however, indicate that the impact of mild feed restriction (no less than 80% of *ad libitum* intake) on gilt puberty attainment is minimal, particularly if the restriction is applied before the gilt reaches approximately 25 weeks of age. Mild feed restriction may be a useful management strategy for those gilts who have a high growth rate and would therefore exceed the target mating weight of 135-155kg at 30 weeks of age on *ad libitum* feed.

SUMMARY

- Selection should not occur before gilts are at least 20 weeks old.
- Gilts should be of a weight at 20 weeks of age that will allow them to achieve a mating weight of 135-150 kg by 30-34 weeks of age.
- Gilts should have a minimum P2 backfat depth of 12mm.
- Assess conformation and locomotion at selection - turned in/out and sickle-hocked/post legged animals are more likely to be removed early for lameness.
- Sows suffering from lameness typically have lower numbers of pigs born (likely due to chronic inflammation).
- From the age of 25-28 weeks, gilts should be exposed at least once daily, for a period of 20 minutes, to a mature boar aged 10 months or older which is performing regular matings (at least fortnightly).
- Exposures should be in small groups (<12 gilts/boar) and should involve full boar contact (ideally with a vasectomised boar).
- The decision on when to begin puberty stimulation should be based on the time it takes to get 85-90% of gilts cycling by 30 weeks of age.
- Purchase or select approximately 10-15% more gilts than you need. After 85-90% of these gilts have reached puberty in response to boar contact, cull the remaining gilts as they are sub-fertile.
- Gilts should be fed a gilt developer diet *ad libitum* from selection until mating, unless the herd encounters heavy gilts at mating (>155kg). In this case, the gilt should be restrict fed, but only to 80-85% of *ad libitum* intake.

3. Mating management of the replacement gilt

3.1 When to mate – first or second oestrus?

The decision on when to breed a gilt is normally taken on the basis of (a) optimising first litter performance and (b) maximising lifetime productivity. Typically, gilts are mated at their second oestrus or later in order to maximise ovulation rate and thus first litter size. However, there is increasing evidence that ovulation rates of modern gilts are much higher than gilts of 20 or 30 years ago. If ovulation rate is no longer an issue, we must consider the effects of when we mate a gilt on the quality of oocytes she releases and the survival rate of embryos/fetuses (i.e. her farrowing rate and litter size).

Oocyte quality is optimised when the gilt is on a high level of feed for 2 or more weeks prior to breeding (**See section 3.2**). There is evidence to indicate that survival rate of embryos is higher in gilts mated at their second rather than first oestrus, regardless of pre-breeding nutrition. This suggests that mating a gilt at her second oestrus may still be optimal (Table 1).

Table 1. Performance of gilts mated at either their 1st, 2nd, 3rd or 4th oestrus (from Kummer (2005), PhD thesis).

	1st oestrus	2nd oestrus	3rd oestrus	4th oestrus
Farrowing rate %	72	87	88	91
1st litter size – total born	9.5	11.3	11.4	11.4

3.2 Feeding

It was standard practice for gilts to be fed *ad libitum* (termed "flush" feeding) in the weeks leading up to mating as this was believed to increase ovulation rate and hence first litter size. This is known as the "flushing effect". This was certainly a wise move in the early days when gilt ovulation rates tended to average 10-13 and be a limiting factor for litter size.

In the modern gilt, the emphasis has changed from the number of eggs shed at ovulation to the quality of those eggs. It has been recognised for some time that nutrition in the 2-3 weeks prior to ovulation determines the quality of the eggs and the ability of those eggs to be fertilised, develop and result in live piglets at birth. Ideally, gilts should be flush fed a Gilt Developer diet at this stage.

3.3 Optimum gilt liveweight at mating

Based on the cost of production, an average breeding sow needs to be retained in the herd until at least parity 4 - 5 in order to start generating a profit. Therefore, to ensure that the selected gilt remains in the herd past parity 3, an important consideration is her liveweight at mating. Studies have shown that gilts weighing less than 135 kg have fewer total pigs born over 3 parities than gilts weighing over 135 kg. Furthermore, no further increase in total born for gilts mated between 135 and 170 kg has been observed, indicating no productive advantage to breeding gilts at heavier weights.

Breeding gilts at weights <160 kg will result in a higher percentage of sows being removed due to lameness prior to reaching their third parity. In an APL study completed in 2017, gilts that were too heavy (≥161 kg) or too light (≤110 kg) at first mating had a reduced retention to parity 4 compared to gilts in the 111 to 160 kg weight range.

There may be other reasons for lowered sow retention in these weight categories such as insufficient reserves to cope with the demands of lactation for gilts under 110 kg. Therefore, liveweight at mating does seem to play an important role in sow retention. Overall, this adds weight to the concept that gilts should be mated at approximately 150 kg liveweight when they are around 30-34 weeks of age and at their second oestrus.

Image source: W. Singleton, Purdue University

SUMMARY

- Gilts should be mated at their second oestrus –. i.e. 3 weeks after they reach puberty.
- Ideal weight at breeding is between 135-150 kg and gilts should be between 30-34 weeks of age.
- All gilts should receive *ad libitum* feeding of a quality, gilt developer diet at least two weeks prior to breeding in order to achieve the 'flushing effect' and improve oocyte quality.

4. Gestation management of the replacement gilt

4.1 Housing of gilts in gestation

As individual sow stalls continue to be phased out in Australia, there is a need to identify key aspects of group housing systems for pregnant gilts. This has already been well reviewed in APL's '*Mixing sows – how to maximise welfare*' publication. There are, however, two further points that are particularly relevant to gilts. Firstly, a gilt's pregnancy (farrowing rate and litter size) is prone to being adversely affected by stress during the first 2-3 weeks after mating. Wherever possible, it is wise to house gestating gilts in groups settled before mating. Secondly, where mixing is necessary post-mating, it should occur as early as possible after mating once the period of standing heat has finished, and ideally only with other gilts and not older sows.

4.2 Feeding

Pregnant females have traditionally been fed at low/maintenance levels during early pregnancy as this was believed to improve farrowing rate and litter size. More recently, several research groups have re-evaluated feeding strategies for both gilts and sows:

In gilts, varying feeding levels in early gestation seems to have very little effect. If anything, increased feeding seems to improve pregnancy rates (Table 2). These results suggest that we can feed gilts around 2.4-2.8 kg/day of a standard dry sow diet during the first 4 weeks of gestation without having a negative impact on reproductive output, and without restricting gilt growth, given that they are still growing towards their mature bodyweight at this stage.

Table 2. Effect of feeding level during days 0-25 of gestation on weight gain and reproductive performance in gilts (from Langendijk et. al. (2011), Manipulating Pig Production XIII)

	Weight gain g/ day	P2 gain (mm)	Pregnancy rate d28 (%)	Born alive
Low (1.6 kg/day)	421	1.7	83 (50/60)	11.5
Medium (2.4 kg/day)	495	0.6	81 (44/54)	11.3
High (2.8 kg/day)	912	2.6	91 (53/58)	11.2

During the second month of pregnancy, the feeding objectives for gilts are to maintain pregnancy, maintain litter size, optimise piglet birthweights, maximise sow feed intake in lactation, and maximise post-natal piglet growth. While feeding a dry sow diet in the usual range of 1.8-2.8 kg/day to gilts in mid-gestation is unlikely to affect the pregnancy in any way, it is known that severe restriction of energy or protein intake at this stage (e.g. feeding less than 1.5 kg/day) will decrease piglet birthweight. Increasing feed intake at this stage can increase the number of secondary muscle fibres in the foetus, thus facilitating faster post-natal growth.

However, this may be at the expense of:

- Reduced sow feed intake in the following lactation – particularly if the gilt's P2 backfat increases beyond 24 mm at farrowing.
- Increased deposition of fat in the mammary gland resulting in lower milk output in lactation.

Therefore, during mid-gestation, the current recommendations are that gilts and sows should be fed around 2.2-2.5 kg/day, but this can be increased or decreased if the gilt's body condition status warrants it.

In the last 3-4 weeks of gestation, it has been common to increase feed level by about 1 kg/day to meet the increasing demands of the growing fetuses, prepare the gilt for lactation and to ensure a prompt return to oestrus following lactation. Recent Australian research suggests that this may be of little value (Table 3), and benefit may be dependent on genotype.

Table 3. Effects of feeding level in late gestation on gilt performance (from Langendijk and Chen, (2013), Anim. Prod. Sci. 53)

	Late gestation feeding level	
	Fed 2.5 kg/day	Fed 3.5 kg/day
No. gilts	15	17
Litter size (total born)	11.0	11.4
Mean birthweight (kg)	1.48	1.40
Mean piglet 21 day weight (kg)	6.1	6.0
Mean gilt feed intake in lactation (kg/day)	4.6	4.0
Mean gilt weight change in lactation (kg)	-8	-13

SUMMARY

- Mix gilts as early as possible after mating, once the period of standing heat has finished.
- Feed a standard dry sow diet or gilt developer diet at 2.4-2.8 kg/day for the first 4 weeks of gestation. For the remainder of the pregnancy, the same diet should be fed at 2.2-2.5 kg/day.
- Depending on expected litter size and genotype of the gilt "bump feeding" during the last 3 weeks may improve piglet birthweight (discuss with your nutritionist).

5. Conclusion

Overall, successful replacement gilt management requires a targeted approach. This approach will vary between production systems, however the recommendations outlined in each summary section above form the basis of best practice gilt management.

Adoption of these recommendations in conjunction with dedicated gilt development protocols will support producers with reducing average annual replacement rates and improving sow productivity and longevity across Australian production systems.

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