FINE TUNING NURSERY MANAGEMENT TO OPTIMIZE PRODUCTION COSTS

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ABSTRACT

It is important that in pig production when buying high lean genetics and quality feed that we maximise the growth potential of the pig by fine tuning management. The benefit of improving the pig performance immediately post-weaning is as critical in determining the lifetime performance of the pig as weaning weight and is relatively easier to influence. Management is important in this post-weaning period to maximise feed intake and growth rate and this paper reviews some of the main areas of management that should be looked at in order to improve nursery performance and optimise lifetime production costs. Targeting a 5% improvement in 20 day post-weaning gain can produce an extra 1 kg gain at slaughter and, on a pig that is growing at 300 g/day, that is only a 17 g/day increase in average daily gain something that is achievable.

INTRODUCTION

With increased pressure on pig price and higher feed prices there is a greater need than ever to optimise lifetime pig production. The impact of improving post-weaning growth on lifetime performance is well known and the following paper reviews different areas of management that can be used to improve nursery performance and gain that extra 5% of gain, 20 days post-weaning.

LIFETIME GROWTH – NURSERY IMPACT

All pig producers around the world strive for the same objective of maximizing performance at the lowest cost/kg thereby providing the best return per pig. This is the everyday question posed to nutritionists and the initial focus of attention is often the sow and nursery production systems. Why the sow and nursery systems? Small adjustments in the lactating sow and nursery systems can have dramatic impacts on lifetime performance. It has been well documented that weaning age and weaning weight have large impacts on lifetime performance. Main et al (2004) showed in two trials the importance of weaning age on wean to finish performance (Table 1).

These results showed the benefit of increasing weaning age not only on pork throughput in the system but also on a greater income per pig. Based on Trial 1, the results indicate that for every 1-day increase in weaning age from day 12 to day 21 there is an approximate increase in income of $1.00 to $1.25 per pig.

Table 1. Weaning age versus lifetime performance.

Trial 1	Days Weaned		12	15	18	21
	Wean – Finish	ADG (g/day)	580	616	637	687
	Mortality	%	9.4	7.9	6.8	3.6
	Weight Sold Per Piglet Weaned	kg	94.1	110.5	104.4	113.1
Trial 2	Days Weaned		15.5	18.5	21.5	
	Wean – Finish	ADG (g/day)	676	697	722	
	Mortality	%	3.9	3.4	2.5	
	Weight Sold Per Piglet Weaned	kg	107.6	111.6	116.2	

Weaning weight is also important in improving post-weaning performance. A commercial evaluation in Canada (Wilcock; Unpublished) showed that increasing weaning weight from 3.8 kg to 6 kg improved the 42-day post-weaning performance by 4.2 kg or the equivalent of 45 g/day for a 1 kg improvement in weaning weight. This is supported by work conducted by the Prairie Swine Centre that showed for every 1 kg extra in weaning weight there was an improvement in ADG by 40 g/day through the nursery (Whittington et al, 2005).

Not only is the benefit seen through the nursery but also through the finishing units and Cooper et al (2001) reported that 1 kg extra at weaning resulted in 4.2 kg at 20 weeks of age (Table 2).

Table 2. Growth of pigs according to weaning weight.

	Weeks Marketed To 113 kg				
Weeks to 113 kg →	21	22	23	24	25
Number of Pigs that reached 113 kg	49	71	113	115	62
	← Weight at 21, 77 and 140 days (kg) →				
21 days	6.3	5.9	5.5	5.0	4.8
77 days	34.7	32.3	30.6	28.7	27.2
140 days	103.7	99.6	95.1	89.1	82.2
	32 pigs did not reach minimum of 113 kg market weight				

These results show that, as we know, improving weaning age and weaning weight improves subsequent performance and attention to the lactating sow is important in order to ensure that high weaning weights for age are achieved. This is too detailed to review here but had been covered in other reviews (Wilcock, 2008).

Although weaning weight and age are important, two studies out of Leeds University showed the importance of early post-weaning growth on subsequent pig performance. In the first study Miller et al (1999) showed that there was a strong correlation between both weaning weight and growth rate in week one on subsequent performance post-weaning. Their influence is very similar and their impact is additive.

Day 20 Liveweight = 3.73 + 1.25 weaning LW + 8.92 ADG in week 1 (r^2 0.798, $P < 0.001$)

As both weaning weight and week one post-weaning average daily gain had equal effect on the Day 20 weight then management practises that promote high feed intake in that first week after weaning should be given as much focus as maximising weaning weight.

The second study at Leeds University (Isley et al, 2001) conducted a similar study but investigated birth weight, weaning weight and 20 days growth rate on lifetime performance and showed the best predictor of weight at slaughter was day 20 post-wean average daily gain > weaning weight > birth weight and that weaning weight with day 20 post-weaning ADG were the best predictor for weight at slaughter. This is supported by Pollman (1993) that showed the importance of one week post-weaning growth rate on days to market with pigs doing greater than 115 g/day in week 1 getting to market 10 days quicker than pigs doing less than 115 g/day.

In the Leeds study it was possible to determine what was required at birth weight, weaning weight or 20-day growth rate to improve weight at market by 1 kg (Table 3).

Table 3. Performance improvement to give 1 kg extra at market.

Performance Parameter	Order of Importance	Weight Chance	% Change	Comment
20 day ADG	1	17 d/day	5%	Achievable
Weaning Weight	2	0.33 kg	5%	Achievable
Birth Weight	3	0.11 kg	10%	Difficult

Looking at the parameters of change required to gain the extra 1 kg at slaughter, both the 20-day ADG and weaning weight are achievable through management and nutrition while increasing birthweight by 10% is more difficult to achieve. It must be remembered that it has been reported in numerous trials that extra gain out of the nursery results in extra gain at finish with 1 kg in the nursery translating to an extra 2 to 4 kg at slaughter. On average the industry would equate an extra 1 kg out of the nursery to 2.5 kg at slaughter or 2.5 to 3.5 days saving to get to the same slaughter weight.

Therefore with respect to the remainder of this paper we are looking at nursery management that can improve post-weaning performance which, if we can achieve just a 5% improvement in that first 3 weeks post-weaning, can deliver an extra 1 kg of live weight to the producer at market. Thus this shows that if we can increase feed intake in the 3 weeks post-weaning and thereby gain then pigs should get to slaughter quicker or produce more pork in the same period both providing returns to the pig producer.

FEED INTAKE

It is well-known that dry matter intake drops immediately post-weaning as the pig comes off the sow's milk onto a dry feed in a strange environment. This is one common stress that reduces feed intake that needs to be overcome but this can be complicated as feed intakes vary dramatically from unit to unit depending on other stresses in the system. This is due to appetite being sensitive to all type of stress, discomfort and disease. Nucleus units with few stresses, for example, have

higher feed intakes while units with many stresses (disease and poor management) have lower intakes. If we are in the situation of low feed intake and low nursery performance due to disease and management, can we change it for the better? By improving feed intake Pluske (1995) showed that there was a positive relationship between increasing feed intake, improving gut integrity (villous height) and improving post-weaning gain - all factors we want to achieve.

A practical example of management improving performance was when five commercial farms all suffering from E. coli scour and mortality had pigs weaned into either their existing production system or into an R&D facility with excellent management and an all in, all out policy. Feed was taken from the commercial farms and fed to the pigs in the R&D facility thereby removing any feed factor on the evaluation as all pigs were fed the same feed program. The results are dramatic (Table 4) with a 140 g/day benefit in ADG and large reductions in mortality and scour.

Table 4. Management x health effect.

	ADG g/day	% Scour	% Mortality
Commercial Unit	325.4	37.14	3.28
R&D	465.8	4.40	0.00
Difference	+ 140.4	- 32.77	- 3.28

Source: Madec and Leon, 1999

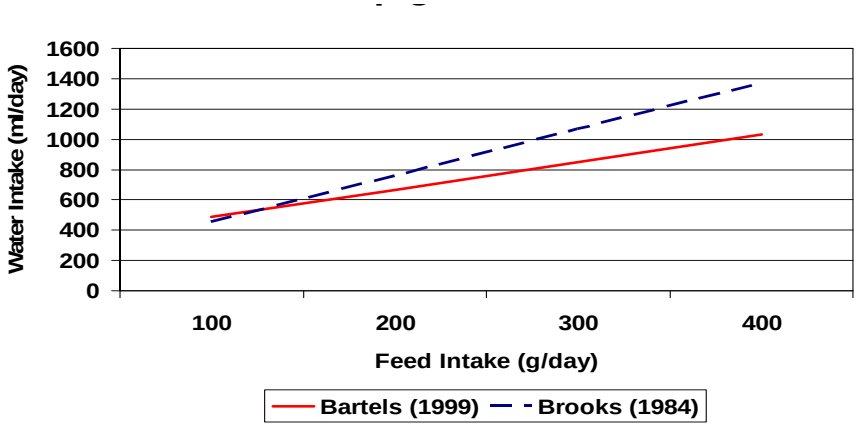
Remember this was achieved by reducing the multiple stresses on the pig and the following looks at some of these stresses and their effects.

WATER INTAKE

Water is often described as the forgotten nutrient as, although it is essential to the pig, it is often neglected with the assumption that as long as water is flowing from the drinker then the need for water is met and checked off. Recently, there has been a greater interest in water usage by piglets and a focus on water requirements.

On entry into a nursery system the pig has gone from the sow's milk which supplies both the food and water requirement of the pig to dry feed and water from a drinker. Lacking familiarity with both feed and water, it takes time for the pig to find the water and food supply and research has shown that it may take up to 35 hours for 85% of pigs (Varley and Stockill, 2001) to find the water supply and 30 hours for 90% of pigs to find the feed supply (Bruininx et al, 2002). Although these studies are not related there may be an indication that one event may be associated with the other and this was shown by Bartels et al in 1999 and Brooks et al (1984) (Figure 1) who both showed a positive relationship between feed intake and water intake. If we, therefore, can get the pig onto water and/or feed soon after weaning the better the post-weaning performance.

Figure 1. Estimation of water intake in young pigs as a function of feed intake for a 21 day weaned pig.



STRATEGIES TO INCREASE WATER INTAKE AND REDUCE WASTAGE

Drinkers

The most common drinkers used in commercial facilities include nipples, bite-type drinkers and bowls/cups. Nipple drinkers are often used in UK nursery facilities due to the perceived ease with which piglets can access the water. Often the problem with drinkers is not the access of the pigs to the water but the wastage that can occur. Wastage not only results in a cost through increased quantities of slurry but also through wasted medication in the event that water medication to the unit is being applied.

Water wastage can come from drinker height, the angle of the drinker, flow rate and type of drinker and so all should be checked to ensure wastage is minimised. For example McKerracher (2007) compared two drinker types in a commercial unit where the standard nipple drinkers were compared to ball-bite drinkers. The results showed that there was a 35% reduction in water wastage by using the ball-bite drinkers and a greater return per pig of approximately $0.50 per pig compared to the nipple drinkers. This assessment needs to be reviewed unit by unit as all production systems differ.

Drinker type can have an impact on water intake and wastage. Comparing three types of drinker, Torrey et al (2008) showed that drinker type did affect water consumption by the pig and the amount of water wastage (Table 5). The float drinker performed poorly which can be partly attributed to the water even with daily cleaning becoming soiled by urine, feces and feed and it has been shown pigs will not drink from an unclean water source (Philips and Philips, 1999). Both the nipple and push drinkers showed similar water intakes which were reflected in improved average daily gains compared to the float drinker. However it was noted that the nipple drinker resulted in 56.1% water wastage compared to the push drinker which had water wastage of 19.3%.

Table 5. Mean water consumed, wasted and used at the three drinker devices averaged across 14 days post-weaning.

	Drinker Type		
Water, ml/pig daily	Float	Nipple	Push/Bowl
Consumed	475a	870b	774b
Wasted	295a	1114b	186a
Used	770a	1984b	960c
% Wasted	38	56.1	19.3
ADG (Relative % to Float)	-	+ 6%	+9%

This data shows the need to invest in the correct drinkers that not only stimulate water consumption and thereby pig performance but also limit wastage. Both improving pig performance and reducing water wastage will increase the return on the pig unit.

It is also important with drinkers that they are adjusted regularly during the nursery so that all pigs within the pen have no issues with obtaining access to water. The general rule is to adjust the height of the drinker to the shoulder height of the smallest pig in the pen. This ensures water intake; thereby feed intake is maintained and water wastage is reduced.

Water Flow

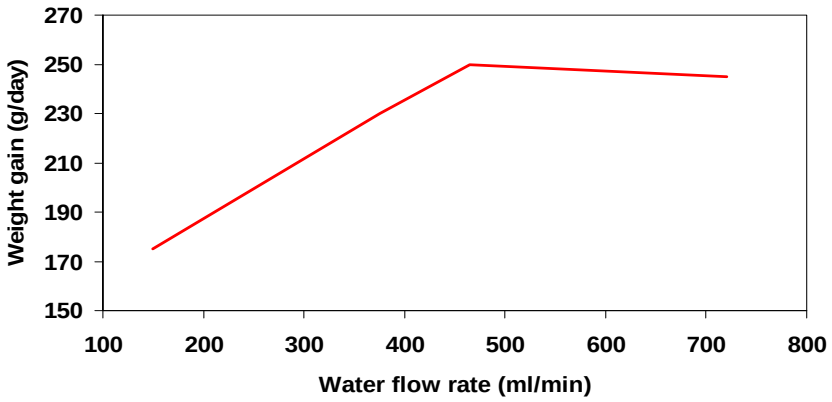
As part of the normal checking procedure drinkers are often checked to ensure no blockage and that water is flowing. However, how often do producers measure the flow rate? Flow rate is critical for the young pig as if it is too low the pig will move away from the drinker before satisfying their daily needs. Hence weight gain (feed intake) is reduced as the flow rate is reduced and water intake becomes insufficient (Barber et al, 1989; Figure 2).

It is generally recommended that a minimum of 500 ml per minute flow rate should be used in the nursery and 1000 ml should not be exceeded. It must be remembered that higher flow rates are correlated to an increase in water wastage. When checking flow rates within a nursery system, it is important to check pens at different parts of the nursery as the flow rate can be reduced due to pressure loss from the first pen to the last pen running the length of the nursery.

Water Enhancers

Although there is a need to stimulate water intake in the piglets post-weaning, it must be cautioned that over stimulation can cause excessive water intake which can result in gut fill and reduced feed intake.

Figure 2. Effect of water flow rate on weight gain.



Flavours

Recently there has been a new interest in using flavours in water to stimulate water intake in piglets post-weaning, although care needs to be considered when using flavours in water and feed as benefits are not always seen. Further work needs to be done in this area. Results (Bertram et al, 2002) have shown that the use of flavours have improved the critical 24-hour period post-weaning water intake by 34% while improving water intake over 14 days by +4%. Extra growth of 1.5 kg was recorded at the end of the nursery period on those pigs fed a flavour in the water post-weaning. This is supported by Roura et al (2005) with a flavour giving an improvement in both water intake and average daily gain 14 days post-weaning.

Globulin proteins

Work has looked at the benefit of using globulin proteins supplied through plasma and serum in the water on stimulating water intake and feed intake on post-weaning performance. Globulin proteins help support the gut integrity of the newly weaned piglet and should thereby stimulate increased feed intake. Data has shown that the use of globulin proteins improves water intake, feed intake and growth immediately post-weaning. (Steidinger et al, 2002; Miller andToplis, 2001).

Water Quality

Water comes from many different sources such as main supplies, lakes and bore holes. Its quality can vary and the impact on pig performance is still not well-known but can lead to refusal and scour if quality is poor. Chemical characteristics are the biggest concern as these are natural properties of the water and high salts can cause water refusal, scouring and loss of appetite. This topic is too extensive to cover here but one of the most important tests to do is to test for Total Dissolved Solids (TDS). This will provide an indication of the level of salts (may include carbonates, sulphates, nitrates, chlorides, phosphates and fluorides) dissolved in the water and a guideline (Table 6) is set out as outlined by the NRC, 1998. It is advisable to do further chemical testing if TDS's are found to be > 1000 ppm.

Table 6. NRC water quality guidelines.

Total Dissolved Solids	Rating	Comment
< 1000 ppm	Safe	No Risk
1000 to 2999 ppm	Satisfactory	Mild diarrhoea in pigs not adapted to the water
3000 to 4999 ppm	Satisfactory	May cause temporary refusal of water
5000 to 6999 ppm	Reasonable	Higher levels for breeding stock should be avoided
> 7000 ppm	Unfit	Risky for breeding stock and pigs exposed to heat stress.

Of the potential chemicals dissolved in water, the main problem normally comes through high sulphate levels. Levels higher than 1000 ppm may cause diarrhoea but work by Patience et al (1997) showed that in commercial situations pigs receiving water with 1634 ppm sulphates performed as well as pigs with low water sulphate levels. High levels of sulphates may result in water refusal.

Improving water quality will ensure that the pigs drink adequate water to sustain high growth.

TEMPERATURE

Temperature control is still poor on many pig units and production and health are affected. Air temperature can affect growth performance mainly through its effect on feed intake if the pig is outside its thermal comfort zone.

The critical time for temperature control is the post-weaning period when the pig's feed intake is low as it adjusts to the new environment. In colder conditions the older pig can adjust somewhat by increasing feed intake to increase energy input, however post-weaning the pig cannot compensate with higher feed intakes and this results in reduced body insulation, and poorer pig performance.

An example of how performance of the piglet is affected by the post-weaning ambient temperature is shown in Table 7. Piglets were weaned at 28 days with a weaning weight of 6.64 kg and weaned into either a pen with a heat lamp or pen without a heat lamp. Room temperature was maintained at 21°C while those pigs with a heat lamp were maintained at 29°C. The outcome was that after 10 days the pigs at 21°C grew 33% less and consumed 53% more feed than those pigs maintained at 29°C.

This shows the importance of ensuring that the pig remains in the comfort zone thereby optimising pig performance. Often as producers we do not know what the temperature is at the pig level and not only is the average temperature important but the daily temperature variation. Studies (Kurihara et al, 1996; Le Dividich, 1981) have shown that large daily temperature variation (minimum and maximum) has a negative impact on performance. Kurihara et al (1996) compared pigs at an average of 58 days in a constant environment of 21°C with pigs that had a variation of 3°C around 21°C and pigs that a 6°C variation around 21°C (Table 8).

Table 7. Temperature impact on post-weaning performance.

	1 to 3 days	4 to 6 days	7 to 10 days	1 to 10 days
29°C – Wt Gain (g)	148	262	1165	1574
21°C – Wt Gain (g)	-68	123	1001	1057

Reference: Maenz et al, 1994

Table 8. Effect of varying pig temperature on piglet performance.

Temperature °C	21	21+/-3	21+/-6
Conditions	Std	Low	High
ADG (g/day)	682	660	602
ADFI (g/day)	1330	1300	1150
FCR	1.95	1.97	1.95
ADG (Relative % to 21°C)	-	- 4%	-12%

The feed intake of the piglets was reduced by 14% under the high fluctuating conditions while there was a 3% reduction in the low fluctuating conditions resulting in poorer performance in both treatments. It is therefore important to not only provide the correct temperature but with a minimum variation throughout the period and although limited data the minimum variation would be < 3°C.

LIGHTING

Lighting application in nursery has had little attention paid to it although in the last few years research has provided some interesting results which need further investigation. Initial research (Bruininx et al, 2002) showed that increasing the continuous light duration from 8 hours to 21 hours daily in the initial two weeks post-weaning resulted in an increased feed intake (+71 g/day) and average daily gain (+85 g/day). Other work by the University of Illinois (Niekamp et al, 2007) has shown similar response whereby ADG has improved when the lighting regime was increased from 8 hours of light to 16 hours of light. The interesting part of this trial is that, in addition to performance, the researchers looked at the immune function and found an interaction between light duration and weaning age on immune status. Interestingly, the study showed that for a 14-day weaned piglet, if the light period was increased from 8 hours to 16 hours then the liveweight at 10 weeks of age was increased. This may be linked to the immune system as those pigs on a 16-hour light regime had a lower level of B lymphocytes. Thereby, more nutrients supplied may be utilised by the pig for growth, resulting in the better gain response seen. Unlike poultry, little work has been conducted on pigs with different lighting regimes and this work throws up interesting areas of management research to improve pig performance.

FEEDERS – DESIGN AND MANAGEMENT

Design

As feed intake is a key determinant of post-weaning performance, the way the feed is presented by the feeder may be significant. The object of the feeder is to give good access to feed, some protection to the pig and sufficient comfort for the largest pig in the pen. On entry into the unit it is important to stimulate early feed intake and so it is important to have a high feeder space so that pigs can feed together as the piglets are used to group feeding from the time on the sow. It is important that, in this early period, pigs are not competing for feed as larger piglets have an advantage over the smaller pigs and, over time, these differences increase.

A comprehensive trial (O'Connell et al, 2001) investigated five different feeder types and their impact on pig performance from 5 weeks through to 11 weeks of age (Table 9). There were two feeding phases: 5 to 7 weeks and 8 to 11 weeks.

Table 9. Performance from 5 to 11 weeks of age.

	ADFI (g/day)	ADG (g/day)	FCR	Variation (kg) at 11 wks[1]
Dry Multi-Space	897	598	1.50	4.9
Wet & Dry Multi Space	951	605	1.58	6.5
Maximat	863	577	1.49	6.4
Lean Machine	839	572	1.47	7.5
Verba	824	575	1.42	7.4

1. Variation is the kg difference between the lightest and heaviest pigs in the group.

The researchers then tried to quantify the effectiveness of the feeders and this is shown in Table 10.

Table 10. Summary of pig performance, behaviour and management of different feeders.

	Stage 1 Growth Rate	Stage 2 Growth Rate	Variability	Feeding Pattern	FCR	Management
Dry Multi-Space	Good	Good	Low	Normal	Good	Easy
Wet & Dry Multi Space	Average	Good	Moderate	Normal	Poor	Prone To block
Maximat	Average	Average	Moderate	Normal	Good	Difficult to adjust
Lean Machine	Average	Average	High	Extended	Good	Very Easy
Verba	Good	Average	High	Extended	Good	Easy

From these observations it would seem that the traditional dry multi-space feeder provides the optimal solution for feeding the nursery pig. It is therefore important when refitting a nursery unit to determine the best feeder that gives maximum growth opportunity with ease of

management and low feed wastage. In this particular trial the difference between the best and worst feeders was a 5% difference in performance.

Management

As producers, it is important to manage feeders on a daily basis in the nursery. This means checking the feeder to ensure that there is not excess feed in the pan thereby resulting in feed wastage and that there is sufficient feed so the pig's feed intake is not compromised. This is difficult to determine but an experiment by Smith et al (2004) investigated the width of feeder gaps on pig performance. The interesting commercial application of this trial was that they related gap width to pan coverage and it was shown that the optimal pan coverage for performance was 38%. Looking at this in a practical sense it is suggested that 40-50% of the pan should be covered by feed in the first few days post-weaning but when the pigs intake starts to increase this can be reduced down to 25-35% pan cover. Ensure that on the walk through there is not a high level of feed wastage; if there is, then look at adjusting the feeder to compensate. Aggressive feeder management was shown by Dritz (2004) to improve growth performance 7 days post-weaning by +36% while FCR was reduced by 0.88 which is due to less feed wastage and continual access to fresh feed.

Mat Feeding

Mat feeding is a cost-effective way of feeding as long as feed wastage can be controlled. Controlled mat feeding over 3 days immediately post-weaning has been shown to double daily live-weight gain as mat feeding encourages the pig's rooting behaviour (Mavromichalis and Baker, 2000). Mat feeding should be done 3 times daily and it is better to use mats with rims to avoid feed wastage especially if feeding pellets. It is advised that if mats without rims are used then a crumb or meal is often better to use so as to avoid pigs rolling the pellets off the mat and increasing feed wastage of a high cost product. Floor mats should be situated away from corners and drinkers to avoid soiling and floor mats situated in front of feeders often help stimulate feeding activity. Mats are commonly used for 3 days post-weaning. Longer periods should be avoided so as to ensure that the pigs transfer feeding to the feeder.

GROUP SIZE

How many pigs to a pen? Interestingly it was always thought that increasing the number of pigs in a pen while maintaining the same stocking density would have a disadvantage on performance. Well, a review by Payne et al (2006) reviewed the literature and it showed that increasing group sizes from 5 to 100 pigs appeared to have a small impact on performance as long as the floor space, number of drinkers and feeders were the same. Gain was slightly reduced while feed conversion was not affected.

This supports the data of O'Connell et al (2001) that looked at 1280 piglets between 4 and 10 weeks of age. Pigs were grouped in pens of 10, 20, 30, 40 and 60 with each pig having the same space allowance, feeders per pig and drinkers per pig. Behaviour was monitored for changes in

aggression between the different group sizes. Variation was determined by the weight difference of the top 20% of the group and the bottom 20% of the group (Table 11).

Table 11. Performance of pigs from 4 to 10 weeks of age at different group sizes.

	Group Size				
	10	20	30	40	60
ADFI (g/day)	770	746	788	774	808
FCR	1.42	1.43	1.50	1.51	1.52
ADG (g/day)					
Small	449	510	517	515	513
Medium	577	540	519	546	536
Large	598	566	537	564	571
All	543	540	524	544	540
Wt Variation at 10 weeks of age (kg)	14.9	12.6	11.9	12.7	11.5

The researchers showed that there was no significant drop in performance with increasing group size and, surprisingly, the variation in weight was reduced. This can, in part, be explained by looking at the small pigs on trial. With 10 pigs per pen the small pigs were at a disadvantage due to greater competition at the feeder with large pigs. In larger pens due to the greater number of feeders available the smaller piglet gets easier access to feed and so growth is improved compared to 10 pigs per pen.

Equations have been determined (Turner et al, 2003) to calculate the small performance reduction seen for pigs when group size is increased (3 and 120 pigs per pen).

ADG (g) = 416 – 0.36 x No of Pigs per Pen
ADFI (g) = 681 – 0.51 x No of Pigs per Pen

This shows that performance reduction is low with an extra pig in a pen accounting for a reduction in ADG of 0.36 g and ADFI of 0.51 g.

It, therefore, seems that group size does not have a large effect on performance and so, in construction of new nursery units, the producer can review the benefits of a large pen system against a small pen system with respect to construction costs and labour costs.

STOCKING DENSITY

It is well-known that overstocking pigs in pen reduces feed intake and growth rate and results in more aggression between pigs and for vices to occur such as tail-biting, etc. The increased potential for vices to occur is bad for the producer as that means more downgrades and culling while increasing workload for stock people — all areas removing potential income from the production unit.

The optimum stocking density for performance may be different from the stocking density required to produce the maximum pork output. Smith et al (2004) showed (Table 12) that reducing stocking density from 0.35 m^2 to 28 m^2 to 0.23 m^2 resulted in a decreased performance. However based on pork output per pen from the nursery (pig number x weight gain) the greatest pork output was with the lowest stocking density (0.23 m^2). It is therefore important to determine the optimal stocking density for the unit that brings the greatest return, balancing pork output per pen against improved performance for the unit while also ensuring that the national welfare standards are met.

Table 12. Impact of stocking density on nursery performance and pork output.

	Stocking Density		
Pig Per Pen	24	20	16
Stocking Density (m^2)	0.23	0.28	0.35
Start Weight (kg)	7.05	7.12	7.07
End Weight (kg)	28.03	29.39	29.69
ADG (g/day)	499	530	635
Gain (kg)	20.98	22.27	22.62
Pork Output (kg)	503	445	361

GENETICS

Different genetic crosses perform differently and a recent trial (Wilcock 2009, personal communication) shows the difference that genetic crosses can have within the same production system (Table 13) when measured over 18 days. Again, ensuring that you have the correct genetic cross to meet your needs is important.

Table 13. Differences in genetic crosses within same production system.

	Cross A	Cross B
ADG (g/day)	100%	118%
ADFI (g/day)	100%	120%
FCR	100%	103% (worse)

AIR QUALITY – AMMONIA

Excreta produces numerous gases including ammonia, carbon dioxide, hydrogen sulphide and methane. Ammonia is the most prominent gas in the pig house and it is recommended that levels below 20 ppm are targeted. Again in production systems ammonia levels are not often tested and if they are tested it should be at the same height as the pigs in the pens. If levels reach 50 ppm in the nursery the ADG can be reduced by 10-15% and pigs struggle to clear harmful bacteria from the lungs. If levels reach 100 ppm the ADG is reduced by 25-35% and there is an increase in vices such as tail-biting as well as irritation of mucosal linings. Ammonia can be reduced by

adequate ventilation or through nutritional manipulation such as the use of feed ingredients such as yucca or calcium chloride.

MIXING LITTERS

When unfamiliar pigs are mixed, pigs become aggressive and fighting can occur in order to sort out dominance within the pen (McGlone et al, 1987). This can lead to a reduced feed intake which in part may be explained by the increased aggression of mixing pigs at the feeder (Tan et al, 1991) or by stress-induced metabolic changes (Gonyou, 2001). Although the indications are that mixing litters is not advantageous in terms of production, many systems are set up to do this at weaning due to numbers of pigs per pen to fill to ensure that pork per area is maximised within welfare and production standards.

So, what is the impact of increasing numbers of litters per group? Research conducted by O'Connell (2008) compared the effect of increasing the number of litters per group on 6 week post-weaning performance with pigs weaned at 28 days (Table 14).

Table 14. Effect of numbers of litters per group on nursery performance.

From 28 (weaning) to 70 days of age				
Numbers of litters per group	1	2	3	4
ADFI (g/day)	847b	765a	792ab	744a
ADG (g/day)	555b	516ab	545b	482a
FCR	1.53bc	1.48ab	1.45a	1.54c
COV Growth Rate	0.11a	0.16ab	0.13a	0.20b
Injury Scores 1 week post-weaning	2.8a	6.6b	8.8c	9.8c

As expected, if just one litter group was used then that gave the better performance and was associated with the lowest injury score in week 1. However if number of litters per group were increased there was a significant linear reduction in performance ($P<0.05$) in respect of feed intake and growth while there was also a significant increase in injury scores. This reduced performance and could be explained in part by the increased aggression associated with the increase in litters per group. This increased aggression may also explain the increased variation seen with higher number of litters per group.

Mixing litters is important from a production standpoint and these results show that minimizing the mixing of pigs at weaning can give a benefit in production through the nursery. Reducing a group of pigs from 4 to 3 litters increases feed intake by +6% while increasing gain by +13%, production benefits that as a producer we want to gain.

FEED

The final area to cover with respect to management and achieving that early post-weaning growth is feed. Feed can assist in many units with overcoming some of the management issues we face but a combination of the correct feed, feed program and good management is the best chance of successful pig production.

Creep Feeding

Should we creep feed? In general there is a split view on creep feeding as in later weaning (> 21 days) most producers creep feed due to the increased intake of feed consumption from 21 days on. Researchers have shown that in late weaned pigs, creep feeding improves post-weaning feed intake and gain. Producers that wean less than 21 days are less likely to creep feed as feed intake is often low and the belief is that there is no potential benefit to performance. However, the use of creep feeding is important in large litter sizes where creep can be used to supplement the sow's milk but also creep feeding is important in the subsequent post-weaning performance. Dutch work (Bruininx et al, 2002) showed that offering creep feeding and getting pigs to consume creep improved the post-weaning gain performance by +17% post-weaning. This was recently supported (Sulabo et al, 2008) when in 21-day weaned pigs creep feeding was monitored by using green dye in the feed which allowed the researchers to determine which pigs had consumed feed or not. The outcome of these results was that pigs that were offered and consumed creep had a 5.5% benefit in post-weaning gain when compared to pigs that did not consume creep or were not offered creep at all. This shows the importance of offering creep but also in ensuring that pigs consume the creep. The US researchers did a further study that showed that one management technique that may work in 21-day-old weaned pigs is to introduce creep feed earlier in the life of the pig. Introducing creep from 7 days of life rather than 14 days was shown to increase the percentage (10% or an extra pig per litter) of pigs consuming creep by the time of weaning.

Another way of increasing creep feed consumption is to increase the complexity of the creep feed. Fraser et al (1994) showed that increased complexity of the diet increased the creep feed consumption of the piglet which improved post-weaning growth.

In addition creep feeder type can impact feed intake and percentage of piglets consuming food. Sulabo et al (2008) looked at three types of creep feeders and showed that one particular feeder type increased the percentage of pigs consuming creep by approximately 30% when compared to the other feeders.

These studies show that creep feed intake by suckling pigs in both early and late weaned pigs stimulates early post-weaning feed intake as improved post-weaning performance. The two studies showed that creep fed piglets improved gain by an average 11.25% at approximately 30 days post-weaning. This advantage in performance can be achieved through focusing on creep feeding and using management to stimulate creep feed intake.

Quality Starter Feeds

High quality starter feeds with improved digestibility (milk, cooked cereals, etc.) have been shown to improve post-weaning performance and result in improved growth performance right through to slaughter. In addition, the use of higher quality diets with lighter pigs at weaning does not promote equal growth performance to the level of the heavier pigs but does appear to help light piglets cope better with weaning and avoid being further disadvantaged. The benefit of quality starter feeds has been reviewed previously by Willis et al (2003) and in that paper the results of a quality starter feed on early nursery performance and subsequent nursery performance was shown (Table 15).

Table 15. Effect of feeding a complex high digestible feed 11 days post-weaning on subsequent nursery performance.

		Stocking Density		
		Standard	Complex	Difference
Test Feed (11 days)	ADG (g/day)	209	259	+23%
Standard or Complex	FCR	1.17	0.95	+19%
Common Feed (10 days)	ADG (g/day)	377	413	+10%
All pigs fed common feed	FCR	1.29	1.24	+4%
Common Feed (20 days)	ADG (g/day)	586	650	+11%
All pigs fed common feed	FCR	1.61	1.60	+1%
Total Weight Gain	kg	18.0	20.2	+2.2 kg

First there was, as expected, an immediate benefit with the complex diet in the first 11 days post-weaning. This is the result of the trial diets containing higher levels of milk protein and cooked cereals resulting in greater feed digestibility and thereby performance. In addition the lack of soybean meal in these early feeds ensured that the pigs fed complex feeds did not become immune activated, thereby diverting important nutrients such as energy and amino acids from growth into maintenance of the gut structure and immune functions. Earlier work has also shown that higher energy intake immediately post-weaning maintains villous height while lower energy intakes have an adverse effect (Pluske et al, 1996a, 1996b).

Using a complex diet for just 11 days post-weaning gave not only a benefit in that period but also improved performance thereafter in the nursery even when all pigs were fed a common diet. At the end of the nursery the use of the complex diet for 11 days improved the gain out of the nursery by 2.2 kg. Again this shows that when the newly weaned pig's early nutritional needs are met without compromising his digestive or immune systems, then the performance benefits are carried forward.

Other work (Mahan et al, 2004) shows the improved benefits of diet complexity and US researchers showed that increasing feed digestibility improved performance through the nursery with an extra 2.65 kg at 28 days post-weaning through the use of an improved starter feed quality.

Other advantages of complex feeds other than performance benefits are the reduced variation in nursery out-weights and the reduction of poor pigs (hospital pen) in the nursery (Wilcock, unpublished).

To achieve the targeted early post-weaning growth and nursery performance, complex high digestible feeds using quality raw materials can be used for 2 to 3 weeks post-weaning prior to moving on to common soy/cereal based diet with benefits not just in the initial 3 weeks but on the subsequent common program.

Gruel Feeding

Gruel feeding is often a method used with piglets up to 5 days post-weaning to be fed alongside traditional dry feed. It should not be fed for longer as it will lead to pigs having difficulty in learning to use the dry feeders. The exception to this is hospital pigs may be fed for longer. Gruel should be fed multiple times (2 or 3 is common) a day and it must be remembered that gruel is an area of potential bacterial growth so gruel pans/feeders should be cleaned out and any stale gruel removed. Additionally, gruel is also used to help pigs that do not move onto self-feeding quickly and would become starve outs. In this process gruel can be placed in a syringe with the end cut off and the pigs hand fed. When placing the pig down it is advantageous to place near the feeders as the pig will associate the gruel/feed with the feeder and improve the opportunity of self-feeding.

FEED PROGRAM

It is important to feed the correct program set out by the nutritionist and not to underfeed the pig so losing performance or overfeed the pig higher cost diets than needed. An example of this was shown by the Prairie Swine Centre (Whittington et al, 2005) in a pig unit where they measured feed used against budget. This showed that the unit was underfeeding phase 1 and phase 2 feeds by approximately 5 kg and this was reflected in a pigs being 4.5 kg behind the nursery target exit weight. On correcting the program nursery exit weights were now much closer at just 0.8 kg behind target. On this unit, it was calculated that although there was an extra cost associated with feeding more of phase 1 and 2 the corrected program increased profit by $1.85 per pig or $25,000 per annum on a 600-sow unit.

One area that seems to differ depending on the country that you are in is whether producers want to feed to kg or to days. It is important, if possible, to ensure that the feed budget in kg is consumed by the piglet rather than switch the feed due to days as getting the correct feed per pig in that immediate period post-weaning is critical in ensuring that piglets do not fall behind target weights. This often means that feed changes will need to be monitored by pen or minimum room, but the advantage is cost-effective growth.

There is still a debate over if there are any benefits of batching pigs by size at weaning and then feeding to start weight. Work by Schinkel et al (2003) showed that the top 80% of pigs through the nursery have a similar ADG while the bottom 20% of pigs have a fall off in gain. It is therefore important, where possible, to treat the bottom 20% of the pigs as a separate population

and take a proactive approach in minimising the negative impact these pigs can have on the production system. It is therefore suggested in typical commercial units that due to practicality the bottom 10% of pigs should be grouped together and fed a separate program whereby they get more of the initial phase 1 program compared to their heavier litter mates. This management practice promotes growth of the lighter pig and reduces the variation out of the nursery.

FEED WASTAGE

With high feed prices in the last 18 to 24 months, it is essential that feed wastage on the unit is minimised. This subject is too large to cover in this paper and is already well reviewed by Carr (2008). In this paper it is estimated on an average farm that 10% of all feed delivered to a farm is wasted. Based on a 500-sow unit, that is 300 tonnes of feed per year (based on 6 tonnes per sow and progeny per year). Based on an average feed cost of $300 to $400 per tonne and 21 pigs marketed per year, that would equate to a cost of $8.57 to $11.42 per pig marketed. This equates to approximately $0.11 to $0.14 per kg of deadweight. Even 2% wastage equates to $1.71 or $2.28 per pig cost. These calculations, although estimates, give a strong indication of what feed wastage can cost a unit in terms of additional cost of production and how a strategy on farm to reduce feed wastage can improve cost of production on the unit.

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