Feeding Growing and Finishing Pigs to Maximize Net Income

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▪ Introduction

If the goal of pork producers is to deliver high quality pork to the packing plant at the lowest possible cost, then any attention paid to the feeding program of the growing and finishing pig is fully justified. This is because feed represents 40 to 60% of the total cost of production, and because feed has such a profound impact on product quality. We all know that the ultimate quality of pork is defined by many factors, including genetics, nutrition, health and environment. The challenge of the feeding program is to achieve the best possible carcass in the shortest possible time at an affordable cost under a specific set of genetic, health and environmental conditions.

The appropriate balance of inputs (feed, housing, etc.) and outputs (carcass) is the essence of management. How much should be spent on feed and other inputs and what can be expected in return for this investment in feed, in order to maximize profitability? This question, at once both simple and complex, is the key to the proper application of nutrition on the farm. It requires an understanding of both the response of the pig to nutrient intake and of the ways to supply these nutrients at the lowest possible cost. In other words, how much energy and amino acids should be fed to achieve production objectives? And, how can available ingredients be sourced and brought together to satisfy the pig's requirements?

Looking at Table 1, current feed costs are estimated to be in the range of $76 per pig sold. This includes an allowance of $15 per tonne ($5.28/pig) for feed manufacturing and delivery, which itself includes a 1% allowance for shrink. Total feed ingredient costs would be about $70 per pig sold; this includes an allotment for the breeding herd.

Table 1. Example feed budget: November, 2001.

Phase	Cost/T[1]	Per Sow Per Year		Per Gilt Sold[2]		Per Barrow Sold[2]		Per Pig Sold[2]
	$	kg	$	kg	$	kg	$	$
Gestation	185	700	129.50	32	5.92	32	5.92	5.92
Lactation	226	500	250.00	23	5.20	23	5.20	5.20
Starter 1	520	-		3	1.56	3	1.56	1.56
Starter 2	396	-		18	7.13	18	7.13	7.13
Starter 3	271	-		25	6.78	25	6.78	6.78
Grower	220	-		65	14.30	65	14.30	14.30
Finisher 1	195/187	-		86	16.77	94	17.58	17.18
Finisher 2	188/181	-		92	17.30	100	18.10	17.70
Total			**379.50**	**344**	**74.96**	**360**	**76.57**	**75.77**

[1] Includes $15/tonne processing charge, which includes 1% allowance for shrink, except Starter 1 that is purchased as a complete feed. Processing charge is equal to $5.28 per pig sold. Finisher diets reported separately for both gilts and barrows. Therefore, ingredient cost per pig sold is $70.50.

[2] Assumes sales of 22 pigs per sow per year. Feed amounts result in growout feed conversion of 2.9:1 and a whole herd feed conversion of 3.1:1.

NOTE: The above information is provided as an example only. Actual results will vary among farms.

▪ Feed Budgets

Feed budgets are estimates of the quantity of each diet that will be fed to a pig. Studying feed budgets can be a very useful exercise. It allows individual producers to determine where they are spending their feed dollar, and whether the correct amount of each diet is, in fact, being fed to each pig. For example, it is not uncommon to see the Stage 1 starter overfed when feed budgets are absent, because there is a strong tendency to try to improve animal performance by providing higher quality diets. However, an increased net cost of feed of $1 per pig or more has been identified when feed budgets were compared with actual feed usage in the nursery.

More than 62% of the pig's total feed intake will be consumed after it reaches 60 kg (Table 1)! More than 54% of the total cost of feeding the pig from weaning to market occurs after the pig reaches 60 kg! Therefore, the last two phases of the feeding program (in this example) must be carefully formulated to avoid additional and unnecessary cost while at the same time ensuring adequate nutrient intake to optimize income.

In the past, it was a common strategy to over-feed the pig, to ensure that the nutrient requirements were being met. Typical examples were calcium, phosphorus and lysine. This approach is no longer acceptable, due to the cost involved. For example, using November, 2001 prices, increasing diet DE content by 100 kcal/kg and exceeding the lysine requirement by 0.10% increases the cost of a finisher diet by almost $11 per tonne - and increases the net feed cost per pig by about $1.00 per pig; this calculation provides for an improvement in feed conversion of 3.2%, due to the increased energy in the diet.

Feed cost can be affected by sow productivity. In this example feed budget (Table 1), 22 pigs are sold per sow per year. If this could be increased to 24 pigs, feed cost would decline by $1 per pig sold. Conversely, if sales were only 18 pigs per sow per year, feed costs would increase by $2.35 per pig sold. Therefore, over the typical range of sow productivity that we see on the Prairies, feed cost can be altered by $3.35 per pig sold, equal to about 4%. (Obviously, the impact of increasing pigs per sow is much greater on the revenue side and in reducing fixed costs per pig sold.)

As important as sow productivity may be, similar savings can be achieved in any number of other ways. To reduce feed cost per pig sold by $1, one would need to buy grains $0.10 per bushel cheaper, reduce feed wastage by 1.5 percentage points (eg. from 7% to 5.5%) or reduce feed processing costs by 19%. Most of these improvements are probably easier to achieve than increasing sow herd productivity by 2 pigs per sow per year.

Another way to increase net income by $1 per pig sold would be to increase feed intake by only 1.4% during the entire growout period. This would increase carcass weight by 1.2 kg, which at current market and feed prices, would increase net income by $1 per pig sold! As we shall see later on, increasing market weights is perhaps the most effective way to increase net income, and improvement in growth rate is within the grasp of most farms today. Indeed, an increase in feed intake of 5% is not an unreasonable target on many farms; this would increase net income by $3.57 per pig sold.

▪ How Do I Establish the Objectives of My Feeding Program?

Targets for an individual farm can take many forms. They may be economic targets, or productivity targets, or personal lifestyle targets. Economic targets for a pig unit generally require information from other farms, to determine what is achievable. Certainly, one might target savings of $1 per pig or $5 per pig, when prices decline, but the most effective targets are those that place one farm in the context of others operating under similar circumstances. For example, if you knew that your feed cost per pig sold was $5 higher than anyone else, and yet your revenues were no different, then you could reasonably conclude that the opportunity exists to reduce your feed bill. In this way, targets for cost of production or net income can be related to industry standards. Unfortunately, comparable information is not often shared among farms, making such information difficult to obtain. It is one very important reason to form production clubs or buying clubs, as such relationships among farms facilitates the sharing of financial information.

In the absence of economic targets, or in concert with them, production targets are often used. Many productivity databases, such as PigChamp©, are broadly available and allow individual farms to establish productivity targets. For example, at the Prairie Swine Centre, our target is to be within the top 10% of 8 key productivity indicators, including farrowing rate, preweaning mortality and pigs weaned per sow per year. Productivity targets are obviously closely aligned with economic targets; the greatest risk, however, is focusing excessively on productivity, such that expenses are increased more than revenues.

The last decades of the 20th century were marked by a declining emphasis on personal lifestyle issues, in response to greater pressures being placed on business and professional issues. As a result, it has become a rarity to discuss personal lifestyle issues in the content of farm objectives; indeed, it has almost become a dirty word. For example, starting in the late 1980's, many pork producers expanded, not only to achieve economies of scale, but also to allow them to hire staff; this allowed the owner to free up more evenings and weekends for family time and to pursue other off-farm interests. Thus, the expansion of the farm was carried out in part to achieve personal lifestyle objectives.

Increasingly, we see that farm targets set without including personal and family targets are more difficult to implement and achieve. Recently, a vice-president of WestJet described how that company, currently the most successful airline in North America, started by aligning their corporate vision with the interests of their employees'. I had never before heard a corporate executive talk in such terms, but it is hard to argue with success and it certainly makes intuitive sense.

Animal Performance Targets

Animal performance targets can be expressed in many ways. Focusing specifically on the growout herd, following are some targets based on our experience of what is happening across the Prairies (Table 2). The "Good" category can reasonably be achieved by anyone, "better" is currently achieved on an on-going basis by some but not all farms and "best" is achieved by some farms sometimes, but rarely achieved on a consistent, on-going basis.

Table 2. Animal performance targets for growout herd.

	Good	Better	Best
Feed conversion	3.0	2.8	2.6
Growth rate, g/d	750	825	900
Protein deposition rate, g/d	110	125	135
Mortality, %	2	1	0.5
Percent lights (<75 kg)	10	5	0

■ Feed Intake: How Important is It?

It is difficult to over-estimate the importance of feed intake, because it is the ultimate driver of growth. As one example, everyone has experienced the decline in growth rate that occurs in the hot summer months; this is the result of reduced feed intake in pigs exposed to elevated barn temperatures. De Lange (1993), using a pig growth simulation model, calculated that income per pig place is reduced by $9.50 per pig sold if feed intake is 11% less than expected.

When comparing performance among farms, differences in growth rate are almost always explained in large part by differences in feed intake. This is not to diminish the importance of properly balanced diets and well-designed feeding programs, or the significant impact of health status on protein deposition rates, feed intake and feed efficiency. However, when problems of slow growth are identified in a barn, and once the "easy" issues are addressed, the greatest challenge to improved growth rate, and thus increased profits, is how to increase feed intake.

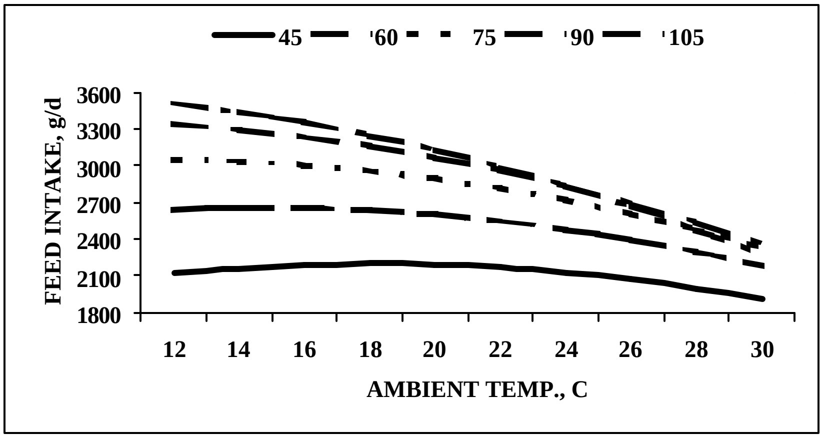
A small survey conducted in Alberta in the early 1990's revealed that feed intake varied by 35% among farms. Looking at individual data obtained since then from various farms across the Prairies, this degree of variation in intake is not exaggerated. Following is a checklist of items to consider when trying to resolve feed intake problems:

Barn temperature

- Too high lowers feed intake (See Figure 1); too low reduces feed efficiency
- Older pigs are affected much more profoundly than younger pigs

- Lowering setpoint temperatures by 6C° in the growout barn in the summer time has been shown to increase net income by up to $0.80 per pig (Lemay et al., 2001). This calculation includes an allowance for the cost of increased fan operation.

Figure 1. Impact of ambient temperature on feed intake of pigs of varying body weights.



Genetics

- The baseline feed intake will be defined by the genotype in use. This will dictate targets for feed intake, as genotypes do differ.
- Genotypes with the greatest feed intake may not be the ones with the fastest growth rate, or the greatest lean gain (Table 3)

Table 3. Genotype effects on feed intake and growth, including relative ranking (in brackets).

Genotype	Feed Intake kg/d	Daily Gain g/d	Lean Gain g/d
1	3.145 (2)	916 (5)	329 (5)
2	3.019 (5)	924 (4)	361 (3)
3	3.055 (3)	1,010 (2)	390 (2)
4	3.238 (1)	1,001 (3)	332 (4)
5	3.028 (4)	1,017 (1)	393 (1)

Source: Gu et al., 1991

Barn entry weight

- It is an undeniable fact that bigger pigs eat more feed. Therefore, anything that can be done to increase the size of pigs entering growout will increase feed intake.

Floor space allowance

- The floor space that maximizes growth rate and feed intake (fully slatted floor = 0.035 m^2 $BW^{0.667}$ corresponds to 8.8 ft^2 at 115 kg; partial slatted floor = 0.039 m^2 $BW^{0.667}$ corresponds to 9.8 ft^2 at 115 kg) is not the one that maximizes the quantity of pork produced per square meter. Producers need to determine the floor space allowance that optimizes their system.

Feed and water access

- There is no financial justification for limiting access to feed or water.
- The capacity of a feeder will depend on its design and whether feed is a mash or a pellet. Dr. Gonyou recently determined that feeder space capacity can vary from 11 to 20 pigs, the variation due to feeder design and mash versus pellets.
- Adjustment of waterers and drinkers is also important to feed and water access.
- Using mash diets, wet/dry feeders will increase feed intake by 5% as compared to dry feeders (Gonyou and Lou, 2000).

Social interaction

- Re-grouping pigs to achieve a perception of more uniform pens will not improve performance, and in fact will increase days to market due to the disruption which occurs during mixing. The less pigs are mixed, the better off they are in terms of overall performance.
- Stookey and Gonyou (1994) reported that mixing pigs 2 weeks before marketing reduced subsequent growth rate by 11%, and thus reduced market weights. Mixing may only make economic sense when it significantly improves building utilization, eg. mixing partially marketed pens of pigs to make room for the next group of pigs from the nursery.

Group size

- Pigs housed in very small group sizes (<5 per pen) will eat more feed than pigs in commercial group sizes (20+ per pen).
- Performance in group sizes up to at least 80 animals is very good (Schmolke and Gonyou, 1999).

Health status

- Even moderate health problems can reduce feed intake by 5% or more. Svere health problems have been shown to reduce feed intake by 15% or more.

Diet composition

- Many issues of diet formulation will affect feed intake. Similar to recent findings in Australia, Ekpe et al. (2001) reported that different samples of wheat or barley affect feed intake. For example, feed intake varied by 21% among 4 barley samples and by 17% among 4 wheat samples.
- Balance of amino acids, as well as the balance of energy in relation to amino acids will affect feed intake.
- Excess minerals, especially calcium, may reduce feed intake.
- Many feed additives will increase feed intake, but the net economic benefit will vary among farms. The use of such additives is under increasing scrutiny, so alternatives such as probiotics and prebiotics are currently being evaluated.

Antinutritional factors

- Many common ingredients contain anti-nutritional factors (ANF) that can lower feed intake. Soybean meal must be heated to destroy undesirable enzymes in the seed. Canola meal and field peas also contain ANF; however, if included in the diet at recommended levels, the impact on feed intake is negligible or nil.

Avoid empty feeders

- As simple as this sounds, some barns have aggravating problems with keeping feeders full. Causes range from feed mill operations through to feed delivery to the barn and to the pen. For example, putting the biggest pigs in the pen where the feed system delivery switch is located will ensure that the pigs with the biggest.appetite dictate how often the feed auger is turned on. If pigs with smaller appetites are put in this pen, feeders in other pens, with larger pigs, could run out of feed.

Energy density and feed cost

It has always been assumed that in the younger pig, up to and including the growing stage, gut capacity and thus energy density is limiting animal performance. It has therefore been logically concluded that increasing energy density will improve performance in pigs up to at least the end of the growing stage (~75 kg). There is now a growing body of research showing that once a moderate level of energy is provided to the pig, further increases will improve feed efficiency but not growth rate (Patience, 2001). Further research is required in this important area; however, we should no longer assume that increasing diet DE will improve growth rate. The data in Table 4, though representing a nursery experiment, illustrates the point very well; increasing dietary DE content does not necessarily increase growth rate.

Table 4. Performance of young pigs (25 to 56 days of age) weaned to on-site or off-site nurseries and fed one of three DE levels[1]

Site	Energy level[2]	ADFI (kg/d)		ADG (kg/d)	
		Phase III	**Phase IV**	**Phase III**	**Phase IV**
On-site	Low	0.51	1.00	0.43	0.62
On-site	Medium	0.46	0.92	0.38	0.58
On-site	High	0.45	0.85	0.38	0.59
Off-site	Low	0.59	1.05	0.49	0.67
Off-site	Medium	0.53	0.99	0.45	0.67
Off-site	High	0.51	0.94	0.45	0.66
Nursery Site					
Off		0.54	0.99	0.47	0.67
On		0.47	0.92	0.40	0.60
Energy Level					
Low		0.55	0.77	0.46	0.64
Medium		0.49	0.70	0.42	0.63
High		0.48	0.67	0.42	0.62

1 Pigs were weaned at an average age of 17 days and an average weight of 5.3 kg. They started on the experimental diets at 25 days of age and switched from Phase III to Phase IV diets at 41 days of age.

2 Formulated to contain 3,350 (low), 3,500 (medium) or 3,650 (high) kcal DE/kg

Source: Levesque et al., 2001

This is not to say that increasing energy will never increase growth rate, because this statement is equally false. For example, in the United States, the practice of adding fat to the finishing pig diet is becoming increasingly popular, due to the benefits in growth rate observed in some farms.

Modifying diet content to increase performance should be accompanied by a simple study, monitoring the response to the new diet to ensure that increased DE has, in fact, increased growth rate. Under current market conditions, with wheat selling for approximately the same price as barley, the cost of increasing diet DE is modest. However, under more typical economic conditions, increasing diet DE concentration by 100 kcal/kg costs anywhere from $3.50/tonne to $9.00 per tonne, depending on the nutrient density of the diet to which the additional energy is added. As more fat is required, the cost of DE will increase. If diets are mixed on the farm, levels of 3%, and possibly 4% added fat can be achieved without adversely affecting flowability through the delivery system.

While increasing energy density may not improve growth rate, it will certainly improve feed conversion. As a simple rule of thumb, if the percent increase in DE concentration is more than the percent increase in diet cost, the increase will pay for itself just in terms of feed efficiency, irrespective of the expected change in growth rate. For example, if barley is priced at $90/tonne and wheat at $105/tonne, increasing diet DE from 3,100 kcal/kg to 3,200 kcal/kg, a difference of 3.2%, will increase diet cost by about $3.00 per tonne, or 2%. This increase, then, would make economic sense, just on the basis of feed efficiency improvement alone. On the other hand, increasing the diet DE from 3,300 kcal/kg to 3,400 kcal/kg, a difference of 3%, would increase diet cost by almost $9 per tonne or 5.5%. This would not make sense economically, if the only improvement occurred in feed efficiency. Under current market conditions, increasing diet DE content is less expensive, due to the smaller spread in the cost of wheat and barley.

▪ Can I Really Solve Grow/Finish Problems by Changing Management in the Nursery?

Perhaps one of the greatest truisms of pig barn trouble-shooting is that problems observed in one phase of production are often strongly influenced by events earlier in the production system. If growth rate is below expectation, and market weights are less than desired, a good place to start looking is in the nursery, or even the farrowing barn. Certainly, there can be problems in the growout barn that need to be addressed, but it would be a critical mistake to focus all attention on one phase of production.

Figure 2. Growth curves for pigs with varying growout performance.

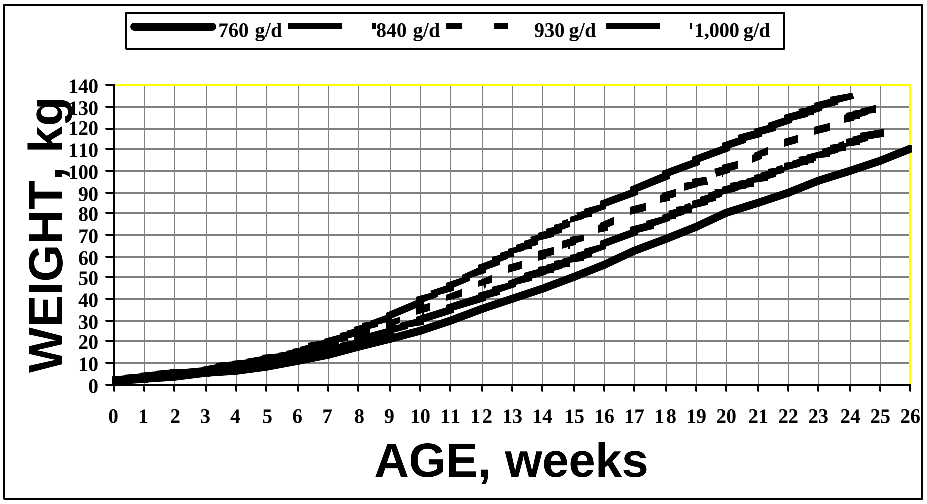


Table 5. Bodyweight of pigs segregated according to their week of marketing at a minimum of 113 kg.

Age	Week Marketed				
	21	22	23	24	25
			- kg -		
Number of pigs	49	71	113	115	62
Age					
- 21	6.3	5.9	5.5	5.0	4.8
- 56	22.8	20.9	20.0	18.8	17.5
- 77	34.7	32.3	30.6	28.7	27.2
- 112	68.3	64.5	61.3	57.3	53.7
- 140	103.7	99.6	95.1	89.1	82.2
Gain, g/d	818	787	753	707	650
Ave. market wt., kg	117.3	116.2	117.1	117.4	117.2

A total of 32 pigs (25 females and 7 males) did not reach the minimum market weight of 115 kg by 25 weeks of age. Source: Cooper et al., 2001

For example, Cooper et al. (2001) recently reported that for every 1 kg increase in weaning weight, bodyweight at 20 weeks of age will increase by 4.2 kg. For every 1 kg increase in weaning weight, nursery exit weight (56 days of age) will increase by 1.9 kg. The growth curves illustrated in Figure 2 also make the same point. While there will be substantial variation among pigs, on average, pigs that are heaviest at birth reach market sooner than their lighter birthweight counterparts. The objective of management is to reduce the variation, wherever possible, but also to raise the overall average performance at each step of their growth stage. Based on our experience to date, it will be easier to achieve improvement in all pigs, than to reduce the variation among pigs.

The data in Table 5 illustrates the point even more dramatically. Segregating all of the pigs according to their week of marketing, their average weight at various points along the growth curve can be compared. Their week of marketing can also be related to their average daily gain from weaning to day 140. The differences are striking, and further illustrate that heavier weights at weaning, or at nursery exit, will translate into either heavier weights at marketing, or shorter days to market.

■ Miscellaneous Management Information

Following are some miscellaneous topics that present new information related to nursery and growout management.

Nursery feeder adjustment and pig performance

Nursery feeder adjustment is an area of surprising controversy. Some people recommend adjustments that are quite tight, arguing in favour of reduced wastage of expensive diets, while others recommended much looser adjustments, to maximize feed intake. An experiment involving over 700 pigs revealed that an adjustment that provides for at least 40% of the trough area covered with feed maximized growth rate. Restricting feed access by tightening the feeder reduced growth rate, but did not improve feed efficiency (Table 6). In other words, the logic that maintaining the feeder with a tight adjustment to reduce feed wastage did not apply in this experiment.

Neither did tight feeders appear to increase aggressive behaviour, as no differences in skin lesions were observed with any treatment. However, tight feeders increased the time required per day to eat, and thus reduced the capacity of feeders from 11 pigs per feeding space to 9.

Table 6. Impact of feeder gap and group size/density on overall pig performance (Source: Smith et al., 2001).

	Feeder Gap, mm				
	9.2	11.8	17.9	24.8	31.5
% clear area[4]	94	88	63	32	9
No. pens	3	9	9	9	6
No. pigs					
Initial	60	180	179	177	120
Final	60	178	175	172	116
Weight, kg					
Initial[2]	6.96	7.10	7.12	7.18	7.03
Final[3]	27.91	28.97	29.55	29.50	29.56
Gain, g/day	480	515	528	517	529
Feed, g/day	724	749	777	774	781
Gain:feed	0.663	0.688	0.680	0.669	0.678
	Pig Density, ft^2/pig			**Significant Effects[1]**	
	2.5	**3.0**	**3.75**		
% clear area[4]	52	54	59		
No. pens	12	12	12	-	
No. pigs					
Initial	284	239	193	-	
Final	279	234	188	-	
Weight, kg.					
Initial[2]	7.03	7.10	7.09	-	
Final[3]	28.03	29.39	29.69	F, D, F X D	
Gain, g/day	495	518	531	F, D	
Feed, g/day	737	765	786	F, D	
Gain:feed	0.672	0.678	0.676	-	

[1] Effect of F (feeder adjustment), D (group size/density) or F X D, significant if $P < 0.05$.
[2] Average age at the start of the experiment was 26.2 days.
[3] Average age at the end of the experiment was 68.2 days.
[4] Percent of feed trough area that was clear of feed, measured weekly throughout the experiment, and then averaged.

Safe levels of ergot in nursery diets

Every so often, when conditions are right, ergot contamination of cereal grains becomes a problem on the Prairies. A recently completed study with nursery pigs found that ergot can safely be fed to weanling pigs up to a level of 0.1%, based on ergot kernel number, i.e. 1 per thousand. This corresponded to total ergot alkaloid content of 2.1 mg/kg. This level slightly reduced feed intake, but growth rate was unaffected and feed efficiency was actual improved (Oresanya et al., 2002). Because this is the total level of ergot in the diet, cereal grains with higher levels could be used in pig diets, depending on the concentration of the grain in the final mix.

Variation in growout is not increased by moderate crowding

Increasing floor space and number of pigs per pen did not materially reduce bodyweight variation in pigs tracked from birth to market (Cooper et al., 2001). With 16 pigs per pen (3.8 ft^2 in nursery; 9.5 ft^2 in growout) or 21 pigs per pen (2.8 ft^2/pig in nursery; 7.2 ft^2/pig in growout), the co-efficient of variation (CV) was the same. At birth, the CV averaged 16.4%, but by weaning, it had increased to 21.3%. Thereafter, CV declined, from 12.3% at nursery exit to 9.3% at 20 weeks of age. The CV for days to market was slightly less than 7%. In this study, crowding pigs did not affect the variation of bodyweights at any point in time, although it did increase days to market. In all cases, the pigs had plenty of access to feed (2 wet/dry feeder spaces per pen) and water.

Crowded pigs required just under 4 more days to reach market than the non-crowded pigs.

▪ Conclusions

While the pork industry has achieved tremendous gains in productivity and efficiency over the past two decades, opportunities for managers still exist to improve profitability. The key to success would appear to be in balancing the need for improved productivity against the cost of achieving those gains, and seeking an appropriate balance. Nonetheless, there is little doubt that the most effective way to improve growout profitability is to improve growth rate, which in turns increases the quantity of product available for sale in a given time period. Interestingly, efforts to improve growth rate will often result in improvements in efficiency and product quality, so the targets are not mutually exclusive.

It has always been the case that information is the key to success, and management decisions should be based on record keeping on the farm, to ensure that expected improvements in performance following a change in management in fact occur. With this information in hand, effective decisionmaking is assured, and the goals of the enterprise are most likely to be achieved.

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