Animal & Grassland
Research and
Innovation Centre

Pig Development
Department

Pig Farmers' Conference, 2015

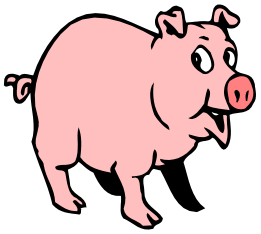
Conference Proceedings

Cavan Crystal Hotel, 20th October, 2015
Horse & Jockey Hotel, 21st October, 2015

teagasc
Agriculture and Food Development Authority

Pig Farmers' Conference 2015

Conference Proceedings



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Teagasc Pig Development Department Strategy Document 2015: DRAFT

Ciarán Carroll, Moorepark

A significant goal set out in the Teagasc Statement of Strategy is to support sustainable farming and the environment. Teagasc's Mission is to support science-based innovation in the agri-food sector and wider bioeconomy so as to underpin profitability, competitiveness and sustainability. The Pig Development Department aims to fulfil this mission by providing research, advice and education across a range of important issues.

Our vision is to increase profitability in the pig sector by producing environmentally sustainable and welfare friendly pigmeat to the highest safety and quality standards.

Teagasc is the body charged by the government with responsibility for research and development in pig production. The Teagasc Pig Development Department research programme covers a range of areas including nutrition and management, sow productivity, animal health and welfare, environment and food safety. The programme is closely linked with the research programmes in Irish and overseas universities through location/supervision of students and jointly funded projects.

Teagasc has committed over €3.5 million to the development of a new state of the art National Pig Research & Food Test Facility at Moorepark. **Independent** applied research will be undertaken by a strong research team at this facility, as well as on commercial pig farms around Ireland. Pig producers showed their commitment to the on-going research and knowledge transfer programme being delivered by Teagasc by signing up to the Teagasc/IFA Joint Programme (JP) in May 2013. Previous studies have shown up to 25:1 return on investment for pig research programmes, i.e. for every €1 invested in research there was a €25 return to the producers from adopting the research findings. Thus, the investment made by producers via the JP will return almost €9 million per annum.

As a result of funding provided via the JP levy Teagasc have appointed three Specialist Pig Development Officers, two Research Officers and a Research Technician. Along with existing staff these personnel will deliver an agreed pig research, knowledge transfer and education programme.

Targets: The Irish pig sector must be able to compete in the international market if it is to survive, prosper and develop. At present, we have higher feed prices and feed costs than other EU countries and we need to reduce these if we are to be sustainable.

A target of producing 27 pigs per sow per year, and a feed conversion from weaning to sale of 2.4 are reasonable goals for the sector to achieve by 2019. These improvements would result in a six cent reduction in feed costs per kg dead weight.

The target is to increase production of the top 25% of recorded herds to 29 pigs/sow/year and the top 10% to 30 pigs/sow/year. The research and knowledge transfer programme being delivered by Teagasc can help realise and monitor these goals. While these targets are physical targets, it is imperative that achieving them translates into economic benefits from reduced feed and non-feed production costs.

Summary of Key Significant Initiatives

Knowledge Transfer

1. Increase numbers participating in ePM PigSys herd recording and investigate the potential to target farms with specific issues and link them to research projects
2. Develop regional Discussion Groups
3. Annual Pig Research Dissemination Day
4. Monthly monitor of pig & compound feed prices, plus a guide price for home millers
5. Use of research findings to further develop feed formulations (best cost & low cost) for producers, incorporating the use of alternative ingredients.
6. Monthly electronic newsletters
7. Upgrade pig section of Teagasc website

Education

1. Develop a Pig Farm Managers course and continue existing Level 5/6 pig courses
2. Appoint a Course Coordinator to oversee all aspects of pig education
3. Publication of Pig Management Manual

Research

1. Establish guidelines on the optimum use of wet feed systems
2. Nutrition and management practices to improve methods of gilt development
3. Investigate use of feed enzymes to improve nutrient availability and digestibility
4. The link between respiratory disease, performance, welfare and antimicrobial use
5. Investigate methods of reducing the risk of tail biting
6. Terminal sire evaluation using different genetic terminal sources

Knowledge Transfer

Teagasc Specialist Pig Development Officers service pig producers from offices in Moorepark, Oak Park and Ballyhaise, providing an **independent** business and technology service, based on the analysis of herd performance data, feed costs and financial records and benchmarking these against industry averages using the Teagasc ePM system. This system provides clients and their advisor with up-to-date detailed information on the technical and financial performance of the herd and helps form the basis for the advisory service delivered to clients.

Data from participating herds is amalgamated annually to provide national information of the technical performance, costs of production and margins in the sector. This national database is the source of benchmarking targets such as average, top 25% and top 10% of herds selected on specific parameters. Herds participating in ePM/PigSys perform significantly better than non-participating herds (Martin, 2009). Increased participation in ePM is essential to the long-term viability of farms. The ePM provides essential information required to enable Ireland to actively and constructively participate in *InterPig* in which participant countries compare production efficiencies and costs.

The ePM system will be used to monitor progress on the targets outlined in this document, ***27 pigs per sow per year, and a feed conversion from weaning to sale of 2.4 by 2019,*** while focussing on the key performance indicator of producing two tonnes of pigmeat from seven tonnes of feed.

Pig sector profitability is largely determined by input and output prices. The largest single input cost is feed (c.70% of total production cost). InterPig 2014 results show that the feed cost per kg dead weight is ~19c higher in Ireland than the average for main EU pig producing countries (Denmark, The Netherlands, France and Germany). The focus on herd performance analysis/benchmarking and dissemination of research findings in order to reduce costs (especially feed) and improve profitability will ensure delivery of an excellent KT programme for pig producers.

Outside the farm gate profitability is significantly influenced by fluctuations in world cereal prices. The industry is further exposed to price fluctuations because it is necessary to import ingredients not grown domestically e.g. soyabean. Significant increased demand by new (bioethanol) and existing (Chinese) markets has resulted in increased global feed ingredient price volatility. This volatility has attracted international hedge fund speculation which further exacerbates the feed ingredient supply-demand volatility. Due to Irelands status as a pig feed ingredient importer (33% of total) and pigmeat exporter (65% of total) Teagasc recognise the importance of providing, timely, accurate, impartial market information on international feed ingredient and pigmeat market trends.

Methods of technology transfer employed (and some targets) include:

- ePM PigSys herd performance analysis (140 farms/year)
- Farm visits: duration 0.5 to 1 day depending on herd size (target 300/year)
- Review of pig farm business operations, including budget & cash flow programmes (50/year)
- Office & telephone consultations: time saving where farm visit not required
- Email & text alerts
- Monthly newsletters
- Discussion groups: new initiative, currently seven groups, 70+ members (60,000 sows).
- Workshops: for farm staff & managers on a variety of relevant topics
- Technical Articles: e.g. IFJ, Farming Independent, Farmers monthly, Pig Progress
- Website www.teagasc.ie/pigs
- Annual pig farmers' conference
- Presentations at industry conferences
- Research Dissemination Day: new in 2015, two days (Moorepark & Cavan)
- Ploughing championship: PDD stand in Teagasc marquee
- Pig Management Manual: to be finalised and published
- Local radio: farming programmes
- Other:

- Pig & feed prices: monthly monitor of pig & compound feed prices, plus a guide price for home millers based on ingredient prices using a standard Moorepark diet.
- Feed programmes; PIGAP (manure management tool); housing accommodation calculator; depreciation calculator; compliance and legislation advice; scheme preparation; Bord Bia QAS
- Promotion of pig slurry as a valuable fertiliser and encouraging Advisors/Agri- consultants to include it in their nutrient management plans.
- Market Trends: reviews & predictions on meat and grain markets, disseminated via Situations & Outlook Seminar, newsletters, email alerts, etc.
- INTERPIG: production and cost comparisons across EU & international countries
- DAFM briefings: Welfare, Salmonella, Grant schemes, health, nutrition
- Liase with others: IFA, DAFM, Banks, Feed Mills, Bord Bia, EPA, Local Authorities

Significant Knowledge Transfer Initiatives

1. Increase the numbers participating in ePM PigSys herd recording & analysis and investigate the potential to target farms with specific issues and link them to research projects
2. Develop regional Discussion Groups
3. Monthly monitor of pig & compound feed prices, plus a guide price for home millers based on ingredient prices using a standard Moorepark diet
4. Use of research findings to further develop feed formulations (best cost & low cost) for producers, incorporating the use of alternative ingredients where available and suitable.
5. Annual Pig Research Dissemination Day
6. Monthly electronic newsletters
7. Upgrade pig section of Teagasc website www.teagasc.ie/pigs

Education

Skilled staff, motivated to deliver a high level of technical performance are essential in pig production. Large, specialised units with skilled, well-trained staff were the drivers of the world class productivity in the sector in the past. In conjunction with Ballyhaise and Clonakilty Agricultural colleges, Teagasc initiated a FETAC Level 6 course in 2009-

2011. Since then over 80 students have been trained and upskilled in pig production. Changes made by QQI (formerly FETAC) resulted in changed course specifications and the current course (2013-2015) is at Level 5. There are 46 students attending this course. These courses help to ensure pig farm operatives are trained to the highest standards of animal husbandry. There is a need to develop a Level 6 course and a Pig Farm Managers course (at Level 7) for those who wish to progress their careers in the pig sector, provided that additional personnel are provided to oversee it.

Initiatives to develop and improve pig education in Ireland

1. QQI Level 5 Pig course: on-going (subject to demand)
2. Level 6 pig course: subject to demand
3. Pig Farm Managers course: similar to the Dairy Course, aim to commence in 2016 (subject to demand); investigate accreditation at Level 7 by DKIT or UCD.
4. Introduction to pig production (Ag college module): to expose the general agriculture students to the pig industry and career opportunities in the sector
5. Appoint a Course Coordinator to oversee all aspects of pig education (Level 5 & 6 courses, manager's course) and who would also work to promote pig production as a career.
6. Publication of Pig Management Manual

Research

Cost of production is a key factor in determining the cost competitiveness of Irish pig meat both in competing with imports on the home market and with other pig meat exporting countries on export markets. Feed represents about 70% of pig production costs as reported in PigSys/eProfit Monitor (ePM) recorded herds. Thus it is important that Irish feed costs are competitive with those of our international competitors. InterPig 2014 results show that the feed cost per kg dead weight is ~19c higher in Ireland than the average for main EU pig producing countries (Denmark, The Netherlands, France and Germany). Our peripheral location and associated increased transport costs for ingredients means our feed costs will always be somewhat higher than that of our competitors. Other factors associated with this cost gap include feed credit, slaughter weights, differences in feed formulation, diet specifications used and efficiency of feed utilisation. Why do we feed higher specification diets, sometimes over longer periods than some of our EU competitors? Efficiency of feed utilisation, feed formulation and diet specifications are areas that we have more control over and should be targeted to help reduce costs. Research on nutrition and management strategies to further improve feed

efficiency and growth rates (e.g. investigation of current feeding strategies, use of the Net Energy system for diet formulation, use of less expensive diets, alternative ingredients, slaughter weights) will form a significant part of the PDD research programme. As outlined above, it should be possible to *target a six cent reduction in feed costs per kg dead weight*.

- More than 70% of the feed cost is incurred in the finisher period so research directed towards improving feed efficiency and reducing costs during this period is crucial. Additionally, previous research has shown that nutrition of sows and early in the pig's life can have a huge impact on lifetime growth, feed efficiency and carcass quality. Therefore it is important that nutritional research is also conducted while the pig is in-utero and in the early weeks of life.
- Formulating diets based on net energy (NE) and standard ileal digestible (SID) amino acids (AA) and feed processing and the use of feed enzymes have great potential to reduce costs. Better formulation and the use of alternative ingredients, including enzymes should result in significant savings.
- Advances in the genetics of the Irish sow herd are largely responsible for the dramatic increases in numbers of piglets born alive in the last 10 years. However, there has been a concomitant increase in the number of small and weak piglets produced. These problems culminate in piglets dying at a younger age, or reaching finishing weight at a slower rate.
- Herd Health and welfare have an important impact on production efficiency and can be a constraint for exports. Ideally pigmeat of the future will be produced in low disease, high welfare herds where the use of antibiotics is minimal and production efficiency is optimised.

Having reviewed the research programme in relation to the needs of the industry, Teagasc is proposing to address a number of key issues in an enhanced research programme on pig nutrition & management, sow productivity, health & welfare and genetics. This is in addition to a number of research initiatives & projects that were agreed at the outset of the JP and which are currently ongoing.

Nutrition

1. Diet formulation systems based on Net Energy/ Standardised Ileal Digestible amino acids (SID AA) and their main advantages under Irish production conditions will be researched. This will include the use of by-products and alternative ingredients that may be used to reduce feed costs. The project will gather information on the ingredients and chemical composition of diets used in Ireland, assess the effect that the NE system and SID AA formulation would

have on Irish pig diets, compare the French and Dutch NE systems in an Irish context. Trials will be conducted to quantify the impact of diet formulation on a NE and SID AA basis for simple (cereal based) and complex (least cost) diets and a cost benefit analysis will be conducted. A Net Energy workshop for feed companies/nutritionists will help move the industry towards more precise formulation that will save pig producers money (estimated saving €2 per tonne). Project ends 2017.

2. Using records from the ePM PigSys database to identify farms with poor Feed Conversion Efficiency (FCE), evaluate their feed and management practices and develop strategies to improve the FCE and reduce their feed costs (FeedStrats, ends 2016). This project will also focus on feed specifications and diet analysis, thus increasing the necessity for feed compounders to be more open about what ingredients are being used in pig diets. Collaboration with the Specialist Pig Development Officers in obtaining feed samples and specifications will strengthen this project, ensuring that the Specialists and their farmer clients keep focussed on this critical area. The project will quantify the effect of selected feeding practices on efficiency and propose new feeding practices that would improve feed efficiency. A cost/benefit analysis of the different feeding practices will be conducted. A 5% improvement in FCE would result in a 5 cent/kg dead weight (€4 per pig) saving to producers.

3. Wet Feeding: up to 70% of Irish pigs are liquid fed. Many farms still use excessive water:meal ratios, negatively impacting on the feed efficiency of pigs and increasing manure volume. A state of the art liquid feeding system will be installed in Moorepark and it is proposed to use this to establish guidelines for producers on the optimum use of such systems. Optimum water:meal ratios, feeding curves and timing of feed splits will be determined and comparison of an optimised liquid feeding operation with meal and dry pellets in feed hoppers and single space wet/dry feeders will be researched. A 5% improvement in FCE would result in a 5 cent/kg dead weight (€4 per pig) saving to producers.

4. Feed enzymes offer the possibility to make greater use of common ingredients and may allow greater use of alternative feed ingredients and by-products. A project on feed enzymes will commence in October 2015 and conclude in 2018. This research will seek to improve nutrient availability from fibrous ingredients, to increase protein digestibility and possibly inactivate anti-nutritional factors. A 5% improvement in FCE would result in a 5 cent/kg dead weight saving to producers.

5. "A whole systems approach to optimising feed efficiency and reducing the ecological footprint of Monogastrics" (ECO-FCE) is a Pan-European collaborative project in which Teagasc personnel are key partners and it is co-financed by the European Commission. Through a better understanding of the interactions between animal genetics, gut structure and function, the microbial population of the gut and the attributes of feed, ECO-FCE will propose strategies to improve feed use efficiency in pigs whilst also reducing the ecological footprint of pig production. A 5% improvement in FCE would result in a 5 cent/kg dead weight (€4 per pig) saving to producers (*ends 2017*).

Sow Productivity

6. Gilt Rearing: identify improved methods of gilt rearing, so that nutrition and management is optimised to reduce limb problems, and improve mammary development. This will not only have positive outcomes for the gilt, but also for the efficiency of the piglets produced. The new herd at Moorepark provides an ideal opportunity to carry out this research.

7. Investigate methods to improve health, welfare and survival outcomes for small and weak piglets. Methods will include using dietary supplements in dry sow feed, use of nurse sows, provision of energy supplements and use of rescue decks. This project targets an increase of 1.3 extra liveborn piglets / litter increasing the Irish average to 13.6. Such an increase is normally associated with higher mortality, particularly pre-weaning. However, the project also aims to increase viability/vitality of piglets. The benefits to sow output could be 2.9 pigs/sow/year. On an average (500 sows) pig farm, this would increase net profit by €35,650/annum. In the ROI this has the potential to increase output at farm gate by 432,100 pigs (12% increase on 2011) and net profit of the national herd by ~€10.6m/annum. Employment in the sector is currently estimated to be ~7,500 people. The increased output could create an estimated additional 860 jobs in the sector and all of the additional pigs produced will be exported (OPTIPIG, ends 2017).

Health & Welfare

8. Investigate the relationship between respiratory disease, performance, welfare and antimicrobial use. Additionally this project will develop novel diagnostic

methods for respiratory disease, and identify risk factors for its development (PathSurvPigs, ends 2018). Estimated improvements would result in savings of €3.20 per pig.

9. Investigate methods of reducing the risk of tail biting and docking using natural substances such as wood and compressed straw. Artificial alternatives (e.g. rubber chew toys) should also be compared with natural products, or used in combination. Dietary adjustments will also be investigated. Research at Moorepark has shown a cost of €1.70 per pig due to condemnations and lost carcase weight as a result of tail biting (Entail, ends 2018).

10. Investigate the link between production diseases, poor welfare and antimicrobial resistance, including experimental and social science work to investigate attitudes around antibiotic usage, and practical strategies to reduce their use. Reduction in antimicrobial usage will be legislated for in the near future, and any improvements that the pig sector can make towards this will have enormous societal benefits (WELPIG, ends 2017).

11. Evaluate and improve the biosecurity status of pig farms throughout Ireland and examine the variability between national and EU counterparts. Results to date show a 12% improvement in profitability for farms who implement the biosecurity procedures recommended (BIOCHECK, ends 2016).

Genetics

12. A terminal sire evaluation trial will be undertaken using different genetic terminal sources with the progeny performance tested and fully dissected after slaughter. A previous trial at Moorepark showed a €6 per pig benefit to producers.

Research will incorporate the use and investigation of SMART technology and precision livestock farming tools (e.g. balance floors in farrowing rooms, thermal imaging, etc.), and address legislative issues that affect pig farming as the need arises. Legislative areas likely to have an impact on the Irish pig sector include:

- Environment: Irish agriculture is responsible for 29.1% of the total greenhouse gas (GHG) emissions generated nationally (pig sector produces ~2% of total agricultural GHG). Environmental sustainability is an important component of any production system and is becoming important in the marketing of pig meat.

Compliance with a number of European Union Directives will become mandatory for Irish pig producers in the near future, with particular relevance to industrial, ammonia and particulate matter emissions. This will have implications for pig house design, ventilation systems and slurry management on pig farms.

- Animal Welfare: coping with the ban on teeth clipping and tail docking, environmental enrichment, floor type/space, and loose farrowing systems. A ban on castration may have a positive impact for Ireland, as other EU countries may be forced to reduce slaughter weights, resulting in a positive impact on pig price.
- Water Quality: changes required to comply with the Water Framework directive, and coping with the end of transition period in relation to Nitrates regulations.
- Antibiotic Usage: continued pressure to reduce usage, and investigate alternatives to antibiotics to help control pig diseases.

Note: there are a number of other on-going projects that are not included in this document, further details on these projects are available at: at:http://www.teagasc.ie/publications/view_publication.aspx?PublicationID=3604) Details available from relevant researcher.

Use of the ePM Database in applied research

The main data collection methods for performance and economics are the e-Profit Monitor (ePM) PigSys system and project-specific research questionnaires. With the ePM system, individual farms keep records which contribute to the Teagasc National Farm Database. This data is used to report annual performance of the national pig herd, currently representing more than 84,000 sows (56% of the national herd). This database is used to improve performance at individual farm level. However, there is further potential to target farms with specific issues and link them to specific research projects. The use of the ePM can contribute to a greatly enhanced applied research programme to improve the competitiveness of the sector. Some examples of this are:

1. FeedStrats project discussed above.
2. Research to examine if ante- and post-mortem lesion inspection can be linked back to pig performance at farm level (PIGWELFIND, ends 2016).
3. Use the ePM database to research and develop an Economic Model to allow economic analysis of pig production technologies. Economic models should be applied to all research projects.

Alternative Ingredients to Reduce Feed Costs

Jannes Doppenberg, Francesc Molist, Schothorst Feed Research

Introduction

For most of the nutritionists the main challenge is to formulate feeds with a consistent and predictable performance while achieving the lowest costs possible. Alternative feed ingredients can be priced very attractively, however the nutritional value can be quite different from the standard feedstuffs. For example the nutritional value will vary among species (i.e. swine versus poultry) and animal categories (i.e. broilers versus layers and pigs versus sows) due to differences in the physiological capacity to digest nutrients in the gastro intestinal tract.

Therefore when using alternative feed ingredients first you need a composition analysis of the nutrients in the by-product to be able to formulate it into diets. Once you have a chemical composition you need to figure out what is the actual nutrient availability to the pig. There are also technical considerations when using new ingredients; storage capacity at the feed mill, effects on feed flow and wastage and on manure, availability of the feed ingredient and consistency in the quality of the ingredient. The producer needs to make sure the feed cost savings will pay for this added capacity at the feed mill over the following years.

In order to avoid differences in technical performances in practice a nutrient based animal category specific feedstuff table, based on digestion trials performed with the target animal, should be used in combination with the possibility to recalculate the nutritional value of feedstuffs based on actual proximate analyses. A reliable, quick (NIR) analytical screening method is needed in order to be able to react quickly upon receiving of feedstuffs and formulating feeds.

Alternative feed ingredients available

There are many alternative feed ingredients available for the swine industry that can help reduce feed costs. Finding a value and inclusion rate may be farm and source specific. Nutrient digestibility of formulated feeds and individual ingredients is dependent on the degree of feed processing (starch gelatinization due to pelleting and particle size) as well as the feed intake level (due to the feed intake related endogenous losses). In order to get a good estimation of the nutritional value of these alternative ingredients, digestibility experiments should therefore be conducted under standardized conditions in

order to be able to study ingredient effects and the effects of varying (chemical) composition on nutrient digestibility. Feed processing will decrease particle size and specifically increase fat digestibility in by-products of plant oil extraction like soy bean, sunflower, palm kernel or rapeseed meal. An increased viscosity due to the heat treatment of grains will positively influence nutrient digestion in pig feeds.

Role of Net Energy system in the utilization of alternative ingredients

The use of Net Energy (NE) and digestible amino acid systems will be of great help for using alternative ingredients without penalizing the performance of the pigs. The NE system differs from the Digestible Energy (DE) or Metabolisable Energy (ME) systems in that the metabolic efficiency by which energy derived from different nutrients like protein, fat, starch, sugars or complex carbohydrates has been taken in consideration. As a result, the energy content of protein is decreased (due to the energy losses resulting from the excretion of excess nitrogen in the form of urea and the low metabolic efficiency for energy production of the remaining carbon fraction after de-ammination) and the energy derived from fat is increased (due to the high efficiency of which digested fat can be used metabolically for fat deposition or fat excretion (via milk fat). Consequently the use of a NE system will result in lower crude protein levels in formulated feeds and a higher fat content. Thereofre, low protein feeds will become more attractive, favouring the usage of highly quality (favourable amino acid composition) and digestible protein sources and synthetic amino acids. Formulating feed on a digestible (AID or SID) amino acid base to meet the essential amino acid requirements for different production goals is essential. Also low energy fibre rich, in general cheaper, ingredients will become more attractive in combination with an increased usage of fats & oils. Because the ability of the pigs to digest the nutrients of the diet is dependent on their physiological status, the utilization of a NE system with different digestibility coefficients for a given ingredient for piglets growing pigs, gestating and lactating sows will give a better prediction of the performance of the pigs.

Specifically the ability to ferment complex carbohydrates is age-dependent and increases with the physiological development of the gastrointestinal tract. In a recent trial conducted in Schothorst Feed Research (SFR), the NE content of the same feed was 2.7% higher for sows than for growing/finishing pigs, mainly due to the higher fermentability of the NSP-fraction but also the faecal crude protein digestibility was 5.1% and the fat digestibility 3.3% higher. Since the protein and fat digestibility of piglets is lower than with growing/finishing pigs a separate NE-piglet will result in ‘safer’ feed formulation which is essential to reduce the (therapeutic) antibiotic usage in piglet production. In conclusion for these alternative ingredients, having a good prediction of

their fermentability together with a good ranking of their crude protein quality might help to predict their nutritional value and decision to use them or not in the formulas.

Table 1: Percentage of fermentable (FCHO) and inert (iCHO) carbohydrate content of different alternative ingredients (SFR Feedstuff Table 2015)

Ingredient	Fibre	NSP*	Fermen-tability	ADL	**FCHO**	**iCHO**
Sunflower sd meal	25.3	46.1	34	7.2	17.7	31.3
Rice bran	5.3	19.7	46	5.3	9.0	11.5
Wheat bran	8.5	37.6	47	2.6	19.3	20.6
Palmkernel meal	16.7	60.9	47	8.9	42.2	19.3
Rapeseed meal	12.4	33.9	55	4.6	20.9	16.4
Maize DDGS	6.8	42.9	71	2.1	30.9	12.5
Soy hulls	35.0	68.0	75	1.2	51.8	17.3
Citrus pulp	12.4	55.5	83	1.1	48.0	9.7
Beet pulp	17.3	66.8	84	1.2	56.1	11.0
Soybean meal 47%	3.8	24.8	88	0.3	23.6	3.1

*NSP = Dry matter%- ash%-crude protein%-crude fat%-starch%-sugar%.

The fermentability of feedstuffs in swine diets

To be able to predict the nutritional quality of fibre rich ingredients it is necessary to define a nutrient that will link the chemical composition of the ingredient with the performance of the pigs. Traditionally in monogastrics the crude fibre content has been used to classify the fibre ingredients. However, as it is described in Table 1, crude fibre is poorly linked with the non-starch polysaccharides (NSP) content of the ingredients and its fermentability. Ingredients where the NSP fractions contain less cell wall material (a lower ADL (Acid Detergent Lignin) content) and more hemicellulose (citrus and beet pulp) have a higher fermentability. Also ingredients like soy hulls which contain a large amount of fermentable sugars have a high fermentability. In general, the economic value (shadow price) of ingredients with a higher fermentability will be higher in sows than in growing pigs. Therefore the utilization of a specific NE system for sows will result

in lower feed costs (due to a higher value of the fibre rich ingredients). In order to better predict the performance of the pigs when fed with fibre rich ingredients, it is also important to understand what will be the functional characteristics of the fibre ingredients. Therefore as it is shown in Table 1, the ingredients can be ranked based on the fermentable carbohydrates (FCHO) or inert carbohydrates (iCHO). The ingredients rich in iCHO will have a positive effect on stimulating transit time and also increasing the water holding capacity and therefore improving the faecal score. On the other hand, because the fermentation rate of the iCHO rich ingredients is lower than the FCHO rich ingredients the heat production will be also lower. This is of special importance under heat stress conditions. In gestating sow feeds it is advisable to use ingredients with a higher FCHO content (like soy hulls, sugar beet pulp or palm kernel meal) so the sows can benefit by getting energy from the fermentation and also might help to reduce some stereotypic behaviour associated with restricted fed sows. However, around farrowing in order to facilitate the farrowing process and for example, avoid constipation, the utilization of ingredients with a higher proportion of iCHO (like wheat bran or sunflower seed meal) can be advised.

Protein quality and value

As discussed before, when the diets are formulated based on NE system and ileal digestibility amino acids (SID), the energy content of the protein is decreased resulting in lower crude protein levels in the formulated feeds. This will not only result in cost savings but also in a better environment in the farm (lower ammonia concentration) and also a higher health of the pigs (less risk of diarrhoea due to fermentation of protein) which in turn will also result in a greater performance. When formulating low crude protein diets, evaluating the nutritional value of the protein and linking this to the requirements of the pigs is of great importance. Therefore it is necessary to rank all the protein sources available based on ileal digestibility of lysine and comparing the costs based on one unit of SID lysine (Table 2).

As shown in Table 2, animal proteins like plasma protein, whey and fish meal are characterized by a relative high lysine content and digestibility. Highly refined plant proteins like potato protein and soy protein concentrate have a high (lysine) digestibility. Poor quality proteins like maize DDGS and palm kernel meal have both a low lysine content and digestibility.

Compared to hipro soybean meal the cost, on a per unit of crude protein basis, of animal proteins and highly refined plant proteins is considerable (2 - 6 times) higher. However when these same feedstuffs are compared on a per unit of ileal digestible lysine content, the (extra) costs are less extreme. Specifically synthetic amino acids, like L-Lysine HCL, become more attractive. Therefore for piglet diets, where post-weaning diarrhoea is of concern the utilization of the proteins with the highest nutritional value such as synthetic amino acids, potato and plasma proteins, whey, fish meal and soy protein concentrate can be advised.

On the other hand, alternative plant protein sources for hipro soybean meal become less attractive, e.g. rapeseed meal is roughly 10% cheaper on a per unit of crude protein basis but 10% more expensive when compared on a per unit of ileal digestible lysine basis. Poor quality proteins like maize DDGS and palm kernel meal are comparable in price on a per unit of crude protein basis but considerably more (3.0 - 3.2 times) expensive on a per unit of ileal digestible lysine basis. These alternative crude protein sources can be used in growing pigs and sows. In situations where the soy bean meal prices are really high, it is possible to formulate finisher pig diets (from 85 to 120 kg BW) without soybean meal and by using rapeseed meal and synthetic amino acids. Especially in grower pigs from 25 - 30 kg until slaughter phase feeding (3 feeds, 25 - 50, 50 - 85 and 85 - 120 kg) can help to reduce feed costs and avoid penalization of performance due to nutrient imbalances.

Consequently swine feeds should be formulated based on SID amino acids and not on crude protein or total amino acids. This will not only result in a consistent and predictable animal performance but also favour the usage of higher quality protein sources. For instance when protein from hipro soybean meal is replaced with poor quality protein sources like maize DDGS and palm kernel meal and feeds are formulated on a total amino acid (lysine) basis roughly two times more protein (from maize DDGS and palm kernel meal) will be needed than when feeds are formulated on SID amino acid basis. Consequently poor quality proteins will increase the crude protein content of feeds while high quality proteins will decrease the crude protein content (when feeds are formulated on a digestible amino acid basis). Low(er) crude protein feeds will improve gut health, reduce heat stress and decrease nitrogen emission.

Table 2: Protein quality and relative cost of different feedstuffs

Ingredient	Protein (%)	Lys in protein (%)	Lys digest (%)	SID Lys (% protein)	Rel. cost*	Rel. costs**
L-Lysine HCL	94.5	83.6	100	83.6	1.7	0.1
Potato protein	79.5	7.8	98	7.6	2.1	1.5
Plasma protein	81.0	8.5	85	7.2	5.3	4.6
Whey	13.0	7.5	91	6.8	5.8	4.3
Fish meal	65.7	7.6	89	6.7	2.7	2.2
Soy protein concentrate	65.0	6.5	93	6.0	2.1	2.0
Hipro Soybean meal	46.4	6.2	89	5.5	1.0	1.0
Wheat bran	15.3	4.0	84	3.3	1.2	2.0
Sunflower sd meal	28.6	3.5	84	2.9	1.1	2.1
Rapeseed meal	33.5	5.5	83	4.5	0.9	1.1
Maize DDGS	26.8	3.0	63	1.9	1.0	3.0
Palm kernel meal	14.7	3.0	61	1.8	1.1	3.2

*Relative cost compared to hipro soybean meal on a per unit of crude protein basis
**Relative costs compared to hipro soybean meal on a per unit of SID lysine basis

Conclusions

In order to be able to use alternative ingredients effectively and economically in practical swine formulations, the nutritionist needs to monitor the quality of the feedstuffs offered carefully (and change table values based on actual proximate analyses) and use accurate animal specific feedstuff tables for key nutrients like the energy and digestible amino acid content in conjunction with precise nutrient recommendations based on the same feedstuff tables. Moving from a DE to a NE system will resulted in lower crude protein in the diets which in turn will be linked to a better performance of the pigs by improving gut health, reducing heat stress and decreasing nitrogen emission.

Pig Production in Brazil

Gerard McCutcheon

Introduction

For the first time since its inception in 2002, the InterPIG group held its annual meeting outside Europe in Florianopolis, Brazil. The meeting was hosted by the Brazilian members from Embrapa, a research centre linked to the Ministry of Agriculture, Livestock and Supply. It is the only research centre maintained by the federal government to develop technology for the pig and poultry sector. They are also involved in developing market access and export promotion.

Brazil is the fifth largest country in the world with an area of 8.5 million sq.km. It has a population of 204 million people and is the worlds' 10th largest economy. It is a large exporter of agricultural products such as sugar, coffee, orange juice, soya, beef, tobacco, maize, poultry and pig meat. Brazil has 12% of the worlds' water.

There has been a steady increase in the output of meat with a 94% increase in beef, a 216% increase in pigmeat and a 439% increase in poultry meat output when compared to 1990. This has been driven by a huge increase in exports of all these meats. In the 1970s and 1980s they had a number of disease problems (including African Swine Fever) which excluded access to export markets. Since 1990 they have been very conscious of biosecurity and disease control on farms. They have worked hard to develop their exports.

Approximately 60% of pig production is in the south of Brazil (in states like Santa Catarina) with more production getting close to the corn and soya growing regions (in states like Mato Grosso).

Brazil had 1.52 million sows in 2014 and produced 37 million slaughter pigs. They consume 83% of their own production and 17% was exported in 2014 (556,000 tonnes). Russia was the main pigmeat export market in 2014 accounting for 38% of exports while Hong Kong takes 22% of their exports.

We made two farm visits: the first into the hills of Santa Catarina and the second to a farm in Mato Grosso which is 2500km north of Santa Catarina. Santa Catarina produces 25% and Mato Grosso produces 5% of Brazilian pigmeat, respectively. Below I describe the two farm visits which outline the more common pig production systems in each.

Farm Visit in Santa Catarina (1,100 sows)

At the time of the visit, even though it was winter, the daytime temperature was around 19°C. This farm is a central farm of a cooperative group that includes breeding-only, breeder - finisher and finisher only farms. This farm sells weaners at 28 days and 8kg liveweight to other farms in the group. They monitor performance and disease status across all farms in the group. This particular farm was started with three pigs by the owner and is now run by his two sons.

They now have 50% Danbred genetics in the breeding sow herd. They were worried about digestive and reproductive problems with their herd so they have moved towards Danbred to see if this will improve things.

There are tall deciduous trees planted between the buildings – these offer shade in very warm weather and let light through in the winter. The buildings have side-sheets which are lowered or raised to allow a cross flow of air and control temperature. The buildings have fans and water sprinklers to mist sows in hot weather. Once they recorded 53°C at this site.

Figure 1. Trees between buildings to act as a shade to help reduce heat in the buildings

Sows are vaccinated for Rotavirus, Erysipelas, Parvo and Leptospirosis. Piglets are vaccinated for Mycoplasma, Circo-virus and an autogenous vaccine for Streptoccus and Staphylococcus.

Seven people work on the farm. They feed the sows in the farrowing house 3 to 4 times each day in summer and 5 to 6 times in winter when feed intake is better. There are 284 farrowing places on the farm and these are all hand fed.

Sows are on fully slatted floors that are raised c.250mm above a solid concrete floor. There is a channel behind this slatted floor that takes all liquids away from the building.

Figure 2. Raised slatted floor and step covering the channel that takes urine and moisture away

Figure 3. Farrowing pen with creep area for piglets at front

Once weaned the sows are then stalled for the first 75 days of the dry period. They then are put into loose sow pens (10 per pen) from Day 76 to one week before farrowing. Floors in the loose pens were covered with household non-slip tiles due to foot problems on concrete.

Figure 4. Loose sow pens with non-slip tiles on the floor and side netting to allow cool air into the house

Figure 5. Close up of non-slip tiles in loose dry sow pens

The farm has its own feed mill on site. The main ingredients are maize, soya and the mineral vitamins. Tallow is also used on this farm. Whey is fed to the sows (6,000 litres per day) from a local cheese plant. It is delivered every second day and used before the next delivery arrives.

There is a legal requirement to have 120 days (approx. 4 months) slurry storage on pig farms. This farm uses some of the slurry on its own land and gives some to farmers in the locality.

They compost their dead pigs using sawdust as the carbon source. The composted material is spread on land a year after the composting started. Usually only the teeth and some bones survive the composting process.

Figure 6. Composting of dead pigs – buried in a deep bed of saw-dust

Capital is borrowed over a 6 to 10 year period at a rate of 6.5%. Inflation in Brazil is running at 8 to 8.5%. They are currently paid €24 for an 8kg pig.

Recorded performance for the first quarter of 2015 was as follows:

- 2.3 Litters/sow/year
- 83% farrowing rate
- 12.4 born alive
- 15% piglet mortality
- 10.6 weaned/litter to give 24.4 pigs weaned/sow/year

Farm Visit in Mata Grosso (12,000 sows)

Nutribras is a family company, the owner originally farming in Santa Catarina before moving to this farm in 2000. There are 5,800 hectares which are double cropped each year growing maize and soya bean. Some areas which are irrigated with fixed booms (therefore circular) grow an organic crop of beans for human consumption. The farm currently has 12,000 sows rearing pigs up to 120kg slaughter weight. They aim to go to 15,000 sows in the next few years.

Figure 7. Circular irrigation system used to spread liquid digestate from anaerobic digestion process

Figure 8. View from aeroplane - circular areas fertilised by irrigation system

The health status is very high and we had to remain in the bus as we had been on a pig farm the previous day. All vehicles pass through a disinfectant wash at the farm entrance which washes the top, sides and undercarriage of the vehicle. Next to the entrance was a lake where they capture and store water for the pig farm (photo 3).

Figure 9. Lake alongside Farm entrance that stores water for the pigs

To control disease spread each worker is assigned to a specific work area and only manages the pigs in this area. All dead animals within a section are moved outside the building where they are collected and composted. The sow buildings are totally separate to the weaner and finisher buildings.

One consideration in this region was that there is an inadequate electricity supply for any development – so the farm put in a biogas plant and generators to burn the gas and generate electricity. This electricity is used to operate the mill on the farm as well as all

other electrical operations on the farm. They also extrude the oil from soya on the farm also and sell the oil separately. This farm grows 75% of their soya and 50% of their maize requirement for feeding the pigs on the farm.

One sow section on the unit has 5,300 sows on it. Sows are fed by augers and they have a Schauer ESF system for their loose sows. The sows are kept for 37 to 40 days after service and then put into loose groups. The herd is stocked with Danbred genetics.

Figure 10. Sow house section as seen from the bus that brought us around the farm

They achieved 25.8 pigs sold/sow/year in 2014. They use ractopamine on the farm but would cease using it if the Russian market was more secure. All pigs are sold to their slaughter plant, situated about 32km from the farm. Eighty per cent of the pigs killed there are supplied from this farm. They kill 1,500 pigs each day but have the capacity to double this to 3,000. Forty five per cent of the meat is exported – currently the main market is Hong Kong. Fifty five per cent is processed and sent to Sao Paolo. This internal movement of carcases is a distance of 2,100km and costs 120 US dollars per tonne for transport.

Meat and bone meal produced at the slaughter plant is also used in the feed for the pigs.

In 2014 their total production cost was 2.24 REAL (€0.72) per kg liveweight. This is €1.00 euro per kg hot dead weight. Feed comprised 74% of this cost, and labour 10%.

This farm is integrated beyond anything we have seen in Ireland. It is growing a large portion of its own feed, using its slurry for energy and crop fertiliser, slaughtering its

own pigs and using the meat and bone meal as a feed ingredient. Its cost of production is much lower because the feed is used at the point of production and it is achieving good production performance.

Figure 11. Biogas collection behind weaner and finisher section

Figure 12. Composting of dead pigs

If Birth Weight is King, How do I become King?

Peadar Lawlor, Moorepark

Introduction

Litter size has increased greatly in recent years. This has led to increases in the number of pigs produced per sow per year and there is further scope for this to increase, as litter size in Ireland continues to rise. However, the downside of increasing litter size is that the average birth weight of piglets born is lighter, the proportion of light-weight pigs is higher and the within litter variation in piglet birth weight is increasing. All of this impacts negatively on piglet survival and growth (Quiniou et al., 2002). Last year, at this conference we highlighted the importance of piglet birth weight with regard to post-weaning and lifetime growth. As birth weight is one of the most important drivers of lifetime growth and feed efficiency we concluded that birth weight was 'King' (Lawlor *et al.,* 2014). Well if this is the case, 'how can I become King?' particularly when litter size is increasing and there is an associated downward pressure on piglet birth weight due to uterine crowding and the associated reduction in uterine blood flow per foetus resulting in foetal growth retardation?

There is no easy answer to this question. The greatest benefit is likely to involve much more precise nutrition of sows than has been the case up to now. Precision feeding of maiden gilts and gestating sows could have a major benefit. Supplementation of sows during critical windows during gestation with various supplements can also help. There are also management practices which have been linked with increased piglet birth weight and selection for increased birth weight and increased within litter uniformity in piglet birth weight is also possible.

Dietary Requirements of Gestating sows

The allocation of feed to sows is based on the sow's energy requirement in MJ DE per day. This divided by the energy content in the diet (MJ DE /kg) gives us the kg of feed that the sow requires each day. For example, if a sow requires 30 MJ DE/day and the diet contains 13.0 MJ DE/kg then the sow requires 2.3kg feed /day. As lysine is normally assumed to be the first limiting amino acid its daily requirement along with the kg of feed provided /day can be used to calculate the optimum lysine content in the diet. For example if a sow requires 15 g SID lysine per day and we know the feed intake is 2.3kg then the diet should ideally contain 6.52g SID lysine per kg. All other amino acids

are then supplied in the diet as proportion of the lysine content in the diet. Amino acid requirements are now normally expressed on a standardised ileal digestible (SID) basis as this best reflects the quantity of amino acids available to the animal.

Table 1 shows the Energy, lysine and phosphorus requirements of sows during gestation at different parities, service weight, expected gestation weight gain and expected litter size (NRC, 2012). Each of these factors will influence the sow's requirements. The sow's requirements also change during gestation and NRC 2012 recommendations reflect this by giving requirements up do day 90 of gestation and requirements for greater than day 90 of gestation. These changing requirements principally reflect the greater demands for foetal and mammary development in late gestation.

Ideally one would feed 2 separate diets during gestation to account for the differing nutrient requirements up to and after day 90 of gestation. In some instances this may be possible depending on the feeding systems on farms. It might also be possible with electronic feed stations to feed one diet during gestation but to dose a supplement/balancer in the period from day 90 of gestation on. Certainly using two diets would allow nutrient requirements to be more closely matched with the nutrients provided in the feed without feeding some of these nutrients in excess. Producers should look at options to do this when renovations are being done.

However, in most situations it is currently only possible to feed one diet during gestation. Doing so means that diets are formulated and feed is allocated so that the nutrients supplied are always at or above the nutrient requirement of all sows at all stages of gestation. There is obviously a cost associated with this, as diets are over supplying nutrients in many cases. Table 2 shows feed, standardised ileal digestible lysine (SID) and standardised total tract digestible (STTD) P intake in a one gestation diet system to meet NRC 2012 requirements. In this example two possible diets are presented one with a DE content of 12.5 MJ DE/kg similar to a 'Welfare' type diet with ~8% crude fibre and the other being more a conventional dry sow diet with a DE content of 13.0 MJ DE/kg. The table also shows the SID lysine and the standardised total tract digestible (STTD) phosphorus contents of each diet which are calculated from the requirements (Table 1) and the feed intake required to achieve the recommended DE intake (also shown in Table 1). If we compare the daily requirements with that supplied

by the diet it is obvious that in many circumstances we must over supply nutrients and this is the cost associated with feeding just one diet during gestation.

Up to 2012 once the lysine content of a diet was known all other amino acids were supplied in the diet as a ratio of lysine (i.e. ideal protein) and these ratios were assumed to remain constant throughout gestation. However, NRC 2012 shows that the 'Ideal protein' ratios change with parity and stage of gestation. The amino acid balances particularly affected are threonine, tryptophan and methionine plus cysteine. This altering of the ideal protein ratio with stage of gestation in particular gives further reason to use a 2 diet system during gestation. In fact it is highly likely that larger farms in the USA are using different gestation diets for different parities also.

If the possibility exists to feed more than one gestation diet then it would be advisable to explore this option. As a start, one diet could be used for all parities between service and day 90 of gestation and another for all parities between day 90 and farrowing . Based on NRC 2012 and assuming this diet contains 12.5 MJ DE/kg then first diet should contain 5.0g SID Lysine/kg and 2.5g STTD P/kg. From day 90 to farrowing the diet should contain 6.2g SID lysine/kg and 3.2g STTD P/kg to meet minimum requirements.

Table 1. Energy, lysine and phosphorus requirements of sows during gestation at different parities, service weight, expected gestation weight gain and expected litter size (NRC, 2012).

Parity	**Gilt**		**Sow (Parity 2)**		**Sow (Parity 3)**		**Sow (Parity 4+)**	
Weight at service (Kg)	140		165		185		205	
Gestation weight gain (kg)	65		60		52		40	
Litter size (mean birth weight of 1.4kg)	12.5		13.5		13.5		13.5	
Period during gestation (days)	**0-90**	**90-114**	**0-90**	**90-114**	**0-90**	**90-114**	**0-90**	**90-114**
Requirements								
Energy Intake DE MJ/day	**28.8**	**34.2**	**29.9**	**35.3**	**29.9**	**35.3**	**27.7**	**33.2**
Total Lysine (g/day)	12.4	19.3	11	17.5	9.4	15.4	7.7	13.1
SID Lysine (g/day)	**10.6**	**16.7**	**9.2**	**15.1**	**7.8**	**13.1**	**6.3**	**11.1**
Total phosphorus (g/day)	9.91	14.78	9.4	14.45	8.67	13.59	7.69	12.47
STTD phosphorus (g/day)	**5.4**	**8.67**	**4.96**	**8.39**	**4.43**	**7.79**	**3.87**	**7.13**

Table 2. Feed, Standardised ileal digestible (SID) lysine and Standardised total tract digestible (STTD) P intake in a one gestation diet system to meet NRC 2012 requirements.

	Gilt		**Sow (Parity 2)**		**Sow (Parity 3)**		**Sow (Parity 4+)**	
Weight at service (Kg)	140		165		185		205	
Gestation weight gain (kg)	65		60		52		40	
Litter size (mean birth weight of 1.4kg)	12.5		13.5		13.5		13.5	
Period during gestation (days)	**0-90**	**90-114**	**0-90**	**90-114**	**0-90**	**90-114**	**0-90**	**90-114**
Possible single diets and intake								
Diet 1 (8.0% Crude Fibre)								
MJ DE/kg	**12.5**							
SID Lysine (g/kg)	**6.00**							
STTD phosphorus (g/Kg)	**3.2**							
Feed intake (kg/day)	2.3	2.7	2.4	2.8	2.4	2.8	2.2	2.7
SID Lysine (g/day)	13.8	16.4	14.4	17.0	14.4	17.0	13.3	15.9
STTD phosphorus (g/day)	7.4	8.8	7.7	9.0	7.7	9.0	7.1	8.5
Diet 2 (4.5% Crude Fibre)								
MJ DE/kg	**13.0**							
SID Lysine (g/kg)	**6.25**							
STTD phosphorus (g/Kg)	**3.3**							
Feed intake (kg/day)	2.2	2.6	2.3	2.7	2.3	2.7	2.1	2.6
SID Lysine (g/day)	13.9	16.5	14.4	17.0	14.4	17.0	13.3	15.9
STTD phosphorus (g/day)	7.3	8.7	7.6	9.0	7.6	9.0	7.0	8.4

Note: Feed allocations assume no feed wastage. Allocations should be increased by 5-10 % to account for this.

Reviewing NRC 2012 requirements for gestating sows can tell us that in many cases that the diet we are feeding and its allocation level may not be currently meeting the gestation sows requirement for amino acids and phosphorus at all stages of gestation and for all parities. Table 2 presents 2 diet options for use where one gestation diet is fed throughout gestation to all sow parities to meet the NRC 2012 requirements for gestating sows. Matching more closely the sows requirements should help increase

piglet birth weight and reduce it's within litter variation. We could do this much more precisely by feeding 2 or more diets during gestation. With the increases in litter size we have seen in recent years there is a much greater need for precise feeding of our gestating sows than heretofore.

Nutritional Supplementation

Dextrose

Supplementing diets with 150g dextrose per day during the weaning to service interval has been found to reduce within litter variation in piglet birth weight and to reduce the proportion of piglets born weighing less than 1kg. However, average piglet number born alive and mean piglet birth weight was not affected. The response observed was mediated by increases in blood glucose and insulin concentrations (Van Den Brand et al., 2006).

L-Arginine

Over the past decade there have been many experiments conducted where L-Arginine has been supplemented to sow diets during gestation. Many of these have found that Arginine can increase born alive often due to a reduction in born dead. Some of these experiments have also found Arginine supplementation to increase piglet birth weight and to reduce the within litter variation in piglet birth weight (Matteo et al., 2007; Li et al., 2011; Gao et al., 2012). Where L-Arginine was found to increase born alive, supplementation often occurred in early gestation. Where birth was increased supplementation occurred during the period between day 22 of gestation and farrowing. The improvements seen are most likely due to increased placental growth and efficiency which increased nutrient supply to the foetus *in-utero.* Arginine was normally supplemented to sows at ~25g per day. L-Arginine is still very expensive, however, should a market develop for this amino acid it could become much cheaper to produce. Furthermore, identifying the exact nutritional windows when supplementation should occur during gestation would mean that the duration of supplementation could be reduced.

L- Carnitine

Carnitine is a quaternary ammonium compound biosynthesized from the amino acids lysine and methionine. Preliminary results from Kathryn Reid's PhD work are finding increases in piglet birth weight of ~75g as a result of supplementing sows with L-Carnitine during gestation. L-carnitine's mode of action in promoting foetal development is thought to be primarily due to its positive effect on energy metabolism and through increasing insulin-like growth factor I levels in the sow. Musser et al. (2007) found that piglets from sows supplemented with L-carnitine during gestation had up to 28% more muscle fibres than piglets from non-supplemented sows. Others found that piglets born to L-Carnitine supplemented sows can have faster growth rates and improved feed efficiency prior to weaning, the effects being greatest with light birth weight piglets (Birkenfeld et al., 2005). Piglets from L-carnitine supplemented sows have also been found to have increased suckling ability compared to piglets from non-supplemented sows which helps explain their increased growth rate during the suckling period (Ramanau et al. 2004). Positive effects due to L-Carnitine supplementation of sows have also been found in pigs at slaughter, with carcasses being leaner and having greater loin depths (Musser et al. 1999). L- Carnitine has normally been supplemented at ~100mg/day to sows throughout gestation or between day 30 of gestation and farrowing.

Management practices

A survey of 19 TOPIGS nucleus farms which had similar genetics and litter size reported some interesting results (Opschoor et al. 2010). The 80 question survey was conducted on 19 farms and aimed at finding relationships between management practices and piglet birth weight. As well as showing the importance of nutrition during gestation the survey yielded some other interesting results which are summarised below:

- Gilts quarantined before entry to the herd had a 39g higher mean piglet birth weight than gilts introduced directly.
- Sows which were group housed had a 61g higher mean piglet birth weights than sows housed in stalls.
- Natural farrowing resulted in a 43g higher mean piglet birth weight than farrowings that were induced.
- Feeding a lactation diet between weaning and service increased mean piglet birth weight by 55g

- Farms with very good hygiene had mean piglet birth weights that were 224g higher than for farms with average hygiene.

Genetics

Individual birth weight has a low heritability, however, it is possible to increase birth weight through genetic selection. Additionally it is important to simultaneously select for both birth weight and increased within litter uniformity to ensure as many pigs in the litter as possible reach an optimum birth weight.

Summary

Piglet birth weight is of immense importance when it comes to piglet survivability and growth to slaughter. However, increasing litter sizes are reducing mean piglet birth weight and increasing within litter variation in piglet birth weight. Although it is difficult to increase birth weight and reduce within litter variation in birth weight there are things that we can do. Our nutrition of sows during gestation needs to be more precise than before. We must ensure that the requirements of individual sows of all parities are met at all stages of gestation. There are supplements that can be added to the diet which will help increase birth weight in the future. Additionally, links have been shown between many management practices and piglet birth weight and the practices that favour birth weight should be adopted. Finally, our breeding companies must select for increased birth weight and increased within litter uniformity in birth weight.

References available on request.

How do I know the Health Status of My Herd?

Edgar Garcia Manzanilla, Moorepark & Hector Arguello, Ashtown

Although 70% of the cost of pig production is feed, feed efficiency is not only related to the diet itself. An equally important aspect to maximise feed efficiency is health. Animals with a sub-optimal health status will have different nutrient requirements and will be less efficient than healthy animals. Although the health problems found in pig herds can be of infectious and non-infectious origin the following text is focused on infectious diseases.

Several agents, both viral and bacterial, can cause disease within pig herds. It is important to discuss with your veterinarian which are a risk to your herd in order to develop a health programme for your farm. Some diseases like swine dysentery, atrophic rhinitis or Actinobacillus pleuropneumonia (APP) can be eradicated. However there are other diseases for which control and stabilization protocols may be more realistic, the main ones being PRRS and Mycoplasma or enzootic pneumonia (EP). Streptococcus suis, Haemophilus parasuis, Actinobacillus suis, rotavirus and Escherichia coli are also important health challenges in some herds.

The first step to implement strategies for stabilization and control of disease is knowing which diseases are costing your operation the most money. The disease status of the farm can be measured by clinical signs and post-mortem examination of dead pigs when there is a clinical disease on the farm. But clinical signs are usually the tip of the iceberg of the diseases circulating on our farms. In subclinical infections such as ileitis, circovirus or EP and most of the infections in a chronic phase, such as controlled PRSS or APP, the herd health status must be determined by other factors such as drug use (which, when, dose...), slaughter-check examinations, evaluation of the productivity of the herd and serological profiling.

Using your records

Accurate production records are a priceless resource to detect any subclinical problem in the herd. Respiratory and intestinal disorders usually affect the feed parameters, increasing the feed conversion ratio and prolonging the time required to reach market weight. Graphing mortality by the week also helps pinpoint when mortalities are occurring, when to submit tissue for diagnostics, and when to start intervention strategies.

On the other hand, complete records on the use of vaccinations and antibiotics are very useful. Vaccination records will tell us if the use of vaccines is working or should be

modified. In many occasions it is not easy to remember changes in vaccines or doses after 6 months. The same applies for antibiotics. Not all antibiotics work against all the bacteria, for this reason, it is important to know if the antibiotic used is appropriate or should be changed.

Slaughterhouse checks

The slaughterhouse is a great source of information. It offers the chance to do inspection of internal organs avoiding euthanasia of live pigs to check diseases. It becomes especially relevant when we want to know the health status of our pigs in reference to the respiratory complex, determining the degree of lung lesions and thus the effectiveness of any treatment or vaccination implemented in the herd. Its main limitation is that we will only observe acute disease happening at the end of the finishing period or chronic problems. Unfortunately there is no slaughterhouse feedback scheme in Ireland yet and PVPs have to do visits under request.

Laboratory analyses

The analyses performed in the laboratory will depend on the disease, sample collected and methods available in the lab. The first thing to know about laboratory analysis is that lab technicians or vets are not detectives! So along with the samples some additional information on the case should be provided. Secondly, the vet must interpret the analysis, considering the technique used in the lab and the result provided. For instance, if we ask for *E. coli* detection in a faecal sample and the laboratory report says "positive", the meaning of the information provided is negligible. *E. coli* is always present in faeces, even in healthy animals. It is advisable that the report includes the fimbriae (F4, F5 F6, F41 are common in pathogenic *E. coli*) or the detection of toxins for diarrhoea or oedema disease. For this reason, it is advisable to know what we need to ask and how to interpret the results. Last but not least, the laboratory analysis can be conclusive and show evidence of the presence of a pathogen which explains the clinical case but in some circumstances the results may not match the clinical signs.

Serology, cultures and molecular diagnostics (PCR) have become common analyses to help understand swine disease profiles, at which stage an infection occurs and thus when is more suitable to establish strategies such as vaccination.

Serology

Serology tells us if the animals have been exposed to the pathogen. Cross-sectional and longitudinal serology is often used to profile a herd's exposure to specific pathogens.

Cross-sectional blood testing is the sampling of a number of pigs at different ages in a farm at the same time point. This method provides a relatively fast answer on immunity, but more interpretation is required. Cross-sectional testing of blood from several age groups can help determine when exposure occurred.

Longitudinal bleeding of pigs involves a subset within a group that is followed throughout the cycle. This method requires less interpretation of the data, but it can take longer to get answers. Both methods help pinpoint when antibody levels increase, as well as when exposure occurs to better target vaccination prior to exposure. Double serum samples are sometimes useful to determine whether the antibodies are carried over from an old infection, which has long since gone, or whether it is associated with your current disease problem. The second is taken 14 to 28 days later. If the antibodies are due to the current infection, they will be rising from zero or very low to high. If they remain level or fall it is probably a past infection.

Cultures and PCR

Cultures and PCR tests tell us whether a pathogen is present in diagnostic samples and guides us closer to knowing the time of exposure. It is important to get as much information as possible, so typing methods should be included (see the example about *E. coli* above). This information can be relevant to establish which vaccine has to be used. In diseases caused by bacteria, the antibiogram is of relevance. An antibiogram of the target pathogen i.e. *E coli*, Pasteurella or Streptococcus is going to tell us which is the antimicrobial of election. The antibiogram will save time and money avoiding the use of useless antibiotics. It will also help to reduce the development of antimicrobial resistances, which are of public concern but which will help the farmer to have other choices if the pathogen becomes resistant to the antimicrobial used on the farm.

PRRS, EP, PCV2 and Lawsonia intracellularis (ileitis) are pathogens that can be routinely tested for antibody response by serology and exposure with PCR.

Which samples should be collected on farm?

The type of sample collected depends on the nature of the disease, i.e. respiratory, systemic, reproductive or gastrointestinal problems. The sample will depend as well on other factors such as potential pathogens involved and diagnostic method used to determine the etiologic agents involved. For this reason, it is of paramount importance that the veterinary consultant receives a clear, concise and accurate description of the problem beforehand. Adequate information will help the vet to focus the problem and collect the appropriate samples for differential diagnose.

Table 1. Type of samples that can be collected for analyses of different diseases

Respiratory	Digestive	Reproductive	Systemic	Cns
• Tracheobronchial washing • Nasal swab • Lung swab, PM • Lung sample, PM • Blood/serum	• Faeces • Intestine, PM • Blood/serum	• Blood/serum • Foetal aborts • Fluids	• Blood/serum • Affected organs, PM •	• Blood/serum • CSL • Tissue, PM

1. CNS: Central nervous system; 2. PM: Post-mortem; 3. CLS: Cerebrospinal liquid sample

The selection of the sample is of paramount importance for the diagnostic. For instance, tracheobronchial washing offers the best results in respiratory diseases. On the other hand lung tissue can yield negative results if the problem is chronic as the isolation of the pathogen becomes more difficult. A recent development on sampling oral fluid is placing cotton ropes in pens for pigs to chew on and collect fluids for testing. This is a fast and easy way to get an idea of when pigs are exposed to pathogens.

Samples collected on farm: how many and how should they be handled?

A reasonable question that arises for the farmer is how many samples does the vet need to collect to determine the cause of the problem? There are not an exact recommended number of samples to be collected; that depends on the pathogen, type of sample collected and the methods used in the lab. However, the larger the number of samples is the greater the chances to get positive or more accurate results. But cost always limits the final number of samples that can be taken. Most PVPs and laboratories agree that 10 samples are enough to find out which pathogens are involved in a clinical case, considering that they are collected from sick animals exhibiting viremia or bacteraemia (high numbers of the virus or bacteria), fact that increases the chances to detect the pathogens involved. Nevertheless, we need to highlight here that if the purpose of the analysis is different, for instance to determine when pigs become infected by a certain pathogen throughout the production cycle, the number of samples that are needed is increased. It is important to consider when we collect samples that untreated pigs in the early phases of the disease provide ideal samples. Antimicrobial treatments can lead to confusing results as they can become negative, so it is important to provide sick but not treated animals for laboratory analyses.

Post-mortem evaluations must be conducted on at least three pigs during a disease outbreak to ensure that the disease process affecting the group is identified. Similar to the previous paragraph, it would be ideal to perform the necropsy in non-treated

animals. If we want to avoid euthanasia of live animals, necropsy and sample collection can be performed from fresh carcasses (it is recommended that animals died in the last 12 hours). Avoid long term dead animals as results can be confusing due to post-mortem changes.

One crucial factor to have success in the laboratory analysis of the samples, which involves culture, for example diagnosing of meningitis or streptococci infections, is to obtain the samples as aseptically (surgically clean) as possible, avoiding contamination of the tissue. Sterile flask, scalpels, disinfected scissors, knifes, disposable gloves etc., are compulsory to avoid any cross-contamination that blinds the results in the laboratory. Time elapse between collection and analysis is important too. A delay in the analysis can lead to negative results (even if the pathogen is there). Remember that carcasses, tissues, serum or faeces are organic samples that get altered by time. Thus samples must be delivered straight after their collection, if it is not possible (e.g. sample collected Friday afternoon can be kept in the fridge, but some analysis can be altered). Sending samples in cool conditions will help preserve the sample during transport.

Focus on replacement gilts and farrowing for a perfect finisher

The breeding herd, and in particular gilts, are key to keeping good herd health. Gilts should be properly adapted to the herd and monitored for the development of immunity. When a breeding herd becomes unstable for any number of pathogens, there is often too much vertical transmission from sow to piglet. Piglets subject to excessive challenge prior to weaning have a reduced ability to respond to vaccination, a lower growth rate and are affected by disease at higher rates than health-stable herds. Once farrowing starts, the immunity-rich colostrum is the biggest driver to successful piglets.

Conclusion

Herd health should be regularly checked and clear objectives should be established in close collaboration with the PVP. Farmers should use all available tools to keep track of the health of their herds including records for drugs use (which, when, dose...), data on productive performance and mortality, slaughter-check examinations, serological profiling and selective pathogen identification. The cost of not doing so may be unknown but still high. As an example, ileitis testing by 12-16 weeks of age shows exposure to Lawsonia occurring and by 20 weeks of age if it has moved through the group. Potential interventions may be to vaccinate six weeks prior to exposure at 10 weeks of age with a Lawsonia intracellularis vaccine or implement an in-feed antibiotic control programme in finishing diets. With no intervention, the potential cost to the producer may be €5-7 per pig.

Progress in Relation to Antibiotic Usage in the Pig Sector

Caroline Garvan & Denis Healy, DAFM

Introduction

The issue of Antimicrobial resistance (AMR) is now seen as one of the greatest challenges to global public health today and the problem is increasing. The rise in antimicrobial resistance also has serious consequences for animal health and welfare and food production. The term AMR is used interchangeably with antibiotic resistance and essentially means that the antibiotics are ineffective to treat the bacteria that have caused the disease in either the human or animal population. The development and spread of antibiotic resistance is driven by the misuse and overuse of antibiotics, and by poor infection control. Existing antibiotics are becoming less effective, with no new veterinary antibiotic coming on the market for nearly 20 years, so it is vital to protect the efficacy of the current antibiotic tools available as they are a valuable resource rather than a commodity. Responsible and prudent antibiotic usage is key to controlling the development and spread of antibiotic resistance. In the Agri-sector the primary responsibility rests with the prescribing veterinarian and the farmer.

There is now a combined global 'ONE HEALTH' focus on antibiotic usage due to the impact of AMR on human diseases, animal diseases and the environment on AMR. The link between usage of antibiotics in animals and the occurrence of resistant bacterial disease in humans has yet to be fully understood. However all evidence clearly shows that increased resistance occurs in both humans and animals where there is an increase in usage and consumption of antibiotics in each population. A recent report in the UK has stated that by 2050 there will be more people dying as a result of antibiotic resistant disease, number estimated to be 10 million, compared with the number of people dying from cancer, estimated to be 8 million. The European Commission launched an AMR Action plan in 2011 with a focus on infection control, surveillance of both antibiotic usage and consumption, promotion of responsible use of antibiotics and research into improved diagnostics, vaccines and alternatives to antibiotics.

Surveillance of Antibiotic Usage and AMR

The usage of veterinary antibiotics in Ireland has been surveyed over the last 4 years at the level of sales data from wholesalers. Although the data could be considered to be a crude estimate due to certain variables, the constant trend over the years analysed have shown that over 50% of veterinary antibiotics sold are to the pig sector, with 34.5% being premixes incorporated either by mills or on farm.

A DAFM pilot study involving 16 farms yet to be completed, has shown that in general patterns of antimicrobial usage are greatest at the creep and link stage with a range of usage seen from 0-21g of active antibiotic (10 different types) at the creep stage, and a range of 0.4 to 12.8g of active antibiotic (7 types) per pig at the Link first stage weaner. The duration of use was not always in compliance with the product datasheet, and in some cases the incorporation rates differed. Other research which investigated antimicrobial usage in relation to *Esherichia coli* resistance showed similar findings in terms of usage patterns.

The DAFM surveillance carried out in relation to levels of bacterial resistance in different species has been ongoing for the last five years with levels fluctuating slightly, with an increase in 2013, but staying below 20% which means that one in five bacteria tested showed resistance to one or more antibiotic. When these results were examined in relation to pigs, which accounted for one third of all samples taken from 2010 -2013, the levels of resistance were much higher than the other animal species sampled with a resistance level of 34% detected in 2013, and a continual year on year increase. Of particular concern was the level of bacterial resistance to the most commonly used antibiotics in feed medication in the pig sector.

Resistance levels to Tetracyclines, Sulphonamides and penicillin's increased from 57% in 2010 to 71% in 2013. This a clear result of prolonged usage of the same classes of antibiotics, and validates the measures in place in other countries that there should be ongoing sensitivity testing as part of any disease treatment to ensure that the appropriate medicine is being used and that it will be effective. In relation to resistance to antibiotics that have been classed as Critically Important antibiotics (CIAs), the surveillance data shows resistance levels much lower with levels of 19 per cent being detected in 2013, but it is important to emphasise that resistance levels have been

steadily increasing since 2010. The CIAs are classed as such as they are considered stronger antibiotics than the previously mentioned ones, as such they should only be used on foot of a current veterinary diagnosis and where sensitivity testing has been carried out. The CIAs such as products containing flouroquinolones, cephalsporins and aminoglycosides should not be used as a first line treatment, but only where initial treatment has been carried out with a less strong antibiotic. This protocol should be followed in order to preserve the efficacy of the stronger antibiotics as otherwise there will be a lack of suitable disease treatment options in the future.

Changes to Legislation

Both the veterinary medicines and medicated feed legislation have been subject to a review for the last few years and the first drafts of the new legislation are currently being discussed at EU level. The current EU veterinary medicines legislation that is over a decade old, and the new legislation will be more restrictive in the context of antibiotic use because of the concern in relation to AMR. This new legislation, being a Regulation must be strictly adhered to in all Member States. The current draft of both the Veterinary Medicines and Medicated Feed Regulation requires strict adherence to the dosage and duration of treatment as per the product data sheet. There is a major focus on not using antibiotics for disease prevention, and further restrictions on the prescribing and use of CIAs. The proposed new legislation will pose a challenge for the Irish pig sector. It is imperative that the industry focuses on the targeted delivery of medicines to small defined groups of pigs, thus avoiding mass medication

Prudent Use Guidelines

As mentioned previously the focus on responsible or prudent use of antibiotics is key to controlling the development and spread of AMR. As a follow on from this action point the Commission has published in September 2015 their Prudent Use Guidelines which highlight various recommendations that have been implemented in other Member States and found to be effective strategies to combat AMR. The clear message from the guidelines which is meant to act as a tool box for addressing the challenge of AMR is that antibiotics should only be used as little as possible and only as much as necessary to treat the disease. General principles on the prudent use of antibiotics need to be applied as a matter of routine on farms and in veterinary practices so that inappropriate use, such as under-dosing, does not occur. Prudent use should lead to more rational and

targeted use, thereby maximising the therapeutic effect and minimising the development of AMR.

In relation to pigs the Guidelines place an emphasis on the following:

- Avoiding preventive use of antibiotics in new born piglet and after weaning as part of a herd health strategy
- Isolation of agent causing disease and use of vaccination where possible
- Ensuring ventilation and housing environment are functioning correctly
- Ensure diet is appropriate for age of pig, e.g. protein levels at weaning
- Reassessing weaning management where there is recurrent diarrhoea

All of the above suggestions should be considered by Irish pig producers in order to adopt a holistic approach to reducing antibiotic usage.

Biosecurity

The ultimate objective to reduce antibiotic usage is to reduce the need for antibiotics by preventing disease. Animal diseases and infections should primarily be prevented by ensuring biosecurity, following good production and management practices and implementing integrated disease control programmes. Implementation of an 'all-in all-out' system of production, and thoroughly cleaning and disinfecting production units when animals move into, within and out of the herd is essential.

Biosecurity encompasses both external and internal farm biosecurity. Improved external biosecurity reduces the introduction of disease and internal biosecurity reduces disease spread within the pig unit. Research in other countries has shown that better biosecurity results in less disease, less antibiotic use and better production results in terms of animal welfare, public opinion and farm profitability.

Biosecurity is a complex issue that requires continued management, a tool to compare practices in different farms which was developed in Belgium has been piloted here by Teagasc on 30 farms. The results so far point towards good external biosecurity but poor internal biosecurity in particular at the farrowing and suckler stage.

Conclusions

Foodwise 2025, the strategy for the development of the Agri-food sector up to 2025 highlights the fact that the Irish pigmeat industry accounted for almost 8% of the output value of the primary Agrifood sector in 2014 (6.14 billion). The demand for pigmeat worldwide continues to increase along with challenges from high feed and energy costs as well as disease issues. In the context of sustainable production of a premium quality product with full traceability, the usage of antibiotics needs to be considered. It does appear that there is an increased awareness at the producer level of the impact of antibiotic usage. There has been a reduction in the usage of antibiotics on some farms through a combination of changes in animal and feed management systems, improved biosecurity and vaccination policies.

Notwithstanding, it is essential to continue to reduce antibiotic usage in the pig sector. It is important that one veterinary practitioner or practice is given the responsibility for oversight of the health of each herd. There should be regular consultation between the herdowner, the responsible veterinarian, the animal nutritionist and the Teagasc pig advisor to ensure a holistic approach to dealing with animal disease and health issues. A collaborative and informed approach involving all stakeholders in relation to antibiotic usage can only serve to strengthen the Irish Pork Brand and maintain the competitiveness of the Irish Pig Sector in an international environment.

To continue making progress in improving the pig herd health status and reducing the threat of AMR, where antibiotic usage is deemed necessary by the responsible veterinarian, the protocol of using the appropriate antibiotic (sensitivity test), at the correct dose, for the correct duration (as per product datasheet) must be followed.

Strategic Mixing & Grading of Pigs - Do You Make The Grade?

Michael McKeon, Moorepark

In Ireland we spend a considerable amount of time grading and sorting of pigs throughout their lifetime from birth to slaughter. This entails a large amount of labour and time but does it give a financial return for the effort invested? This paper attempts to differentiate the performance benefits of grading as-opposed to the Atheistic satisfaction of having all pigs the same size within pens.

Why do we grade?

Many units grade their pigs at the various stages because they believe that pigs of a similar weight range will perform better. In general this is **not** the case unless higher specification diets are used for the lighter pigs. Unsorted pigs will perform as well or at times better than sorted pigs when all are fed the same diet.

Farrowing House Cross-fostering:

In Ireland we tend to 'even-up' all litters on the basis of piglet weight, as many believe that small light piglets will not fare as well against much bigger littermates and therefore will have less teat access. This 'evening-up' of litters can occur a number of times over the 4 week period that pigs are in the farrowing house. Research has shown (Cutler et al, 1999) that lightweight piglets perform better (+0.5kgs at weaning) with heavier littermates as there is less aggression than when graded to a similar weight. When lightweight piglets are graded together, there is more teat competition causing them to miss milk let-down events. The lightweight piglets (compared to mixed weights) may also be less effective at nuzzling the sow's udder which is an important stimulant for milk production and milk let-down (Milligan, 2001).

If lightweight piglets perform better in variable weight litters, should the practice of cross-fostering be eliminated? The answer is **no**! Cross-fostering is still necessary but only if done once (and only once) correctly between 24-48 hours post farrowing and where only the lightest (high risk) piglets are grouped together thereby allowing greater supervision. The only other time a piglet should be moved from their litter is if they are sick or hungry. Continuous grading of pigs after the first 48 hours reduces the overall performance of the donor and recipient litters as it appears to compromise the growth

rate of the fastest growing piglets rather than increase the daily gain of the lightest piglets (Tokash, 2004).

Weaning: "Surely grading is essential"?

There is no performance gain from grading at weaning unless different feeds or feeding regimes are going to be implemented. A Kansas State University trial examined the weight gain of weaned pigs (graded vs ungraded) in group sizes of 21 and 30 pigs. The ungraded pigs performed substantially better in both group sizes.

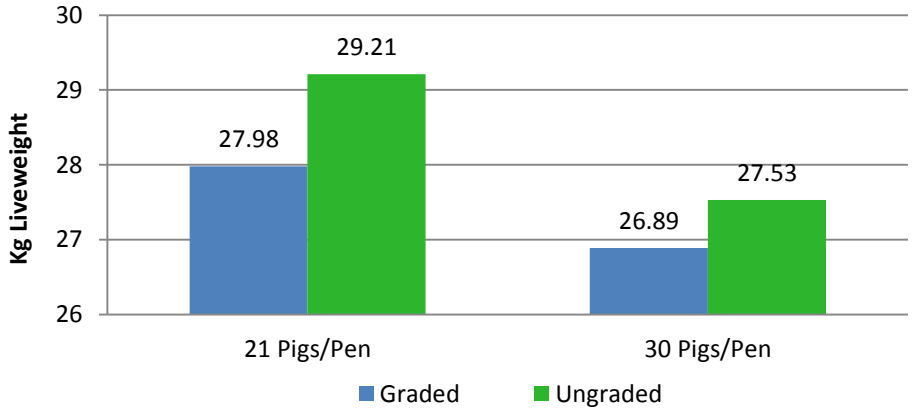

Figure 1. Effect of Graded vs Ungraded weaned pigs on exit from weaner stage (Dritz et al, 1996)

If ungraded weaned pigs perform better should we stop grading pigs at weaning? Yes, especially if we are not going to implement different feeding regimes. There is no point grading pigs by weight into light, medium and large groups unless this is going to be used to achieve something. Grading without further intervention will not achieve anything.

Ideally, grading should be carried out on a limited basis (lightest 10% and gilt litter progeny only) and these pigs should be fed an enhanced diet or given access to creep and link for a longer period. Gilt progeny are included with the lightest pigs as these have lower lifetime growth rates, then progeny from other parities, and therefore are generally among the lightest finisher pigs at sale weight. This is due to their lighter weaning weight and their lower immune status as a result of inferior quality colostrum at

birth (Moore, 2003). An Australian trial estimated the daily gain of gilt progeny to be 50g/day lower when compared to sow progeny.

Table 1. Growth rates of gilt and sow progeny (Smith & Collins, 2009)

Treatment	Weaned Wt	Sale Wt	ADG (g/day)
Gilt progeny	6.9 kg	90 kg	695
Sow Progeny	8 kg	99 kg	754

Finishers: "I grade them to improve growth rate & reduce sale weight variation"

If minimal grading is undertaken at weaning (as recommended in the previous section), will undertaking further grading at transfer-to-finisher's improve performance and reduce sale weight variation? The answer is **no**. Lightweight pigs (Table 2, Quinn et al 2001) grow at the same rate whether grouped together or left ungraded with heavier pigs. However medium sized pigs grew slower when graded due to increased aggression within pens. Increased aggression, leads to more stress, poorer health, more injuries, reduced welfare and ultimately reduced performance.

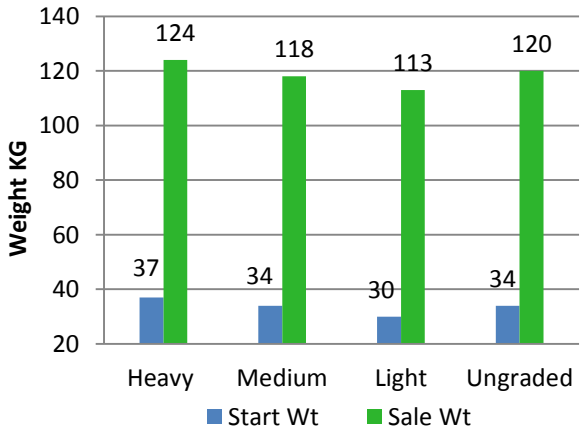

Figure 2. Start and sale wt for Graded Vs Ungraded

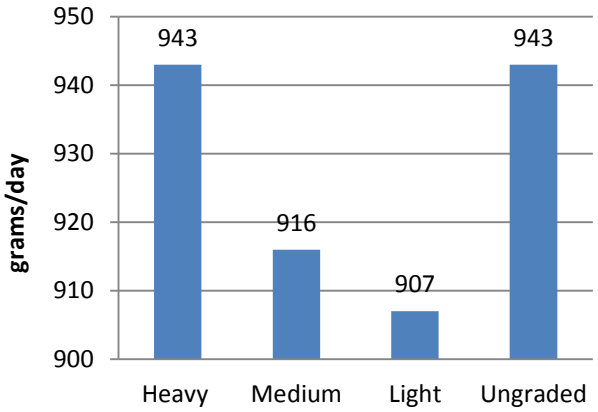

Figure 3. ADG for Graded Vs Ungraded

The variation within pens was also analysed. At the start of the trial the ungraded pens had obviously the greatest weight variation when compared to the graded pens. However at sale weight there was statistically no difference in the weight variation among any of the pens. This shows that the weight variation in the ungraded pens decreased over the finisher period when compared to the average.

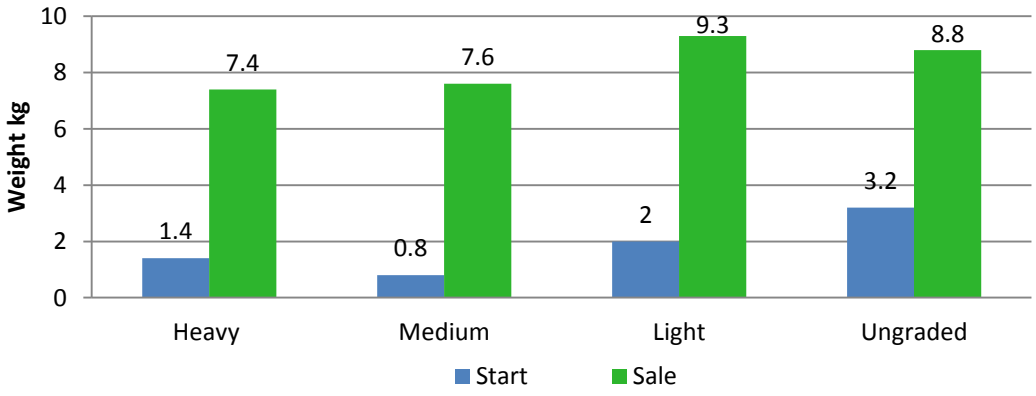

Figure 4. Average within pen weight variation (std deviation) for finishers (Quinn et al, 2001)

Conclusions

- Grading achieves little unless followed-up by a different feed regime for the graded pigs
- In farrowing houses grade, once at 24-48 hours and do not do further moving unless individual pigs are sick or hungry
- Frequent cross –fostering reduces the growth of the heaviest pigs in the recipient litter
- At weaning, grade the 10% lightest and gilt progeny into one batch - do not further grade the remaining pigs
- Do not grade on transfer into the finisher section as this will reduce the growth rate of the medium sized pigs – less fighting when there is +3kg of weight difference between pigs
- Pre-sale take the heaviest pigs (tops) off a number of pens as this will increase space allocation for the remaining pigs across many pens instead of one/two pens

References available on request

Improving Gilt Management to Optimise Parity Profile

Keelin O'Driscoll, Laura Boyle and Amy Haigh, Moorepark

Introduction

Having an appropriate parity profile on your farm is a key component for efficient and profitable pig farming. However, parity profiles can be skewed by involuntary culling and early sow deaths. Many sows are removed from the herd before they reach their peak performance (parity 3 – 5), and Teagasc PigSys data indicates that 13% of gilts introduced to the breeding herd are removed before they even have one litter. Better awareness of the costs and causes of involuntary culling are essential to reduce this problem. This paper will describe some of the practical steps that can be taken to achieve a healthy, highly productive sow herd, by improving the early management of gilts.

Immediate consequences of a poor parity profile

Recent work from Moorepark nicely demonstrates the importance of parity when it comes to sow output (Figure 1). Sows at low and high parities produce fewer live born piglets than those of parities 3, 4 and 5 (Figure 1); thus the herd should be managed to maximise the number of sows reaching at least parity 3. This is also the parity at which a sow becomes profitable, so it is important that gilts and sows remain healthy and productive until at least this stage.

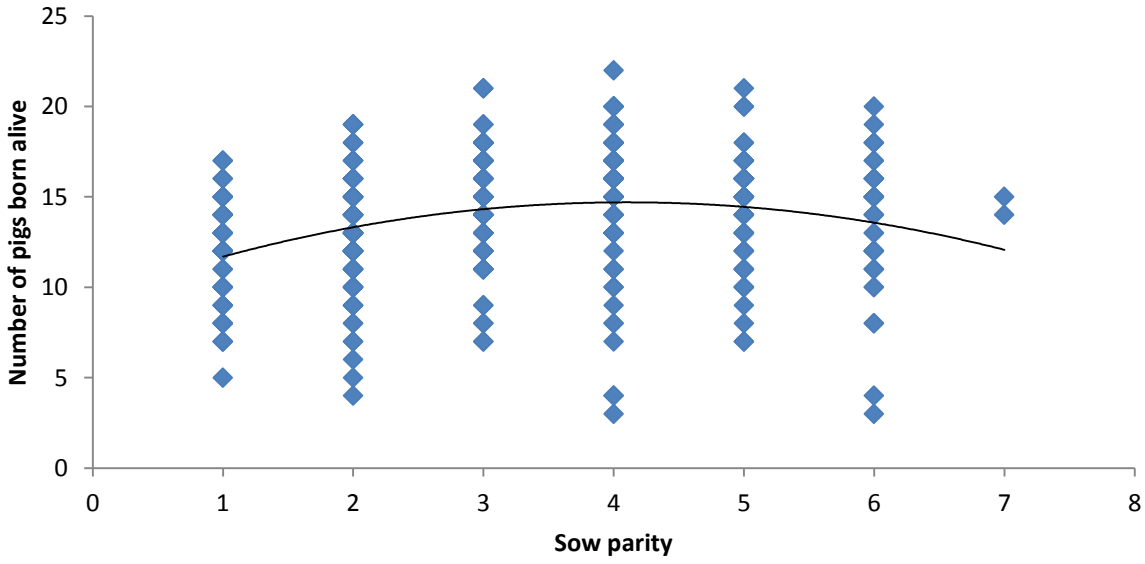

Figure 1. Number of pigs born alive relative to sow parity, based on 420 farrowings

However, replacement rates in Ireland are high compared with our European competitors (55%, joint highest with Denmark, Figure 2). A high replacement rate leads to too many gilts in the herd, as they are brought in to replace culled animals. Likewise, a low replacement rate (below 40%) leads to too many old sows remaining on the farm beyond their peak productivity.

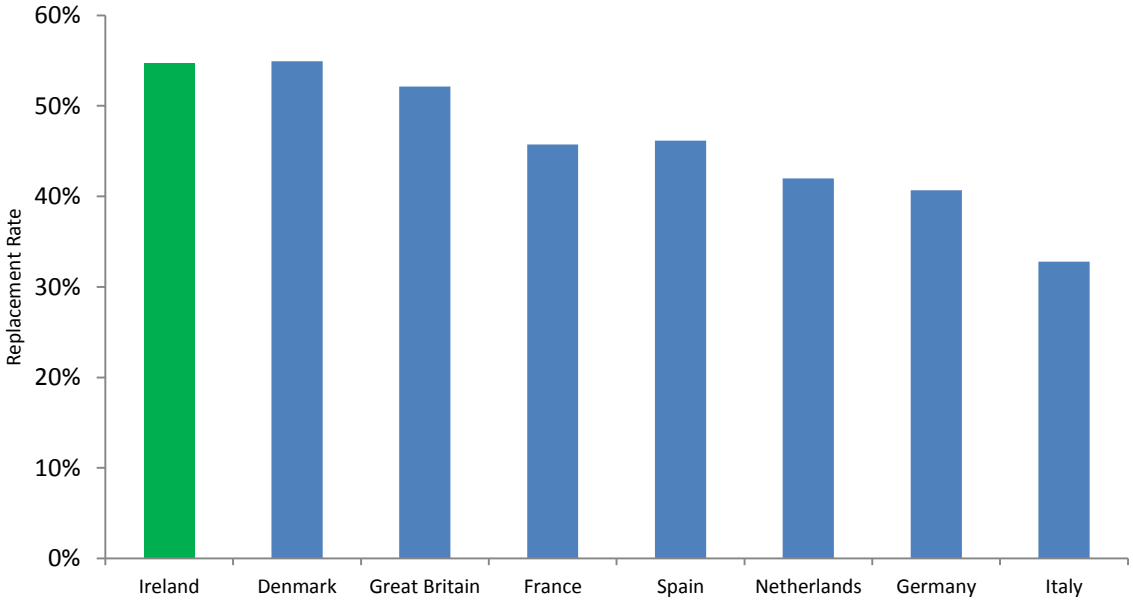

Figure 2. Sow replacement rates across Europe in 2014 (InterPig, 2014)

A higher proportion of voluntary, rather than involuntary culling is fundamental in establishing a stable, profitable, parity profile. Voluntary culling occurs when a decision is taken to cull an otherwise healthy sow so that she can be replaced by a younger, and hopefully more prolific animal, or so that there can be a change to the genetic stock. The decision to cull should be taken based on the biological condition of the sow, and a proven healthy sow may in many cases be less of a risk for poor future performance than an unproven replacement gilt. Involuntary culling, on the other hand, occurs when the stockperson has no choice over whether to cull the animal, for instance due to a health problem (lameness is the most common), or infertility. In fact reproductive failure is the most common cause of involuntary culling of young animals followed closely by lameness.

Hidden costs of a high proportion of gilts

There are many negative consequences of having a high percentage of gilts on your farm. These include:

- If buying in gilts, their purchasing price is higher (approx. €250), than the sale price of a cull sow (approx. €120)
- Gilts are still growing, so 70% of feed costs goes towards growth rather than output
- The labour involved in early induction of first oestrus and efficient breeding is above that which is necessary to re-breed a mature proven sow.
- A high replacement rate necessitates breeding more sows on the farm to maternal lines to produce replacements, reducing the number of terminal line piglets produced on the farm. This represents a compromise in the genetics in the finishing herd.
- Piglets produced from gilts have a lower birth-weight than those from sows. Low birth weight in piglets correlates with decreased survival and lower postnatal growth rates, leading to longer finishing times.
- Milk yield and quality from gilts is lower than that of a sow, and thus piglets feeding from gilts do not perform as well as those from sows.
- Recent work where piglets from sows and gilts were cross fostered at birth showed that at 40 days of age, piglets reared on gilts had lower antibody levels and higher acute phase proteins (indicators of inflammation) than those reared on sows. A poor immune status could result in piglets reared on gilts being more susceptible to infection and stressors, and thus less efficient.
- If purchasing replacement gilts there are potential indirect 'costs' for bio-security and disease prevention. Bought-in gilts need to be quarantined and acclimatised on-farm for 6–7 weeks.
- High replacement rates due to a high level of involuntary culling is considered a 'waste' of young animals and is often viewed by the public as evidence of poor animal welfare.
- Production of replacement gilts requires considerable investment of dwindling natural resources in the form of expensive protein and oil so there is also an environmental cost associated with high replacement rates.
- Finally, in an era of growing concern over the threat posed by antimicrobial resistance to human and animal health an animal production system that relies on in-feed medication of numerous animals that are wasted is not sustainable and could potentially lead to a negative public perception of pig production.

Good management of gilts will improve longevity

The myth of 'hardening off'

All too often we forget that our replacement gilts are the most valuable animals in the herd, and that this should be considered when it comes to their management. The first step in reducing wastage of young sows in the early parities is to dispel the notion that gilts need to be 'hardened off' in order to stimulate good performance. Gilts need to be at their very best in terms of their ability to cope with pregnancy and entry to the breeding herd. Considering one of the primary reasons for culling of gilts is lameness, it makes sense that they should not be managed in accommodation, or group structures, that cause or aggravates this disorder. Typically in Ireland selection of gilts as replacements is done at 90kg. However, potential replacement gilts should actually be managed with care from a much earlier stage, in fact before they are born, so that their development and comfort is optimised.

Prenatal considerations

The attention which should be given to potential replacement gilts should begin in utero i.e. while they are foetuses. Stress (e.g. re-mixing, competition for resources, chronic pain) on their mother sows during pregnancy should be minimised. Stress during pregnancy causes hormones to be released that have a negative impact on the developing foetuses. This is known as **prenatal stress** and it can have life lasting effects on the resulting gilts behaviour, learning ability, stress physiology, immune function, and growth, metabolic and reproductive performance. These traits are highly relevant to a replacement gilts success in the breeding herd.

At birth

There is a hypothesis that birth weight may have some association with subsequent reproductive potential; large gilts at birth exhibit a tendency to perform better than their smaller counterparts. It is probable that there is a minimum birth weight, below which gilts do not have the reproductive capacity to produce consistently large litters for at least 6 parities. Furthermore, Tummaruk et al. (2001) revealed that gilts born in larger litters were more likely to produce more piglets in their own litters. Hence in order to maximise the reproductive success of replacement gilts it is generally important that heavy birth weight gilts are selected from large litters. This can only be done if birth weight is recorded. Thus potential replacement gilts should be tagged with individual numbers.

During lactation

Tagging also offers the best way of ensuring that an accurate record of the gilts developmental history is recorded. It is important that gilts are fostered as little as possible, and that illnesses and/or injuries incurred during suckling are recorded. Research at Moorepark indicates that cross fostered piglets miss several nursings during the first 24 hours following fostering and they are involved in an increased number of teat disputes (fights). It is unlikely that repeated food deprivation and aggression at such an early stage is beneficial for the development of replacement gilts. Thus it is recommended that piglets are never moved between sows more than once (see paper by Michael McKeon).

The navel poses an obvious risk for infection, and management practices such as tail docking, teeth clipping, ear notching and iron injections in the first days of a gilts life provide numerous other points of entry into the body for bacteria. Bacteria can also enter the body via limb and claw lesions which are highly prevalent in Irish suckling piglets (Quinn et al., 2014). Recent diagnostic work in conjunction with pig pathologists in the Central Veterinary Research Laboratories in Backweston revealed evidence of arthritis in the forelimbs of weaned piglets with knee abrasions and gum abscesses from teeth clipping. These were otherwise healthy animals. If such animals are selected as replacements it is highly likely that these infections would compromise their overall health and productive potential, and possibly lead to early involuntary culling. Hence there is a strong case for paying better attention to these seemingly minor lesions in young potential replacement gilts.

Weaning

Obviously weaning poses a major nutritional and psychological stress for all pigs, and it is important that such stresses are minimised for replacement gilts because of the detrimental effects of long term stress on immune function etc. Recent research in this area has found that:

- Piglets learn best about solid food from their mothers so ideally they should not only be able to watch her eat but also to share her food. Piglets that can do so grow better post-weaning
- Co-mingling litters prior to weaning by removing barriers between pens can lead to lower levels of aggression, and improved coping with weaning
- When grouping pigs at weaning it is more important to minimise the number of litters that groups are composed of rather than attempting to create uniform

groups composed of piglets from numerous litters (see M McKeon paper on re-considering the need to grade pigs).

Beyond weaning

It is essential to document illnesses in potential replacement gilts post-weaning. Multiple courses of antibiotics and periods spent in the hospital accommodation are not desirable features of replacement gilts. The former damages gut health and may delay development of the animals innate immunity, and the latter exposes gilts to a wide variety of potential pathogens.

Growth rate and nutritional management

The growth rate of replacement gilts during development should be carefully monitored. With regard to reproductive performance a high growth rate is often seen as favourable, as gilts with a high growth rate have larger litter sizes, shorter weaning-to-first-service intervals and sometimes a higher farrowing rate. However, very high growth rates are associated with leg weakness or osteochondrosis, a major cause of lameness in young sows. Feeding a 'developer diet' that is high in calcium, phosphorus and other trace minerals, and has a high energy: lysine ratio to favour fat deposition can improve limb health, while still allowing gilts to reach physiological maturity at 230 days and 135 kg of bodyweight. Developer diets should ideally be fed from 60kg. Interestingly, Dutch research shows that restricted (vs ad lib) and dry (vs liquid) feeding of gilts is a key success factor for the top 10 performing herds of the 70 included in the study (Wageningen UR Livestock Research Report 283).

Space allowance

Replacement gilts can often be overstocked on many units. This is in spite of research showing that an increased space allowance is a critical factor to the success of gilts in group housing (Wageningen UR Livestock Research Report 283). Again, the top 10 best performing farms in the Wageningen study gave gilts 1.9m2/head prior to A.I. compared to the bottom 10 performing farms which gave gilts 1.4m2/head (as per EU Directive).

In several EU countries the minimum unobstructed floor space requirement for gilts is greater than that demanded in the EU legislation. For example, in Denmark the 1st 10 gilts must have 1.90m^2 each, the 11th-20th gilt 1.70m^2 each and where there are 21 or more gilts they must have 1.50m^2 each.

Better underfoot conditions to reduce injury and improve comfort

Concrete is a harsh and uncompromising surface, and slats in particular are highly injurious to the claws of pigs fighting on them, no matter what condition the slats are in; research at Moorepark confirms that slatted flooring is the major risk factor for lameness across all classes of pigs. Obviously the feet of the most valuable animals in the herd must be protected from damage caused by the floor if we are to stem wastage due to lameness. This should ideally be from the point of selection, but at least from entry to the herd until service, or better still, until farrowing. The best way to achieve this is to keep gilts on deep straw bedding. If this isn't possible rubber slat mats for pigs are also being developed and could offer a more feasible alternative. Culling for lameness is reduced in gilts kept on rubber mats from service through their first pregnancy. An additional benefit of improved comfort underfoot is that gilts kept on straw or rubber during pregnancy crushed fewer piglets in the farrowing crate, probably due to superior limb and claw health.

Behaviourally ready

Replacement gilts must not only be 'sound', in good body condition and physiologically prepared for group housing they should also be prepared behaviourally, and should be given the opportunity to develop their social skills during rearing. It is essential they have adequate space to perform normal types of social behaviour such as showing submission by fleeing from socially dominant pen-mates (only possible with higher space allowances), to develop these skills. A single remixing event at 6 months of age could also help prepare them for group housing. They should be mixed with cull sows, as they cannot inflict too much damage to the gilts, yet the gilts will learn a lot about the appropriate social behaviours to use during establishment of the dominance hierarchy. This practise will also pre-expose them to pathogens in the breeding herd. Re-mixing should be done in a very safe environment where they are not in danger of injuring themselves, especially their feet. It is also important to train gilts before service to the housing and feeding system they will encounter during gestation. Clearly this is of major importance when it comes to electronic sow feeding stations but may also apply to other feeding systems e.g. Trickle feeding.

Take home points

- As well as the actual costs of buying them in, there are many hidden costs to having a high percentage of gilts in the herd
- Thus the herd should be managed to improve longevity, and maximise the number of sows reaching at least parity 3
- Minimising involuntary culling is essential to achieve this
- Gilts are vulnerable to stress and health problems during development, so careful management is needed to minimise these
- Dietary and management strategies to optimise gilt development and longevity should ideally be applied from before the gilt is born, to the time of introduction to the main herd

The Effects of Water Quality, Intake & Wastage on your Unit

Amy Quinn, Moorepark & Shane Brady, Ballyhaise

Water is the nutrient required by the body in the largest quantity, yet it is considered to be the most mismanaged nutrient on farms as it can be taken for granted due to its relative abundance and low cost. The quality and supply of water can affect pig performance across all stages of production, and water wastage can result in additional costs due to an increase in manure volume produced.

When we talk about the nutritional requirements of pigs it is easy to focus solely on the nutritional components of the feed (i.e. carbohydrates, fats, proteins etc.). However, water is an essential requirement for many of the bodies' functions and without an adequate water intake pig performance in all stages of production can be substantially suppressed. Water is essential for metabolic functioning and biochemical reactions throughout the body and plays a vital role in regulating body temperature, the transportation of nutrients to, and removal of waste products from the cells of the tissues throughout the body and aids in digestion, absorption and removal of water from the body in the form of urine and feaces. Insufficient water intakes can negatively affect feed intake, feed conversion, reproduction, lactation and feed digestibility.

Water requirements of pigs

It is a legal requirement, within the European Union, that all pigs over two weeks of age must have permanent access to a sufficient quantity of fresh water. Table 1 outlines the recommended water requirements for the various stages of production. However it can be difficult to determine the exact water requirement per pig as this value is dependent on a number of factors, as firstly it varies with the weight and age of the pig and thereafter varies based on; feed intake, temperature, housing and the presence of stressors.

Table 1. The average water requirements for each stage of production

Stage of production	Litres/Pig/Day
Piglets	1-2
Weaners	1-5
Growers (30-50 kg)	8-12
Finishers (50-110 kg)	12-20
Non-pregnant gilts	12
Pregnant sows	12-25
Lactating sows	10-35
Boars	8-20

A gestating sows' water intake may exceed its typical requirement as limit feeding means it may take in additional water to improve gut fill. Lactating sows have the highest water requirement due to the demand for milk production, as milk contains over 80% water. In the days after farrowing sows often may not consume their daily water requirement which results in reduced lactation performance. This may be a sign of ill health but can also be due to lethargy and sows may need to be encouraged to stand if this is evident to avoid compromising milk production and quality. Piglets will start drinking water within the first 24 hours however, wall mounted drinkers may not suffice for new-borns as they are too much of a challenge and an additional user friendly source (i.e. water dish) of water may be required. This is particularly important if the sow is not milking well. A dish type drinker with a small amount of fresh, clean water should be placed in the creep area to optimise water intake. Often the same can be said for newly weaned pigs. Weaning stress can supress their water intake in the first few days post weaning, as suddenly they are required to get all of their water requirements from a drinker which may be completely novel to them. Placing a water dish in the pen for the first few days can make the transition easier and encourage both increased water and feed intakes.

What affects water intake in the pig?

Drinking is the main source of water intake, however some water is also obtained from the feed and generated by the body's metabolism. Water is then lost from the body in one of four ways; urine, feces, through the skin and breathing. This balance of water intake and water loss is influenced by a number of different factors; temperature, health status, drinker numbers, drinker heights and flow rates.

- *Temperature:* Increased water intakes are associated with high ambient temperatures, while a decrease in water intake is associated with low temperatures.

- *Health status:* Increased water intake is often associated with sick pigs. Scouring pigs and pigs with raised temperatures have been found to have a higher water intake than healthy pigs. In some cases water meters are used to monitor fluctuations in water usage in order to identify disease out breaks rapidly. Additionally, pigs which are bored increased their water intake as they use it as a form of environmental stimulation.

- *Drinker number & position:* It is recommended that there should be at least 1 nipple drinker for every 10 pigs and 1 bowl drinker for every 20. A study conducted by the Prairie Swine Centre found that the addition of a second drinker at three different stocking densities (0.76, 0.69, 0.63m^2) resulted in an improvement in average feed conversion by 0.09 from 33-122kg, which results in an overall saving of €2.20 per pig. Drinker height may also affect intake as if a drinker is too low it becomes awkward for a pig to drink, reducing water intake and increasing water wastage. The pig will need to give the same level of effort or more to drink but will gets less in return. Drinkers should be positioned at the shoulder height of the pig, with both the smallest and tallest pig in the pen being able to reach them. If necessary the addition of a step (e.g. a block) below the drinker may help.

- *Flow rate:* Flow rates should be set appropriately for the stage of production (Table 2). Appropriate flow rates are essential to ensure appropriate water intake as too high or too low a flow will prevent the pig from consuming its target water intake. Excessive flow rates are associated with high water wastage and reduced intakes due to difficulty consuming the fast flow. Low flow rates are associated with reduced water intake and negative behaviors. Flow rates should be

monitored on a regular basis, at least once per year. This can be easily done, using a measuring jug and a minute of your time. It is also useful to monitor the difference in flow rate between the drinkers closest to and furthest away from the water supply. Differences here may be the result of a problem with water pressure or a blockage in the line and not the drinker itself.

Table 2. The minimum flow rates for the each stage of production

Stage of production	Minimum Flow Rate (Litres/min)
Piglets	0.3
1st Stage Weaners	0.3-0.75
2nd Stage Weaners	1.0
Finishers	1.0-1.5
Non-pregnant Gilts	2.0
Pregnant sows	2.0 - 4.0
Lactating sows	2.0 - 4.0
Boars	2.0 - 4.0

Water wastage

Wastage of water on a unit should be kept to a minimum. Spillages and leaks increase he manure volume produced, thus increasing the storage requirement, manure transport costs and reducing the fertilizer value per cubic meter. Additionally, if water medication is being administered this can substantially increase the cost.

Water spillage is one of the main causes of water wastage on farms and is caused by a number of factors, primarily inappropriate drinker height and high flow rates. Wastage is associated with pigs playing with the drinkers. Pigs tend to use the drinker for playing out of boredom and therefore the provision of environmental enrichment may displace such behaviour. Wastage may also be caused incidentally by the pigs rubbing up against the drinkers, which is mostly an issue in overstocked pens, or when drinkers are

positioned too low so the body of the pig repeatedly hits off it. Nipple drinkers are most susceptible to this, and are thus associated with a higher wastage than bowl drinkers (e.g. up to 5.7 V's 3.4 liters/pig/day in weaners and finishers). Water wastage may also be the result of leaks due to damage to waterlines and drinker's or inadequate maintenance. If leaks are not addressed they can rapidly increase the slurry volume produced, so once leaks are spotted they should be addressed straight away. For example on a 600 integrated sow unit, if 5% drinkers are leaking at a rate of 500ml a minute this results in a water wastage of 10.8m^3 (2376 gallons) per day. This is an extra 1.2 loads of pig manure for every day they are leaking, using a 2000 gallon tanker. The best way to establish the cause of spillages is to stand outside the pen and observe it for several minutes.

Water Quality

Water quality is one of the most costly oversights on farms as it can affect both water intake and animal health. The quality of water being supplied to the pigs should be of a standard fit for human consumption. The main sources of water for Irish farms are deep bore wells, local water schemes and mains supply. If you are like the majority who source their water from wells it is important to take water samples at source at least twice a year and get it tested for both its biological and chemical properties. It is important to remember that the water at source can have a completely different content at the delivery point in the pen as the pipeline may become coated in biofilms which serve as a continual source of contamination. Therefore it is also essential to test the water at the delivery point. These water samples should be routinely taken from the end of lines in each house, and this is particularly important in younger pigs. Water sampling is relatively low cost (€50/sample) and has a fast (1-2 days) turn-around.

In order to prevent contamination of the water, there should be a clear routine for protecting water quality. Initially you should ensure that all header tanks have lids, which will prevent dust, dirt and vermin from getting in. The header tanks and waterlines should then be flushed out with detergent after each batch to prevent the build-up of biofilms which contaminate the water and cause blockages in the drinkers; once more this is particularly important for younger pigs. Another option is the addition of organic acids to the water supply as this will lower the pH of the stomach improving gut health as it kills off bacteria.

Take home points

- All pigs over two weeks of age must have permanent access to a sufficient quantity of fresh water.
- Water requirements per pig vary per stage of production, environment and health status.
- Water intake is influenced temperature, health status, drinker numbers, drinker heights and flow rates.
- The addition of additional drinkers can significantly improve feed conversion.
- Flow rates should be set appropriately for the stage of production and monitored regularly.
- Wastage of water on a unit increases the manure volume produced, storage requirements, manure transport costs and reduces fertilizer value per cubic meter.
- Water quality can affect both water intake and animal health.
- It is essential to take water samples at source at least twice a year and at the end of waterlines on a continual basis.
- Header tanks, pipelines and drinkers should be cleaned out regularly.

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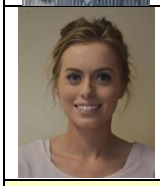	**Emer McCrum,** Teagasc, Ballyhaise, Co. Cavan Tel: 049-4338642 Email: emer.mccrum@teagasc.ie
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