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T Research

Research and innovation news at Teagasc

Unlocking farm forest potential

Mobilising soil phosphate
E. sakazakii – an emerging pathogen
Nitrogen efficiency for grazing cows

Volume 3: Number 1. Spring 2008

Contents

50 years a-growing

February marks the 50th anniversary of the establishment of An Foras Taluntais (AFT – now part of Teagasc) under the visionary leadership of the late Dr Tom Walsh. At the time, over 60% of total national exports were agricultural, and the level of agricultural production had been relatively static for some time. AFT responded to the challenge by putting in place a national programme of agricultural research, which underpinned the dramatic developments in Irish agriculture and enabled it to benefit from access to new markets following accession to the EEC in 1973.

The organisation has continued to provide the technological base to enable the industry to adapt to many subsequent policy changes. It initially set out to help farmers increase productivity and income, broadening its research over the years as the policy environment, market conditions and new consumer demands set new priorities for research. By putting representative liaison or advisory committees in place from the start, AFT ensured not only that its programme would focus on the real problems of the industry, but also ensured a productive two-way flow of information. This two-way flow was consolidated with the merger of AFT and ACOT (the farm advisory and training body) in 1988.

While maintaining close contact with the industry, AFT emphasised the importance of developing a comprehensive science base, with particular emphasis on recruiting high quality scientific and technical staff and developing national and international linkages.

Public investment made in AFT/Teagasc has paid off, and the organisation has contributed greatly over the past 50 years. This must be maintained as we embark on new challenges. The existence of a strong research function, fully integrated with advisory and training services, is an essential component of that future.

A number of events will be held throughout 2008 to mark the anniversary.

Dr Tom O'Dwyer
Chairman of Teagasc

Environment

Comment

Credits

TResearch is an official science publication of Teagasc. It aims to disseminate the results of the organisation's research to a broad audience. The opinions expressed in the magazine are, however, those of the authors and cannot be construed as reflecting Teagasc's views. The Editor reserves the right to edit all copy submitted to the publication.

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T News

Fertility in dairy cows

The greatest problem facing the dairy industry today, at primary production level, is the continuing decline in cow fertility. Low fertility leads to reduced milk yields, increased labour and veterinary costs, increased culling of cows due to failure to become pregnant, and the resultant loss of income to dairy farmers.

With a recent grant award of €7.4 million from Science Foundation Ireland, a group of internationally recognised scientists from University College Dublin (UCD) and Teagasc, along with industry partners Pfizer and Biotrin Technologies, will focus on investigating the biology of peri-ovulatory and post-ovulatory events that lead to the establishment of pregnancy in the dairy cow. "The idea is to develop approaches and/or technologies to improve fertility in dairy cows, discoveries that may also have real implications for the treatment of infertility in other species, particularly humans," says Professor Alexander Evans from the UCD School of Agriculture, Food Science and Veterinary Medicine, who is leading the research project.

Stimulus Fund

The Minister for Agriculture, Fisheries and Food, Mary Coughlan TD, recently announced details of 38 research projects (of which Teagasc will be involved in 29) that have been awarded grant assistance totalling €21m under the 2007 Research Stimulus Fund Programme (RSFP).

The selected research projects cover a broad range of areas including agri-energy, agri-environment and biodiversity, plant bioscience, and agri-economy and policy. Most of the projects will be of three years' duration and will involve inter-institutional collaboration. The research involved will be of a 'public good' nature and the results will be made freely available.

Environ2008

Congratulations to Samuel Dennis and Rochelle Fritch (both Walsh Fellows at Johnstown Castle), who recently won awards at Environ2008, the 18th Irish Environmental Researchers Colloquium, held at Dundalk Institute of Technology from February 1-3, 2008.

Samuel won Best Soil Science presentation, receiving a €500 prize for his presentation on 'Nitrous oxide emission from soils reduced using DCD nitrification inhibitor'. His Teagasc supervisor is Dr Karl Richards, and the university supervisors, Professor Keith Cameron, Professor Hong Di and Dr Jim Moir, are based at Lincoln University, New Zealand.

Rochelle was runner-up in the Best Theatre Presentation section for her presentation on 'Methods to enhance biodiversity within field margins in grassland farming systems'.

The Teagasc supervisors are Dr Daire O'hUallacháin and Dr John Finn, and the university supervisor is Dr Helen Sheridan (UCD).

Marine Functional Foods funding

From left: Declan Troy, Head of Teagasc Ashtown Food Research Centre; Mary Coughlan TD, Minister for Agriculture, Fisheries and Food; and, Dr Peter Heffernan, Chief Executive, Marine Institute, at the announcement.

Ireland's marine food industry received a €5.2m boost with the announcement of a multidisciplinary research consortium involving universities on both sides of the border. The Marine Functional Food Research Initiative (MFFRI), which is led by Teagasc under the direction of Declan Troy, will identify novel marine food ingredients and products, allowing Ireland to become players in what is already a US$74bn worldwide market for functional foods. The initiative involves University Colleges Cork and Dublin, NUI Galway, the University of Limerick and the University of Ulster Coleraine.

The MFFRI will focus on three themes: the use of fish processing waste; the sustainable exploitation of underutilised species of fish and seaweed; and, the development of value-added products from aquaculture – both for finfish and shellfish. These themes were identified as research priorities in a workshop hosted by the Marine Institute in January last, and attended by food companies, food ingredient suppliers, seafood processors, biotechnology firms, and researchers from industry and other institutions.

The consortium will provide new additional research staff, including two principal investigators at professorial level, seven post-doctoral posts and seven PhD places. A Professor of Marine Natural Product Chemistry will be recruited internationally and located at the Teagasc Ashtown Food Research Centre–UCD axis of the consortium. A similarly internationally ranked Professor of Marine Functional Foods Biochemistry will be recruited at the Moorepark Research Centre–UCC axis.

T News

Roadmap for agri-food

The need to broaden the skills base of the university graduates who will help the agriculture and food industry to become more competitive and innovative was highlighted by the Head of the UCD School of Agriculture, Food Science and Veterinary Medicine at a conference in UCD recently.
Professor Maurice Boland told the conference on 'A New Roadmap for Education, Research and Innovation' that the graduate of the future must play a more central role in entrepreneurship and innovation, and must be the key link in the transfer of new science and technology to farmers, food processors and those involved in rural businesses. The conference was organised by the Department of Agriculture, Fisheries and Food, Teagasc and UCD.

Speakers at the conference in UCD on 'A New Roadmap for Education, Research and Innovation in Agri-Food' (from left): Professor Maurice Boland, Head of the UCD School of Agriculture, Food Science and Veterinary Medicine; Professor Paddy Cunningham, Chief Scientific Adviser to the Government; Mary Coughlan, TD, Minister for Agriculture, Fisheries and Food; Dr Hugh Brady, UCD President; and, Professor Gerry Boyle, Director, Teagasc.

Teagasc 2030
creating knowledge for the bioeconomy

The Teagasc 2030 Foresight project was formally launched in December 2006 with the two broad objectives of:

- developing a shared vision for the long-term future of the Irish agri-food and rural economy; and
- identifying the responses required from Teagasc in terms of strategies, programmes, structures and resources to ensure its continuing relevance in 2030 and beyond.

In our work to date, the project has addressed the first objective, which has to do with defining how Teagasc sees the industry it services in 2030. The principal outcomes are five scenarios outlining different perspectives on the future agri-food sector and a Vision statement synthesising the key messages of the five scenarios. This Vision statement describes:
"A knowledge-intensive, innovative, internationally competitive and market-led bio-economy profitably producing quality products and services for global markets that contribute to the health and well-being of consumers and stakeholders and to the sustainable development of rural areas and communities".
The concept of the bio-economy provides a broad framework within which to consider the overall scope of the Foresight project. The concept encompasses our traditional understanding of agriculture and food, but also encompasses a wide range of other economic activities. The bio-economy represents economic activity that uses renewable bio-resources, efficient bioprocesses and eco-industrial clusters to produce sustainable bio-products, jobs and income. It encompasses the natural and biological resources that provide the raw materials for the products we depend on across all areas of life and fully integrates not only the production of food, feed, fuel and public goods, but all other activities along the value chain. The bio-economy can lead to opportunities for agriculture and food product markets through productivity gains, enhanced attributes (health and nutrition) and the development of substitutes for fossil-based products that make use of agricultural products as feedstock.
This vision of the industry in 2030 sets the context for the task of identifying what the Teagasc response should be by way of organisational vision, mission, objectives, strategies and structure. The Vision for Teagasc in 2030 is:
"An internationally recognised centre of excellence in scientific knowledge creation and transfer, in support of the innovation needs of the knowledge-based bio-economy (KBBE) for the benefit of all Irish citizens".
In pursuit of this Vision:
Teagasc will configure its resources to become a more integrated research, education and extension organisation. Its primary focus will be as a leader and supporter of innovation in the KBBE based on partnership, accountability and a pursuit of excellence and quality in all of its activities.
For further details, see: www.tnet.teagasc.ie/foresight_public/index.asp.

Dr Lance O'Brien
Foresight Project Manager

EAAP award

Congratulations to Kelly Buckham, who received the best paper award from the Animal Management and Health Commission at the 58th annual meeting of the European Association for Animal Production (EAAP) in Dublin last year. The presentation covered her PhD research and was entitled 'Neutrophil transcriptome analysis during transportation stress of cattle'.

Kelly carried out her PhD in Teagasc, Grange Beef Research Centre, under the supervision of Dr Bernadette Earley (Teagasc) and Dr Mark Crowe (UCD). Kelly has recently taken up a post-doctorate post at Michigan State University.

FP6 food publication

A booklet on 'Irish Success in the EU 6th Framework Programme 2002-2006 (Food Quality and Safety – from Fork to Farm)', for which Irish researchers secured over €15m in research funding, has been launched by the Minister for Agriculture, Fisheries and Food, Mary Coughlan, TD.

For Call 1 of FP7, Irish researchers are involved in 30% of the recent awards by the EU Commission covering agriculture, fisheries and food. The value of funding to Irish researchers is in excess of €3.8m. Teagasc is involved in the RobustMilk, PRO-IMMUN and GMSAFOOD projects.

The Department has also published the 'Compendium of Irish Agricultural Statistics 2007'. Both publications are available from the department.

Science Week 2007

Tomás Murray, Teagasc Oak Park Crops Research Centre, explaining the importance of bees to crop pollination to students from Carlow IT.

At the annual Teagasc Walsh Fellowships Seminar are: Lisa Costello, winner of the Young Researcher of the Year award with (background, from left) Professor Patrick Cunningham, Chief Scientific Adviser to the Government (keynote speaker); and, Professor Gerry Boyle, Director, Teagasc.

Opportunities for a science-based career in agriculture and food research were presented to school students at Teagasc research centres as part of Teagasc's Science Week activities. Teagasc scientists demonstrated the practical applications of science in their respective fields to show students the opportunities that can emerge from studying science, and can ultimately culminate in an interesting and successful career in scientific research.

Secondary school students visited Grange, Athenry, Moorepark and Ashtown. In a new development this year, third-level students from Carlow Institute of Technology visited Oak Park.

The Walsh Fellowships Seminar took place in the RDS. The 2007 winner was Lisa Costello, a Walsh Fellow working at the Teagasc Animal Production Research Centre, Athenry and at the Physiology Department in the National University of Ireland, Galway. She received the award for her research work on early embryo loss in cattle, looking at the influence of the protein environment of the pre-implantation embryo during the oestrous cycle.

Certificates of merit were also presented to Tony Woodcock and Anthony Dolan. Both Fellows are based at Ashtown Food Research Centre. Tony's project looked at a new method of confirming the geographical origin of honey, while Anthony's looked at methods of determining the microbiological quality of foods. The best poster went to Siobhan Walsh at Teagasc Moorepark for her poster on 'Effects of breed, feeding systems and parity on udder health and milking characteristics'.

T News

EuroDIVERSITY

Dr John Finn, Agri-Environment Research Department, Teagasc Environment Research Centre, Johnstown Castle, was invited by the European Science Foundation to make a presentation at the first annual EuroDIVERSITY conference, which was held in Paris in October 2007. Representing a project team that includes Dr Laura Kirwan (Teagasc, Johnstown Castle), Dr Finn presented results from an EU project that developed new methodology to investigate the relationship between biodiversity and ecosystem function. The work reported the effects of increased agronomic diversity in grasslands on yield and weed invasion (see *TResearch* Autumn 2007). John and Laura are also co-authors of an invited plenary paper at the European Grassland Federation, which will be held in June 2008 in Uppsala, Sweden.

Dr Finn was also invited by the Dean of Graduate Studies, UCC, to present the first Annual Christmas Lecture for postgraduate students. The lecture was delivered on the theme 'Postgraduate skills for a professional career'.

International nitrogen conference

Dr M. Ibrahim Khalil of Johnstown Castle Environment Research Centre made Ireland's first representation at the International Nitrogen Conference of the International Nitrogen Initiative held in October last in Bahia, Brazil. Dr Khalil presented two oral papers on his work on the subsoil and groundwater denitrification and mitigations of global warming potentials from agro-ecosystems.

Microbe magic

An interactive website seeking to educate primary school children about the human body was recently launched by the Alimentary Pharmabiotic Centre (APC). The website – http://microbemagic.ucc.ie – will be a major information resource for students on body and health issues. It provides access to research undertaken by the APC, and the Science Foundation Ireland (SFI)-funded research centre at University College Cork (UCC), in collaboration with Teagasc, Moorepark, which conducts cutting-edge research at the interface between food and medicine.

Artisan food business advisers

Two newly appointed food technologists will provide technical support primarily for artisan meat and dairy businesses.

Sara McSweeney and Carol Griffin will be based at Teagasc Moorepark Food Research Centre and Ashtown Food Research Centre, respectively. They will liaise with food businesses to identify their food technical and development needs, and will ensure that best knowledge, skills and technology are made available through training, advice and technical support.

IAHS conference

Owen Fenton, Teagasc Johnstown Castle Environment Research Centre, presented a paper entitled 'Assessing the performance of phosphorus retention using an Avoca–Avonmore catchment, ochre, Ireland', at the 6th International Groundwater Quality Conference held under the aegis of the International Association of Hydrological Sciences (IAHS) in Fremantle, Australia in December last. The aim of the conference was to secure groundwater quality in urban and industrial environments.

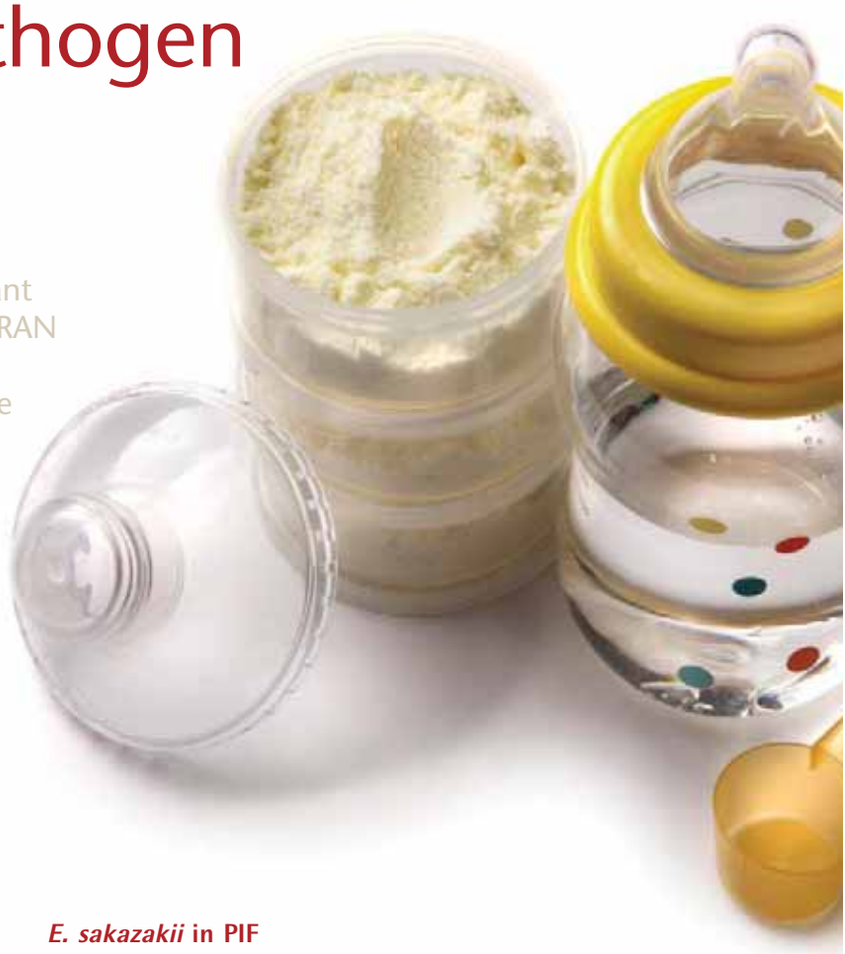
AlphaGalileo seminar

The AlphaGalileo Foundation, in collaboration with the Irish Research Council for Science, Engineering & Technology (IRCSET), recently held a one-day seminar at the Royal Irish Academy on the practice and experience of public relations in European and Irish research. The event was sponsored by IRCSET. The proceedings can be downloaded at: http://www.ircset.ie/alpha_seminar.html.

Catriona Boyle, Science Writer/Editor, Teagasc, is pictured at the event with Professor Frank Hegarty, Deputy Chair of IRCSET.

Enterobacter sakazakii – an emerging pathogen

Enterobacter sakazakii contamination is a significant issue for the powdered infant formula sector. KIERAN JORDAN and GERALDINE DUFFY explain the characteristics of this emerging pathogen and the ongoing work at Teagasc to address concerns.



For the vast majority of the population, *Enterobacter sakazakii* is of little significance. However, for a particularly vulnerable group of low birth weight and immunocompromised infants, this bacterial pathogen can cause a rare and potentially fatal illness, with symptoms including neonatal meningitis, septicaemia and enterocolitis. The mortality rate is about 30-80%, and for those that survive, the consequences are severe. A number of *E. sakazakii* infections have been associated with powdered infant formulae (PIF) worldwide, though none have been reported in Ireland.

E. sakazakii infection

Although first identified in 1958, only a little over 100 outbreaks of *E. sakazakii* infection have been reported worldwide, and none of these have been in Ireland. However, there have been at least 26 deaths associated with these outbreaks and there is concern that it has been under reported. In the US, the rate of infection is reported as 1 per 100,000 infants (children less than 12 months of age) but, in infants of very low birth weight (less than 1.5kg), the incidence is estimated at 9.4 per 100,000. Children greater than 12 months of age and adults are thought to be at much lower risk than infants. A study of 27 cases of *E. sakazakii* infection by Iversen and Forsythe (2003) cites infant formula milk as the suspected source of the *E. sakazakii* infection in eight incidences. The source was unknown, or not specified, in the remaining 19 cases. In another study, PIF samples associated with 15 of 22 cases yielded *E. sakazakii* and, in 13 of these cases, the clinical and PIF strains were indistinguishable.

The vast majority of *E. sakazakii* infections occur in hospital neonatal intensive care units, and improved training and hygiene in hospitals are critically important in avoiding *E. sakazakii* outbreaks.

E. sakazakii in PIF

Current regulations governing the presence of *E. sakazakii* in PIF were introduced by the European Commission (EC 2073/2005). These require the absence of *E. sakazakii* from 30 samples of 10g of powder taken from each production run. Codex/International Commission on Microbiological Specifications for Foods are now considering similar recommendations.

Since the first published survey in 1988, where 14% of PIF samples were reported to contain *E. sakazakii*, there has been a marked decrease in the occurrence of this organism in PIF. A 2004 international survey by Iversen and Forsythe found 2% of samples positive, and a 2007 Irish survey carried out by the Food Safety Authority of Ireland (FSAI) on 715 ready-for-sale PIF samples from around the country indicated that all were negative. This decrease in the occurrence of *E. sakazakii* in PIF is probably due to the heightened awareness of the risks associated with it and the increased vigilance of the manufacturers.

Research on this emerging pathogen is needed to provide the infant formula industry and regulatory authorities with a scientific assessment of the risk posed. Addressing these key issues in Ireland is

a national project team, which includes research partners from Teagasc, Ashtown and Moorepark Food Research Centres (AFRC and MFRC), and University College Dublin, together with the FSAI and the PIF sector. The objective of this research is to establish the routes by which *E. sakazakii* can be transmitted along the complete chain, from raw ingredients through to the preparation of formula in a hospital or domestic setting, as well as the effectiveness of current controls and management systems.

Being aware of the risk posed by E. sakazakii in PIF, infant food manufacturers take extensive measures at the factory level to ensure the highest level of product quality and safety.

Environmental occurrence and persistence

Worldwide, *E. sakazakii* has been isolated from many different environmental sources and foods, and has been shown to survive in dry conditions. Research from AFRC and MFRC is investigating the occurrence of *E. sakazakii* in the Irish context, survival of the organism in the environment and the stress factors that contribute to this survival. This work will focus on assessing the underlying genetic mechanism(s) that allow *E. sakazakii* to survive in very dry conditions, and establish whether these characteristics (stress adaptation) confer cross resistance to current control measures, such as thermal processing and drying.

Methods for detection and molecular characterisation

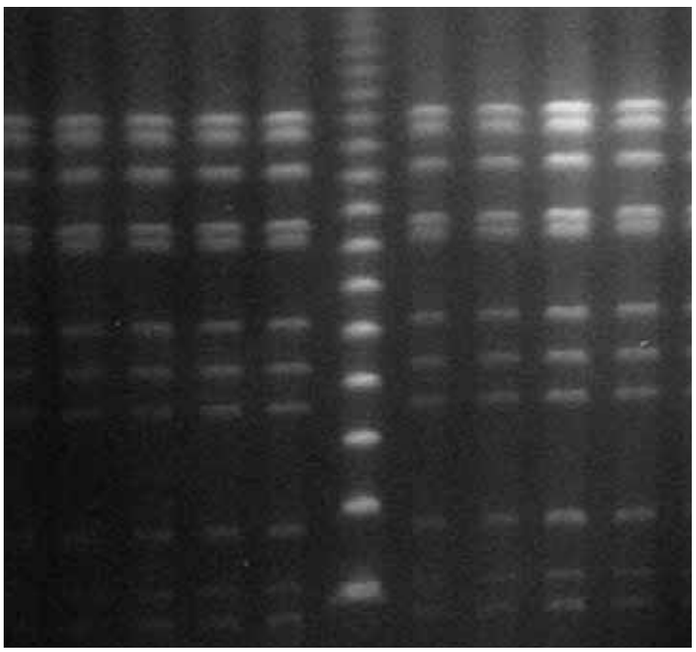
Currently, there are various sensitive and specific methods for isolation of *E. sakazakii* but they take up to six days before confirmed results are available. One such method (the ISO/IDF [International Standards Organisation/International Dairy Federation] standard method of culture)

E. sakazakii *colonies showing the typical green colour on chromogenic agar.*

involves a general enrichment step in Buffered Peptone Water, a selective enrichment step in modified laural sulphate tryptone broth, isolating colonies on agar and confirmation of presumptive positive colonies by biochemical tests. Recently, several media have been developed for specifically detecting *E. sakazakii* on selective agar plates.
These chromogenic selective agars are used to plate the enriched cultures and take advantage of the key biochemical characteristic of this bacterium, the production of alpha-glucosidase, which is an enzyme not found in any other *Enterobacter* spp. Chromogenic agars use chromogens that are cleaved by alpha-glucosidase to produce a characteristic colony colour.
As part of the ongoing national research on *E. sakazakii*, methods for detection have been adapted to allow recovery from environmental samples using combined cultural and molecular real time polymerase chain reaction (PCR) approaches, which allow confirmation of *E. sakazakii* by targeting a specific gene (the MMS operon gene). An important national database of *E. sakazakii* strains has also been established and is housed at University College Dublin. A national database of genetic profiles for each strain generated using a pulsed field gel electrophoresis (PFGE) approach has also been generated by the national research team, and both AFRC and MFRC are contributing to this. This database will be an invaluable resource for tracking and genomic comparison of isolates recovered from different sources (environmental, clinical) and geographical regions, etc., to determine the source of contamination.

Control and risk management

Being aware of the risk posed by *E. sakazakii* in PIF, infant food manufacturers take extensive measures at the factory level to ensure the highest level of product quality and safety. Irish formula manufacturers have invested significant resources in ensuring that all



Pulsed field gel electrophoresis (PFGE) patterns showing the similarity between 10 strains. Standard is in the middle lane.

infant formulae are manufactured and tested under strict regulatory requirements that require manufacturers to operate under good manufacturing procedures, assuring that their products, ingredients, processing conditions and packaging meet all applicable safety and quality requirements at every stage of the manufacturing operation.

Some of the procedures in place include:

- strict compliance with national legislation and international recommendations based on scientific expertise to provide safe and nutritionally adapted infant food;
- along with their normal strict hygiene standards, manufacturers take additional actions to minimise possible contamination of powder products;
- a series of rigorous processes that prevent contamination from production to the point of purchase by the consumer;
- close monitoring of ingredients, especially those added after the final step of heat processing;
- extensive measures to minimise *E. sakazakii* in the manufacturing environment to prevent post-process contamination;
- training of personnel to ensure that hygiene control measures are understood and closely followed; and,
- testing of finished products to confirm the effectiveness of these procedures.

Ongoing national research is investigating the efficacy of specific control measures used in PIF manufacture and final preparation, including thermal and drying treatments.

Recently, the WHO/FAO produced guidelines for the safe preparation of PIF in healthcare and home settings. These guidelines are risk based and were developed from the WHO/FAO risk assessment of *E. sakazakii* in PIF. The FSAI has published similar guidelines. The greatest reduction in risk can be achieved by reduction in the time between preparation and storage of PIF, and use of water at 70 degrees for reconstitution (see: http://www.fsai.ie/publications/guidance_notes/gn22.pdf).
Ongoing national research is investigating the efficacy of specific control measures used in PIF manufacture and final preparation, including thermal and drying treatments. All the data generated on source and controls will be used to generate a quantitative risk assessment on ***E. sakazakii.*** This will provide the PIF sector and regulatory authorities in Ireland with sound scientific guidance on the risk posed and how it should be addressed. The completed risk assessment will include recommendations to the industry and end users on risks and best practice in the manufacture and preparation of infant formula.

This research is funded by the Department of Agriculture, Fisheries and Food (FIRM funding).

References and further reading

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Dr Kieran Jordan, Moorepark Food Research Centre, Teagasc, and **Dr Geraldine Duffy**, Ashtown Food Research Centre, Teagasc.
E-mail: kieran.jordan@teagasc.ie; geraldine.duffy@teagasc.ie.

Raising standards

Researchers at Ashtown Food Research Centre are involved in an EU project that aims to help SMEs to comply with the food standard requirements of retailers.

All food companies face the pressures of complying with national and European legislation, as well as satisfying commercially focussed retailer food safety and quality standards. For small- to medium-sized enterprises (SMEs), this can be even more difficult, as these businesses may lack sufficient technical knowledge and resources. Staff at Ashtown Food Research Centre's (AFRC) Food Training and Technical Services Department are taking part in the INPLISTA project, which is designed to assist SMEs in overcoming these difficulties. INPLISTA is a Specific Support Action project funded under the EU Sixth Framework Research Programme.

The majority of food companies in Ireland and Europe are classified as SMEs. The Census of Industrial Production 2004 (Central Statistics Office, see: www.cso.ie) reported that more than 90% of Irish food companies employ less than 200 staff. Of these SMEs, just over one-quarter can be classified as micro enterprises (employing less than 10 staff), with small (10 to 49 employees) and medium (50 to 199 employees) enterprises comprising 40% and 23%, respectively. Also in Ireland, there is renewed interest in the area of artisan or speciality food businesses, which fall very much into the micro food category in terms of numbers employed.

The majority of food companies in Ireland and Europe are classified as SMEs.

For many of these food SMEs, retailers are critically important customers for volume and status reasons. Across Europe, the retail channel represents the most important route to market, with an estimated 70-75% of food and drink sales passing through a small number of retail groups. In addition to supplying Irish retailers, Irish food companies also export significant amounts of product. The 2004 Census mentioned above reported that just over half (53%) of food companies were exporters. The gross output exported was valued at €10.6 billion, of which 28.1% went to the UK and 39.6% to 'Other EU'.

Food standards

In the absence of an international food standard, SMEs have difficulty supplying the major European retailers, e.g., Spar, Metro, Sainsbury's, REWE, Aldi, Carrefour, etc. The retailer standards encompass the requirements of commercial customers, retailers, legislation and the consumer. Therefore, it is important for SMEs to know exactly how to meet the requirements of standards without becoming uncompetitive. It is also true that different countries favour different standards. For example, the British Retail Consortium (BRC) is more popular in the UK and the International Food Standard (IFS) is favoured in Germany and France. Exporting SMEs are often required to deal with one, two or even more standards.

In order to assist SMEs, the INPLISTA project was conceived. The objective of INPLISTA is to create a supporting information platform specifically directed at SME food enterprises in order to improve and stabilise their position in the European market and assist in keeping up-to-date with current standards and requirements. The project will enable SMEs to choose and implement the appropriate food safety system.

INPLISTA will enhance food safety for SMEs by providing comprehensive information on globally adopted guidelines such as HACCP (Hazard

INPLISTA project consortium members at a meeting in the Netherlands in September 2007.

An estimated 70-75% of food and drink sales pass through a small number of retail groups.

Analysis and Critical Control Point), BRC-GFS (Global Food Standard), IFS (International Food Standard), Dutch HACCP, ISO22000, and Codex Alimentarius (FAO/WHO Food Standards Programme).

Enhanced food safety

It is envisaged that the project will strengthen European food safety through the achievement of standard requirements such as improved monitoring, documentation systems, HACCP systems, traceability systems, allergen monitoring, GMO handling, etc. An added benefit of the project will be the promotion and cross-linking of European research, enabling innovative ways of implementing standards requirements. Ultimately, INPLISTA aims to translate complex topics to practical and suitable solutions for the needs of SMEs.

Exporting SMEs are often required to deal with one, two or even more standards.

Information platform

The project, which has 16 partners from 14 countries, began in April 2007 and is scheduled to run until April 2009. The partners will develop, organise and arrange one-day seminars presenting general information on the standards in 13 countries, including Ireland.
Sector-specific seminars will be created in order to develop practical solutions for three major sectors, namely meat processing, dairy and fruit/vegetables. In addition, one-day issue-specific seminars about allergens, GMOs and food traceability will be held in six countries in 2008. These topics were chosen in light of recent EU legislation and consumer/retailer concerns.
The 16 partners of the INPLISTA project hope to activate and motivate food SMEs from different European countries to join the discussion and information exchange. The project will focus on dissemination of information via its web page, but also via newspapers, newsletters, magazines and face-to-face contact. A web page is being set up (www.inplista.eu), which will be accessible by all food SMEs. This will provide information on standards, and links to standards bodies and research projects.

INPLISTA is co-ordinated by the ttz Bremerhaven and funded by the European Commission as part of the Sixth Research Framework Programme.

Dr Áine Sommerfield is a Research Officer at Ashtown Food Research Centre. Email: aine.sommerfield@teagasc.ie.
Dr John Rae is a Research Officer at Ashtown Food Research Centre. E-mail: john.rae@teagasc.ie.

Honeysweet apple slices: a new addition to the fruit salad range

SANDRA STAHEL, Teagasc, Ashtown Food Research Centre, outlines results from her trials on producing fresh-cut apple slices containing honey as part of the EU ISAFRUIT project.

Fresh-cut pre-packed chilled fruit salads are an increasing feature on supermarket shelves both in Ireland and abroad. Their composition varies but apple slices are usually a major component. These products have a good appearance and shelf life, and are convenient for consumers. They are also added value products and represent an attractive opportunity for food processors. The fresh-cut fruit salad area is expanding rapidly and new innovations are both desirable and essential; hence, the current trials on producing apple slices (wedges) sweetened with honey. Both honey and apples have a good health image and contain antioxidants.

EU ISAFRUIT project

This research was conducted as part of the EU ISAFRUIT project, which is part of the Sixth Framework Programme. This project embraces 200 researchers from 61 institutions, and also SMEs in 16 countries, and runs from January 2006 to the middle of 2010. ISAFRUIT focuses on all aspects of tree fruit from its start as a seed to consumption by the consumer. The trials at Teagasc, Ashtown Food Research Centre (AFRC) are in Pillar 3 of the programme, which has the theme 'improved appeal and nutritional value of processed fruit', while the overall slogan of ISAFRUIT is 'healthy fruit for a healthy Europe'. AFRC and Nature's Best Ltd. are the Irish partners in ISAFRUIT.

Evaluating browning inhibitors

Enzymatic browning is a major problem in the production of fresh-cut apple wedges and permitted browning inhibitors are used. In this context, the efficacy of different inhibitors was tested as a pre-requisite to the honey infusion trial, with emphasis on Natureseal AS1 (AgriCoat, UK). This was applied as a dip at three concentrations (1.5, 3, 6%) and three dipping times (2, 60, 120 minutes) to 'skin-on' wedges of Bramley's Seedling apples, which were then sealed in plastic trays with a breathing film and tested after seven days at 2-4°C. The results were compared with values for fresh-cut untreated samples (i.e., baseline values). Dipping times of 60 and 120 minutes were used as they represent the times normally applied in the osmotic infusion of fruit pieces with sugar solutions such as honey. Both concentration and soaking time in Natureseal AS1 influenced the white/yellow colour ratios (high values are best) of the wedges (**Table 1**), with the largest values for the higher concentrations and longest dipping times. These day 7 values compared with a white/yellow ratio of 5.73 in untreated fresh-cut day 0 wedges and 2.86 in day 7 wedges. This indicates that, while not all of the original wedge whiteness was maintained by Natureseal AS1, nevertheless, it had a strong protective effect on colour during the seven-day storage period. The use of Natureseal AS1 did not influence the texture (shear values), soluble solids (sugar) content, dry matter content, pH or the titratable acidity of the apple wedges. However, the ash content (used to determine mineral content) of the wedges rose with increasing dip solution concentrations, i.e., ash contents of 0.188, 0.191 and 0.236% for dip solutions of 1.5, 3 and 6%; corresponding calcium contents were 13.8, 17.2 and 33.9mg/100g in the apple wedges. This was due to the calcium content of Natureseal AS1 (circa 90mg/g). The calcium content of the untreated wedges was 4mg/100g. These data allow calculation of Natureseal AS1 uptake by the wedges; for example, this was circa 0.072, 0.125 and 0.199g/100g for wedges soaked for two minutes in 1.5, 3 and 6% Natureseal AS1 solutions, respectively. A dip regime of 6% for two minutes was chosen for subsequent trials in order to maintain an acceptable level of whiteness coupled with a moderate level of AS1 in the apple wedges.

Honey infusion by osmotic treatment

Bramley's Seedling apple wedges were pre-treated with Natureseal AS1 solution (6%; two minutes) and were then transferred to a 50% solution of Boyne Valley honey (Boyne Valley Foods) at room temperature for one, two or three hours in an attempt to infuse them with honey. The soluble solids content of the wedges increased by up to 4% in some of the treatments but this was mirrored by a corresponding decrease in moisture content and a loss in weight due to the removal of water. Tasting of the infused wedges indicated only a slight honey flavour, which was classed as a surface effect. It was concluded, therefore, that osmotic treatment resulted mostly in removal of water from the wedges and virtually no infusion of honey. This trial was concluded and vacuum infusion was tested as an alternative.

Honey infusion by vacuum treatment

Initial tests with Bramley's Seedling apples were unsuccessful due to browning, and the mainstream trial was conducted using Granny Smith apples, which have a lower browning tendency. Mexican and Argentinian

TABLE 1: The effect of concentration and dipping time in Natureseal AS1 aqueous solution on the white/yellow colour ratio (Hunter colour meter L/b) of Bramley's Seedling apple wedges (tested after seven days at 2-4°C).

Natureseal AS1 (% in dip water)	2-minute dip	60-minute dip	120-minute dip
1.5	3.21	3.58	4.82
3.0	3.44	4.52	4.71
6.0	4.02	4.83	4.63

Honey samples and Granny Smith apples.

Honeysweet apples – the final product.

honeys (Boyne Valley Foods) were used because of their strong flavour and also their dark colour, which is an indicator of antioxidant content. Sets of untreated wedges, and sets pre-treated with Natureseal AS1 (6% solution for two minutes) were submerged (day 0) in 50% honey solutions in a vacuum tumbler (Inject Star) (in stationary mode) at a vacuum of 700mbar (residual pressure of 300mbar) for 10 minutes. The vacuum was released over a period of two minutes and the samples were allowed to stand in the 50% honey solutions on the bench for a further 10 minutes. A control sample was infused with water. The samples were drained (two minutes), packed in trays and sealed with a breathing film. The sensory acceptability was assessed on day 1 and the physicochemical properties on days 1 and 7 after storage at 2-4°C. Only selected outcomes are presented below because of the large scope of the trial and the many data obtained, i.e., tests conducted on day 1 on sample sets pre-treated with Natureseal AS1 solution (6%, two minutes) (**Tables 2** and **4**).

TABLE 2: Effect of vacuum infusion with 50% honey solutions or with water on a range of quality parameters of Granny Smith apple wedges[a].

Parameter	Argentinian	Mexican	Water
Weight change (%) on infusion	-0.36	-0.29	28.3
Soluble solids (%)	17.0	15.3	8.4
Dry matter content (%)	18.6	17.2	10.1
Whiteness (Hunter L)	56.1	50.7	41.3
Texture (shear; kN)	2.63	2.24	2.47
Titratable acidity (meq/100g puree)	8.4	8.6	7.3
Calcium (mg/100g)	8.3	8.3	8.6

[a] **See baseline values, Table 3**

The infusion process used was successful in that soluble solids and dry matter content values increased by 3-5% in the honey-treated samples (**Table 2**) relative to the baseline values (**Table 3**). However, there was no weight change on infusion with honey solution (**Table 2**). This suggests that water was removed from the wedges and that solutes (honey sugars) penetrated the wedges in quantity during the infusion process; this was confirmed by spot taste tests, which indicated a strong honey flavour throughout the wedges and not just at the surface. There was a large weight gain in the water-infused samples due to water uptake and a consequent reduction in soluble solids and dry matter content; this contrasted dramatically with the very small weight changes following infusion with the honey solutions. Whiteness values for the wedges fell with the treatments, but the lower values obtained (**Tables 2** versus **3**) were due to a slight translucency rather than to a large change in visual whiteness. The treated wedges were also slightly softer than the fresh-cut samples. Titratable acidity values were not affected by the different treatments, while the higher calcium content in the treated samples (**Table 2**) compared to the fresh-cut samples was due to Natureseal AS1 in the former.

TABLE 3: Baseline values for quality parameters for fresh-cut Granny Smith apple wedges.

Soluble solids (%)	11.8
Dry matter content (%)	13.6
Whiteness (Hunter L)	75.1
Texture (shear; kN)	2.95
Titratable acidity (meq/100g puree)	8.6
Calcium (mg/100g)	4.6

Packing the honeysweet apples.

Vacuum tumbler for infusion.

Sensory acceptability scores were lower for the treated samples than for fresh-cut samples, especially for the sample infused with water (**Table 4**). However, the lower scores for the two samples with honey were due, in part, to the fact that panel members (untrained panel) were confronted with a new product concept and were unsure of how to react to it; this was apparent from comments written on the score sheets.

Conclusions and future research

Honeysweet apple slices were satisfactorily produced by a vacuum infusion process. However, the procedure needs further fine-tuning. This will be conducted in co-operation with Nature's Best Ltd. as a first step towards possible commercialisation of the process and product. Further tests at AFRC will include microscopy studies on the infused wedges, an assessment of the antioxidant status of the honeys and the infused wedges, and the possibility of enrobing the infused slices with edible coatings, thus extending the product range.

TABLE 4: Sensory acceptability[a] scores for Granny Smith (GS) apple wedges vacuum-infused with honey or with water.

Sample	Acceptability score[a]
Fresh-cut GS apple wedges	4.14
GS wedges infused with Argentinian honey	2.82
GS wedges infused with Mexican honey	3.36
GS wedges infused with water	2.01

[a] 6cm line with end-points of 0 (unacceptable) and 6 (very acceptable); 15 untrained tasters.

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E-mail: ronan.gormley@teagasc.ie.

Sandra Stahel was a visiting student from ZHAW University of Applied Sciences, Wädenswil, Zurich, Switzerland, who was on placement at AFRC for five months working with Dr Ronan Gormley. Sadly, Sandra passed away unexpectedly just four days before her return to Switzerland in mid-December 2007. Sandra was a highly intelligent, communicative, warm-hearted and beautiful person who had many friends at AFRC, and is greatly missed and fondly remembered by all. Deepest sympathies are extended to her parents Astrid and Peter, her sister Isabel and boyfriend Stefan. May she rest in peace.

Extended grazing of the ewe flock – the current thinking

Given Ireland's rich natural grass resources, TIM KEADY and JP HANRAHAN have been investigating whether a year-round grazing system for sheep could replace the conventional system.

To extend the grazing season into the period from December to March, herbage must be accumulated in late summer/early autumn. The earlier the closing date, the higher the yield, regardless of subsequent grazing date. However, it should be noted that, regardless of closing date, once the swards reach peak yield, subsequent herbage yield declines. This reduction in yield is due to senescence (leaf decay) exceeding leaf production. Date of closure and date of grazing also impact on the proportion of dead material in the sward, which is negatively correlated with feed value, as determined by digestibility and intake characteristics. This article summarises information on the use of extended grazing in sheep production systems, based on recent studies undertaken at Teagasc Animal Production Research Centre, Athenry.

Year-round grazing

Grass, either grazed or conserved, accounts for over 95% of the annual feed budget in mid-season lamb production systems. A major study was undertaken over four years to develop and evaluate a system of mid-season prime lamb production involving year-round grazing, thus removing the requirement for winter housing and forage conservation. The study involved two systems as follows:

Grazing, silage and housing (GSH). This system involved housing the ewes unshorn and offering grass silage *ad libitum* from early December until lambing (approximately 100 days). The mean lambing date was March 20. For the last six weeks prior to lambing, the ewes received 21.5kg concentrate. Ewes were stocked at 14.1 ewes/ha and annual fertiliser N input was 85kg/ha.

Year-round grazing (YRG). This system involved no housing or forage conservation. The ewes were at pasture from early December until lambing, i.e., extended grazing. During extended grazing, the ewes received a grass dry matter allowance of 1kg daily until early February and 1.3kg daily from early February until two weeks prior to lambing. The ewes were then spread out for lambing and received grass supplemented with concentrate. The mean lambing date was March 30. For the last six weeks prior to lambing, ewes received 23.1kg concentrate. Ewes were stocked at 10.4 ewes/ha and annual fertiliser N input was 92kg/ha.

Lambs were weaned at 14 weeks of age in both systems. In two of the four years there was insufficient herbage available for the duration of the extended grazing period. Consequently, ewes were supplemented with sugar beet pulp nuts (0.4kg/day), while daily herbage dry matter allowance was reduced by

0.2kg/ewe for up to 15 days/year. The effects of the system on ewe productivity and lamb performance are presented in **Table 1**. The system used had no effect on the number of lambs reared per ewe put to the ram or lamb carcass weight. Lambs from the YRG system were 0.7 and 2.9kg heavier at birth and weaning, respectively. Lambs from both systems were marketed at similar dates, reflecting the higher birth and weaning weights on the YRG system and the earlier date of birth on the GSH system. It can be concluded from this study that year-round grazing increased birth weight and subsequent lamb performance. However, to make the year-round grazing system feasible, stocking rate had to be reduced by 26%. This dramatically reduced lamb carcass output per hectare by 26%, which is equivalent to 121kg/ha. The YRG system also raised the following issues, which have been addressed in component studies at Athenry.

1. What is the feed value of extended grazed herbage?

The feeding value of extended grazed herbage was evaluated in three studies, two relative to grass silage and one relative to concentrates. In terms of lamb weaning weight (which takes into consideration both lamb birth weight and subsequent growth rate), an allowance of 1.3kg of extended grazed herbage dry matter in mid-pregnancy had the same feed value as 0.9kg of low (65% DMD) or medium (70% DMD) feed value grass silage. The results showed that during mid and late pregnancy a daily intake of 0.8kg silage DM by housed shorn ewes had the same feed value as a 1.8kg allowance of extended grazed herbage. For over-wintering ewe replacements, an extended grazed herbage dry matter allowance of 1kg had the same feed value as 0.5kg concentrate. These results clearly show that the feed value of extended grazed herbage was no better than low or medium feed value grass silage and, consequently, the improvement in lamb birth and subsequent weaning weight observed from year-round grazing could not be attributed to a higher feed value of extended grazed herbage.

2. Why does extended grazing increase lamb birth weight?

Shearing ewes at housing increases lamb birth weight relative to ewes housed unshorn, which is similar to the weight of lambs from ewes extended grazed throughout mid and late pregnancy (**Table 2**). Consequently, the increased lamb birth weight due to extended grazing is most likely due to reduced heat stress, as evident by the longer gestation length (**Table 2**), rather than by extended grazed herbage having higher feed value.

3. What is the effect of herbage allowance in mid pregnancy on subsequent performance?

The effects of herbage allowance on extended grazing from early December to four weeks prior to lambing on herbage intake and animal performance were evaluated. Increasing herbage dry matter allowance by 0.8kg/day increased forage dry matter intake by 0.19kg/day. However, utilisation rate was reduced from 44 to 34%. Increasing herbage allowance increased ewe condition score by 0.24 units at lambing. Lambs from ewes on the higher grass allowance were heavier at birth (+0.5kg) and at weaning (+2kg) and grew faster from birth to weaning (+17g/day). Furthermore, increased herbage allowance resulted in less damage to the paddocks and increased subsequent herbage regrowth.

4. Is frequency of grass allocation important?

Standard practice in extended grazing systems is to allocate herbage daily. To evaluate if labour input can be reduced, the effect of frequency of herbage allocation on forage intake and utilisation, and on animal performance, were

TABLE 1: Effects of system of lamb production on animal performance.

		System	
		Conventional	Year-round grazing
Stocking rate (ewes/ha)		14.1	10.4
Duration of housing (days)		100	0
Mean lambing date		March 20	March 30
Number of lambs reared/ewe to ram		1.77	1.78
Lamb	- birth weight (kg)	4.0	4.7
	- weaning weight (kg)	27.9	30.8
	- carcass weight (kg)	18.8	18.8
Carcass output (kg/ha)		468	347

TABLE 2: The effects of extended grazing in mid, late and throughout pregnancy on birth weight and subsequent lamb performance.

	Management in mid and late pregnancy				
	Housed		Extended grazed/ housed	Housed/ extended grazed	Extended grazed/extended grazed
	Unshorn	Shorn			
Birth weight (kg)	4.2	4.8	4.4	4.5	4.9
Growth rate to weaning (g/day)	288	307	299	303	312
Weaning weight (kg)	32.4	34.8	33.6	34.1	35.2
Gestation length (days)	145.8	147.5	146.6	146.9	147.2

evaluated. During extended grazing the ewes were allocated herbage either daily or twice weekly. Frequency of allocation did not alter forage intake or utilisation. Furthermore, there was no effect on lamb birth or weaning weights, or lamb growth rate from birth to weaning.

An on-farm study was undertaken to evaluate the effects of the system of herbage allocation to ewes in late pregnancy. The two systems consisted of the ewes either grouped separately (according to litter size) or in a leader-follower system (twin-bearing ewes were leaders followed by the single-bearing ewes). The herbage allowance in the leader-follower system was similar to the combined herbage allowances that the single- and twin-bearing ewes grouped separately were allocated. Allocating grass daily to the single- and twin-bearing ewes separately or in the leader-follower system did not affect lamb birth weight, lambing assistance, growth rate or weaning weight. The leader-follower system reduced labour requirements by decreasing the number of fence moves required by 50%.

An effective year-round grazing system can be practised successfully. However, stocking rate must be reduced significantly and, consequently, lamb carcass output and gross margin per hectare are dramatically reduced.

5. Is the response in lamb birth weight and subsequent performance related to stage of pregnancy when extended grazing takes place?

On many sheep units where extended grazing is practised, there is only sufficient herbage available for a period of extended grazing either in mid or late pregnancy. A study was undertaken in which ewes were either housed for mid or late pregnancy or during both stages, and extended grazed in either mid, late or in mid and late pregnancy (**Table 2**). Relative to ewes housed unshorn, extended grazing in mid or late pregnancy, or during both stages, increased lamb weight by 0.1, 0.3 and 0.7kg and increased weaning weight by 1.2, 1.7 and 2.8kg, respectively. Consequently, if only limited grass supplies are available for extended grazing, extended grazing in late pregnancy gives a greater response, in terms of lamb birth and weaning weights, than extending grazing in mid pregnancy.

6. What is the impact of extended grazing management on subsequent herbage yield?

The effect of extended grazing on herbage yield in the early part of the subsequent grazing season was evaluated. The results showed that frequency of herbage allocation (daily, twice weekly) during extended grazing did not affect subsequent herbage yield in spring. However, date of grazing during the winter had a major effect on subsequent herbage yield. Each one-day delay in grazing date reduced herbage dry matter yield by 54.2kg/ha, which is equivalent to 18 ewe grazing days, and may impact on grass availability post lambing, depending on grass growth rates during the spring.

Extended grazing ewes in mid-pregnancy at Athenry.

Conclusions

1. An effective year-round grazing system can be practised successfully. However, stocking rate must be reduced significantly and, consequently, lamb carcass output and gross margin per hectare are dramatically reduced. Furthermore, to comply with the Nitrates Directive, adequate slurry and/or farmyard manure storage facilities for a six-week period are required.

2. Extended grazing:
- increases lamb birth weight relative to lambs from ewes housed unshorn;
- limits stocking rate to a maximum of 10 ewes/ha;
- requires excellent grassland management;
- provides a low cost system, particularly for flying flocks; and,
- is a relatively inefficient system for utilising herbage.

3. Allocating herbage twice weekly rather than daily has no effect on animal performance or subsequent herbage growth, thus allowing labour inputs to be halved.

4. Concentrate supplementation is still required to enable the year-round grazing system to succeed.

5. The increased lamb birth and weaning weights associated with extended grazing can be achieved indoors by shearing ewes at housing.

6. On a 50ha farm, year-round grazing reduces gross margin by up to €10,500.

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Dr TWJ Keady is a Principal Research Officer and **Dr JP Hanrahan** is Head of the Sheep Production Department at Teagasc, Animal Production Research Centre, Athenry, Co. Galway. E-mail: tim.keady@teagasc.ie.

Novel management practices that reduce the labour inputs for calving and calf care

DAVID GLEESON, BERNADETTE O'BRIEN and JOHN MEE outline how novel labour-saving practices can reduce the workload on many dairy farms during the spring calving period.

Calving supervision and rearing the pre-weaned calf are some of the most challenging tasks on the dairy farm, particularly with a spring milk production system, where 90% of calves may be born over a 12-week period. The labour requirement associated with calving supervision and calf care can create a severe demand on limited labour resources. A series of studies was undertaken to establish management practices that would have the potential to reduce this labour requirement during this busy period. This article reports on labour-saving strategies, such as manipulation of the time of calving by changing the feeding regime, the association of farm facilities with calf care labour demand, and the evaluation of a low labour input calf-rearing system with respect to calf performance.

Manipulating calving time to facilitate labour availability

The high labour demand associated with the calving period may be reduced, and monitoring of calvings would be facilitated, if a management practice could be applied that would minimise the incidence of calvings at night. The practice of feeding cows in late evening is considered by many farmers to inhibit night-time calving.

Two grass silage-feeding regimes were imposed on housed spring-calving cows (n=250). One group of cows did not have access to the feed face from 10.30am until 8.30pm. Access to the feed face was controlled by closing cows into the cubicle house. During the designated silage feeding time adequate headspace was allocated to allow all cows to feed at the same time. A second group of cows had continuous access to silage over a 24-hour period (*ad libitum*). Cows remained on their respective feeding regimes until time of calving (mean days on treatment = 45). Day-time and night-time calvings were defined as calvings occurring between the hours of 6.30am and 12.29am, and 12.30am to 6.29am, respectively. Both groups had grass silage delivered to the feed passage daily at 10.30am. Restricting silage

TABLE 1: Effect of feeding regime (restricted silage access; *ad libitum* silage access) on calving performance.

	Restricted silage access (n=125)	*Ad libitum* silage access (n=125)
Night calvings* (% of cows)	17	26
Cow weight post calving (kg)	579	591
Gestation (days)	283	283
Assisted calvings (%)	14	15
Calf mortality (%)	5	4
Calf weight (kg)	43	43

*** 12.30am to 6.29am**

feeding time to between 8.30pm and 10.30am resulted in 9% less calvings at night compared to cows with full access to silage (**Table 1**). Calvings peaked between 10.30am and 11.30am, and 5.30pm and 6.30pm, with nine calvings per hour, respectively, for cows on a restricted silage feeding time. These peaks in calving occurred shortly after silage access was denied in the morning and after the evening milking was completed. The lowest period of calving activity occurred between 12.30am and 1.30am, and 2.30am and 3.30am, with 0 and one calvings per hour, respectively. Calf mortality was 5% and 4% for restricted silage access and *ad libitum* access, respectively.

Farm factors influencing labour required for calf care

Calf rearing accounts for a large proportion of labour associated with the dairy enterprise during the spring period. To establish the factors influencing the labour requirement for calf care, a study was undertaken on spring-calving dairy herds during the peak time for calf care from February to April. The time and practices associated with calf care were recorded on 129 farms. Herds were categorised into three groups depending on herd size (small: ≤50 cows; medium: 50-80 cows; and, large: ≥80 cows). The average time consumed by calf care peaked in April, with herds in the small, medium and large groups taking 63, 74, and 112 minutes per day, respectively. The total average time consumed by calf care per farm increased with herd size and the average time consumed per calf was highest in the small herd group (2 min/day). The increased labour efficiency associated with scale may be due to less individual bucket feeding of calves and mechanical transfer of milk from the dairy to the calf house on large farms (**Table 2**). This also coincided with significantly greater use of teat feeding methods, automatic feeders and *ad libitum* feeding. Large farms were more likely to feed cold milk to calves; this allowed the task of calf feeding to be carried out during an off peak labour time during the day. There were no differences in the use of mechanisation between herd sizes to clean calf houses. Inadequate access to calf houses to operate mechanical cleaning was the main factor why manual cleaning was used. A significant reduction in labour input per calf was shown where loaders could be used for the complete cleaning process. The larger herds tended not to clean pens daily and tended towards cleaning on a monthly basis.

When the labour input of different calf feeding systems was compared, a higher labour requirement was required for bedding and cleaning calf houses with an automatic feeding system and lowest for the once-a-day feeding system. This is due to the extra urine and wet bedding with the automatic system. Farms feeding milk to calves once a day had a lower labour input per calf for total calf care (total feed time, bed and clean pens, veterinary) compared to farms feeding calves twice daily.

Calf feeding system tested for labour efficiency and calf performance

A calf care management system that involved the grouping of calves (nine per pen) at approximately seven days old and feeding once daily with fresh milk using teat feeders was tested for calf performance and the labour input requirement. Female calves (n=54) were assigned to one of three milk-feeding treatments for 70 days. The treatments were: twice daily milk

TABLE 2: Proportion of herds practising different calf rearing methods within small, medium and large herd sizes.

	Small (<50 cows) (n=32)	Medium (50-80 cows) (n=55)	Large (>80 cows) (n=42)
Milk transfer method			
Bucket	0.53	0.52	0.39
Pump	0.16	0.25	0.20
Mechanical	0.31	0.23	0.41
Milk temperature fed to calves			
Cold	0.03	0.15	0.23
Warm	0.97	0.85	0.77
Calf feeding method			
Bucket	0.50	0.33	0.25
Teats or automatic	0.19	0.45	0.49
Trough	0.31	0.22	0.26
Feed frequency			
Ad libitum	0.20	0.47	0.50
Twice daily	0.80	0.53	0.50
Calf house cleaning frequency			
Daily	0.22	0.09	0.10
Weekly	0.34	0.65	0.40
Monthly	0.44	0.26	0.50

feeding with weaning at 56 days of age (TAD56); once-a-day feeding with weaning at 56 days of age (OAD56); and, once-a-day feeding with weaning at 42 days of age (OAD42). Calves that were offered milk twice daily received 2.5 litres of milk at each feeding time and calves that were offered milk once daily received 5 litres of milk at the morning feeding time. Calves were offered fresh water and a starter ration *ad libitum* throughout the 70-day experimental period. Calves were housed in a naturally ventilated house with a total pen area available per calf of 2.6m^2 and bedded using sawdust. The labour input per day associated with all tasks related to calf care for each feeding system was recorded. Some 10% of calves from each treatment did not adapt to group feeding with cold milk and were losing bodyweight. These calves were removed and fed individually or placed in smaller groups.

There were no differences in the total live weight of calves at any weighing date or at day 70 (**Table 3**). The overall weight gain was 48.5, 47.2, and 47.2kg/calf for TAD56, OAD56 and OAD42 treatments, respectively. Daily live-weight gain was similar for all treatments for the different time periods and over the 10 weeks.

TABLE 3: Live weight (LW) (kg) and average daily gain (ADG) (kg) for calves offered milk either twice daily (TAD) and weaned at 56 days or once daily (OAD) and weaned at either 56 or 42 days.

Day	TAD56 (n=16)		OAD56 (n=16)		OAD42 (n=16)	
	LW	ADG	LW	ADG	LW	ADG
0	42.4	-	42.2	-	42.4	-
14	47.6	0.38	47.5	0.37	50.4	0.58
42	64.9	0.74	66.4	0.67	63.6	0.56
56	76.7	0.84	71.5	0.79	76.9	0.95
70	90.7	1.00	89.5	0.85	89.5	0.89
ADG (0-70d)	-	0.69	-	0.68	-	0.67

n=number of calves

Associated publications

Fallon, R.J. (1999) General principles of management of calves. Proceedings of Teagasc Symposium, Kildalton, Co. Kilkenny, February 4: p46.

Gleeson, D., O'Brien, B. and Mee, J.F. (2007) Effect of restricting silage feeding prepartum on time of calving, dystocia and stillbirth in Holstein-Friesian cows. *Irish Veterinary Journal*, 60: 667-671.

Gleeson, D., O'Brien, B. and O'Donovan, K. (2007) The labour input associated with calf care on Irish dairy farms. *Livestock Science – Sci.* doi:10.1016/J.Livsci.2007.08.019.

Gleeson, D., O'Brien, B. and Fallon, R. (2007) Feeding of cold whole milk once daily to calves in a group and its effect on calf performance, health and labour input. *International Journal of Applied Research in Veterinary Medicine*, 5: 97-104.

OAD42 calves were weaned from milk at a lower live weight (63.7kg) than TAD56 (77kg) or OAD56 (77kg) calves. The lower weaning weight had no effect on calf live weight at day 70. The early-weaned calves consumed a higher level of concentrates post weaning and had similar live-weight gain post weaning compared to later-weaned once-a-day calves and twice a day fed calves. The total concentrate intake per calf for 70 days was 82.3, 80.4 and 91kg for TAD56, OAD56 and OAD42 feeding systems, respectively. The feeding of cold (ambient temperature) whole milk to calves either once or twice daily had no effect on calf daily live-weight gain when calves were fed as a group. However, instances of diarrhoea occurred in all groups during periods of very cold weather when both the calf house temperature and the milk temperature were low.

The labour input required per calf per day was higher for TAD56 (88 seconds) compared to OAD56 (66 seconds) or OAD42 (53 seconds) feeding systems. This labour input per calf recorded was considerably lower than has been previously reported for calves that were reared individually in hutches (8-10 minutes). The labour input observed in this study was probably lower due to group feeding and the use of teat feeders. Should Johne's disease be suspected in a herd, pooling of milk and grouping of calves should be avoided to prevent the spread of the disease. It is recommended that the general principles of good calf management and welfare as outlined by Fallon (1999) always be adopted.

Conclusions

Restricting cows' access to grass silage to between 8.30pm and 10.30am pre calving tended to reduce the number of cows calving at night and, as a consequence, the labour requirement during night-time hours was reduced. The main factors influencing labour input associated with calf care are herd size, calf feeding system and calf house cleaning methods. As herd size increased, labour-saving practices such as *ad libitium* feeding of milk, mechanical milk transfer and feeding of cold milk are more likely to be used. Calves can be reared successfully using a once-a-day whole milk feeding system when calves are fed as a group and weaned from milk early (42 days), with a reduced labour requirement.

David Gleeson MSc, **Dr Bernadette O'Brien** and **Dr John F Mee** are researchers in the Dairy Production Research Centre at Teagasc Moorepark. E-mail: david.gleeson@teagasc.ie.



Unlocking farm forest potential

A new Teagasc project, funded by COFORD, has commenced in Athenry and will provide a framework for quantifying the wood resources from farm forests in order to maximise potential markets. NIALL FARRELLY, BRIAN CLIFFORD and STUART GREEN explain how this new research will provide a significant stimulus to the farm forestry sector, and its potential contribution to the national wood supply chain.

A critical mass of private and farm forestry is now developing in Ireland, with over 219,000 hectares planted since 1980. Many of these plantations are coming to the stage where decisions on management requirements need to be made. Currently, 105,000 hectares of private forests are over 10 years of age and 40,000 hectares are over 16 years of age. The majority of private forest owners are farmers (84%). Recent research conducted by Teagasc and reported in the *Small-scale Forestry* journal indicates that if only 50% of private owners decided to thin their plantations, the annual output from farm forest first thinning could potentially rise to in excess of 200,000m^3 (Farrelly, 2007a). COFORD (National Council for Forestry Research and Development) estimates that the private sector's market share will rise to 23% by 2015 (Gallagher and O'Carroll, 2001). However, the actual supply from the private sector is still far short of this target, with many farm forest plantations in Ireland currently unthinned for many reasons, including the high cost of harvesting, economies of scale, lack of knowledge about when to thin, and the price attained for farm forest produce.

New research

While we have a general picture of the area of forest approaching first thinning age, there is very little information at a local level on exactly where the resource is located and which plantations are suitable for thinning in the next five to 10 years. In addition, there are few structures in place to quantify, locate or market the timber for owners, and there is a danger that the resource will be overlooked if the potential is not fully recognised. It is timely then that Teagasc, with the support of COFORD, intend to conduct research to address critical issues facing farm forestry, such as the the lack of local level information about forests for specific market requirements. This research will address the critical issue of economies of scale among small forest owners. A cluster-based approach will be developed so that the management, thinning, harvesting and marketing requirements of farm forests can be achieved for a particular district. The outputs of this research should improve the ability of farm forest owners to market and sell their produce. The work will quantify the material from farm forests by providing a methodology for assessment of the wood resource within any particular location, and link that resource to sawmills and wood energy markets.

New methodology

The 'cluster' methodology involves the capturing and compilation of high-level inventory or growth information on forest plantations, using available database resources from the Forest Service, remotely sensed imagery such as aerial photography, satellite imagery and airborne laser scanning (LiDAR), and field-based measurements.

The first phase of the study utilises a geographic information system (GIS) in order to provide information about the location of forest plantations. The research uses a cluster approach performed in a GIS for locating areas with large concentrations of private forest cover (**Figure 1**). The method is extremely efficient in grouping large concentrations of forestry together and concentrates survey resources where forest cover has reached a critical mass.

Thinning promotes revenue returns in farm forests.

FIGURE 1a and 1b: GIS cluster analysis used to locate large concentrations of farm forest plantations in Ireland and showing cluster locations in the west of Ireland.

Forest clusters were identified at a national level based on two parameters:

- private forestry in excess of 5% of the total land use; and,
- cluster area greater than 10,000 hectares.

Some 16 separate areas matched these requirements spread throughout the country (**Figure 1a, Table 1**). It would appear from this preliminary analysis that private grant-aided (PGA) forestry does have spatial concentrations. A total of 42% occurs within identified cluster areas, while these cluster areas make up less than 14.5% of the total national land area (**Table 2**).

TABLE 1: Cluster areas identified at national level.

Cluster	County	Forest area (hectare)
Limerick, Kerry, Cork	Limerick, Kerry, Cork	28,400
Killaloe	Galway, Limerick, Tipperary	13,455
Ballaghaderreen	Mayo, Sligo, Roscommon	9,693
Ennis/Ballyea	Clare	8,922
Leitrim	Leitrim, Sligo, Cavan	8,901
Glenties/Stranorlar	Donegal	4,287
Kilcormac	Westmeath, Laois	3,506
Donegal Town	Donegal	2,219
Castlecomer	Kilkenny, Laois	2,041
Bellacorick	Mayo	1,440
Buncrana	Donegal	1,200
Cappoquin	Waterford, Tipperary	1,104
Waterville	Cork	881
Moatfarrell	Longford, Westmeath	768
Glenamoy	Mayo	728
Tinahely	Wicklow	715

Mature Sitka spruce.

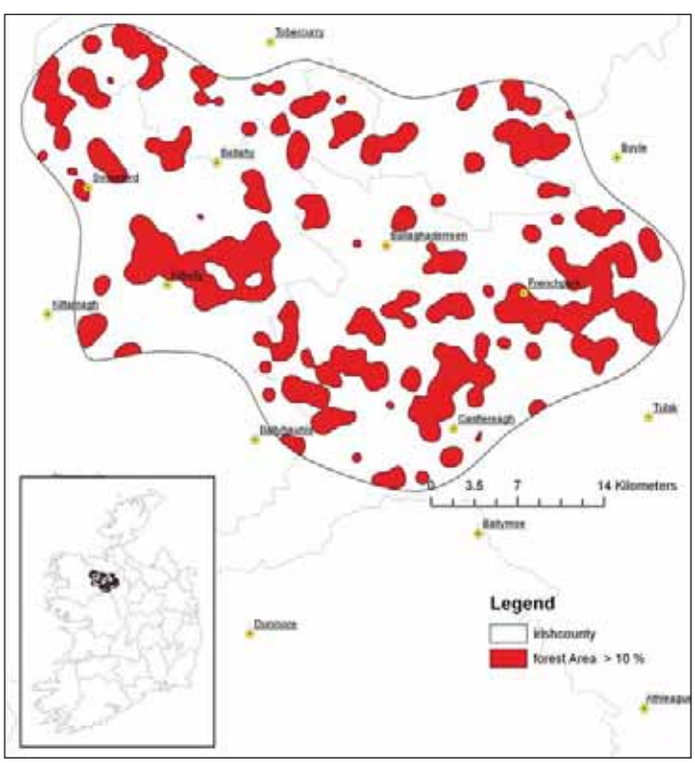

FIGURE 2: Illustration of the Ballaghaderreen cluster in Mayo, Sligo and Roscommon.

Of these cluster areas, four were identified as being priority areas. These priority areas include the Ballaghaderreen (**Figure 2**), Glenamoy, Bellacorrick and Leitrim clusters (**Figure 1b**). These areas were chosen based on the initial intention of this research programme to concentrate on the west of Ireland. Therefore, 10% of PGA forestry will be assessed by concentrating resources in only 0.3% of the national land area (**Table 2**).

Remote sensing methods

Work is underway in identifying the best available methods for determining forest stand parameters. The latest aerial photography is being used in order to capture value-added data about plantations in the cluster areas. This involves determining field boundaries, identifying development stage and stocking levels, and providing information on roadways and access (**Figure 3**). This will be further aided by SPOT satellite imagery, which will be made available from the Teagasc Spatial Analysis Unit in 2008.

The potential of LiDAR (Light Imaging Detection and Ranging) in obtaining stand-related parameters is also being assessed. LiDAR is a remote sensing system, which appears to have great applicability for the estimation of canopy height models that can be used to estimate other forest parameters, such as stand heights, stand volume and the structure of the forest canopy. In turn, canopy structure gives vital information on stocking density and wind damaged areas (Naesset, 1997; Suarez *et al*, 2005). Therefore, this research will evaluate the potential of these new technologies for analysing species, spatial distribution, monitoring forest cover fragmentation, planning of forest road networks and the monitoring of forest land cover change.

TABLE 2: A breakdown of area by total cluster area and forest cover within clusters.

	Area (hectare)	% of national land area
Total national land area	6,984,799	100.0%
Total cluster area	1,015,565	14.5%
Total PGA forestry	207,897	3.0%
Total PGA forestry in cluster	88,260	1.3%
Cluster area to be surveyed	20,762	0.3%

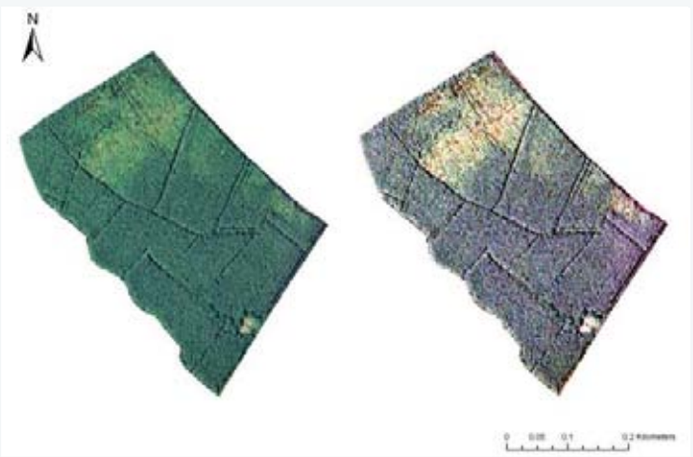

FIGURE 3: Identification of resource details using aerial photography. The left image is a traditional aerial photograph showing forest boundaries and the right image is enhanced to show areas where the crop has failed in yellow (Copyright Ordinance Survey Ireland – license 6155).

Above left: Glaspullagh, Co. Limerick.

Field assessment and production forecast

All plantations within a cluster that are approaching first thinning stage or have passed first thinning stage (or a certain age criteria) will be visited in the field, where an assessment of timber quality and volume will be performed in each stand using tried and trusted forest sampling methods The field survey will be based on capturing forest growth parameters. All the data will be compiled into a field database and the volume of each stand will be computed using the COFORD Dynamic Yield Model 'Growfor' (COFORD, 2007). These models will be used to generate forecasts of volume production by projecting the growth of stands forward to a reference age and quantifying the effects of thinning a crop (Farrelly, 2007b). A forecast for timber production for each stand in the cluster will be made and will be used as the main tool for further development work, especially in the identification of suitable locations for new market opportunities. Further analysis will be performed using GIS technologies such as: distance from sawmill; optimum haulage route; and, optimising the location of additional wood utilising facilities (such as wood energy boilers).

Acknowledgements

The Cluster Research Programme has been part-funded by the Council for Forest Research and Development (COFORD). This work is also funded by the Teagasc Core Programme.

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Niall Farrelly and **Brian Clifford** are forestry researchers in the Forestry Development Unit, Teagasc, Athenry, and **Stuart Green** is a Research Officer in the Spatial Analysis Unit in Teagasc, Kinsealy Research Centre, Dublin 17. E-mail: niall.farrelly@teagasc.ie.



Meeting the challenges of sustainable agriculture

A collaborative research project is looking at the key microbes involved in the mobilisation of soil phosphate using conventional and novel techniques, and how these could be used in sustainable agriculture.

Over recent decades, land use in Ireland has undergone significant changes, with economic and political policies driving agriculture towards more intensive land use regimes. Modern agricultural practices have become increasingly dependent on the addition of chemical fertilisers (nitrogen and phosphate) for high crop yields. However, this reliance on chemical fertilisation comes at a price, both environmentally, with pollution threats to water tables, rivers and drinking water, and economically, with higher production costs. Remarkably few studies have focused on the effects of fertilisation on soil health and, in particular, on the soil's microbial biodiversity, a factor that is considered critical to the integrity, function and long-term sustainability of soil ecosystems. Despite the evidence that microbes are the main drivers of ecological processes in a range of soils, we are limited in our understanding of the diversity and function of such microbial systems, especially with respect to phosphorus cycling. Most of the phosphate present in soil is not directly available for plant growth, but can be made available by the solubilisation of mineral (rock) phosphate and/or mineralisation of organically bound phosphate by different groups of microbes. Given the advanced nature of the investigative tools now available, it is surprising that variations in the phosphate-solubilising microbial communities of soils under different land uses have not been extensively studied to date. There is, therefore, a need for research into the nature of the microbial communities present in agricultural soils, and the likely impact of altered fertilisation and pesticide inputs on their functions.

Novel crop management regimes were initiated in 1994 at the Teagasc Oak Park Crop Research Centre in Carlow to compare the impact of a conventional (high) and reduced (low) input system on grain yield, quality, production costs and overall profitability of different commercial crops (**Figure 1**). With increasing emphasis on environmentally friendly food production, this experiment has provided a wealth of information that will drive agricultural-based policy, in both the present and future. By focusing on this long-term crop rotation experiment, the P-solve project (**Figure 2**) will analyse the microbial communities in the soils from these plots and will place particular focus on microbial inorganic phosphate solubilisation within these agricultural regimes.

Bioavailability of phosphate

This project specifically addresses the application and subsequent bioavailability of phosphate within an agricultural environment and the environmental issues that this raises. Inorganic phosphate can be rapidly immobilised by iron (Fe), aluminium (Al) and calcium (Ca) upon application to soils, making it unavailable to plants. To compensate for this, phosphate fertilisers are typically over applied, which can result in run-off to rivers and lakes where it is implicated in key environmental problems, such as eutrophication. Mobilisation of phosphate into forms that are bioavailable for plants is a process mediated by bacteria and fungi naturally present in soil ecosystems, an action mediated through the activity of enzymes such as phosphatases or the production of organic acids. This process varies dramatically from one agricultural system to another, as it is

FIGURE 1: Teagasc experimental crop sites at Knockbeg, Carlow. These crop rotations are grown under two different agricultural management regimes: 1. conventional (high) levels of phosphate, nitrogen, fungicides and pesticides; or, 2. a decision-based (low) input regime of no phosphate, 80% of the recommended nitrogen rates and 50% of the recommended plant protection product rates based on the levels used in the high input regime.

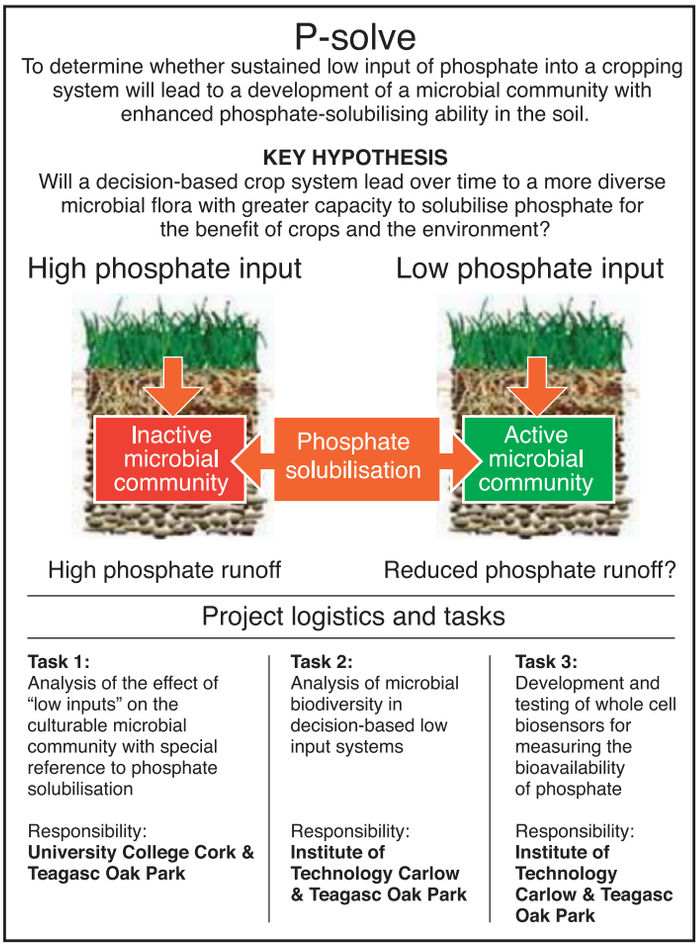


FIGURE 2: P-solve is a multidisciplinary project dealing with microbial biodiversity linked with phosphate availability.

directly linked to soil microbial diversity, which in turn is affected by the numerous abiotic and biotic factors involved in soil ecosystems. As phosphate is one of the major limiting nutrients for plant growth, it has been hypothesised that soils that receive low phosphate inputs will contain microbes that have adapted to or been selected for an increased phosphate mobilisation ability by the plants present.

Microbial biodiversity

Numerous taxonomic groups of soil fungi and bacteria play an important role in increasing phosphate bioavailability, especially by releasing phosphate from organic sources such as plant- or microbe-derived phytate or by solubilising inorganic phosphate complexes within soil. Indeed, by investigating the total soil microbial community, we will obtain a better level of understanding of the microbial biodiversity present under the low and high input conditions present at the Oak Park site. To fully benefit from this work, analysis of the total soil microbial communities has been undertaken using genetic fingerprinting techniques such as PCR-TGGE (temperature gradient gel electrophoresis) (**Figure 3**), where it is being used to study the total microbial community structure (by analysing 16S and 18S rDNA genes). Metagenomics (study of genetic material recovered directly from environmental samples) will also be used to assess the diversity of these communities, as it provides a useful means for investigating biodiversity and/or identifying novel microbial genes of interest, particularly those involved with phosphate-solubilising abilities.

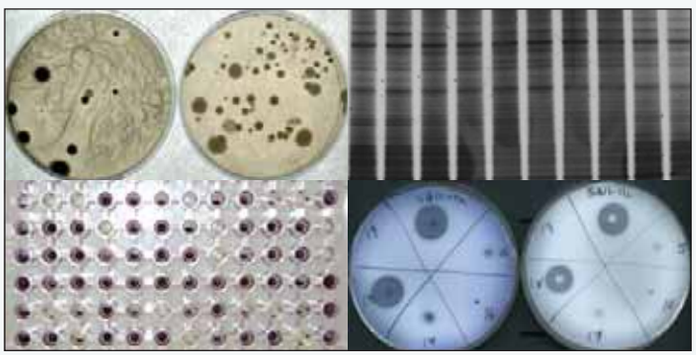


FIGURE 3: A variety of techniques will be applied to the study of the microbial community at this unique site, including: (top right) the isolation of selected and non-selective microbial species; (bottom right) analysis of the total functional community using BIOLOG™ substrate plates (Ecoplates™); (top left) use of molecular fingerprinting methodology for analysing the uncultured microbial community; and (bottom left), screening of the culture collections for inorganic phosphate solubilisation.

Functional biodiversity

In order to better understand the key processes involved in microbial mobilisation of phosphate, profiles of the functional community diversity are being generated using approaches such as screening of cultured isolate collections on BIOLOG™ substrate utilisation plates and tri-calcium phosphate assay plates (**Figure 3**). This approach has specific advantages, such as identifying keystone or indicator species, which could provide a snapshot view of the state of phosphate-solubilising members in the microbial community. These microbes could also have potential for use as future inoculants – microbes that will augment the natural process of a community, reducing the need for chemical phosphate inputs.

Biosensors

A significant problem exists in distinguishing between bioavailable phosphate and insoluble or organically-complexed phosphate. Morgan's reagent, or electroultrafiltration (EUF), are the routine methods used to measure phosphate levels within agricultural soils. These methods vary greatly in sensitivity, precision and availability to the tester. With whole-cell bacterial biosensors, this offers an exciting new resource to evaluate soil phosphate health (**Figure 4**). Here we will apply our expertise in bacterial gene expression and fluorescent reporter construction to develop bacterial biosensors to evaluate phosphate bioavailability in soil.

Future potential

During this project, we will address the hypothesis that structured soil management strategies, particularly focusing on the level of phosphate input, can select for microbial populations with higher phosphate mobilisation ability over a period of time. Both classical culture-based and molecular culture-independent microbiological methods will be applied and integrated into the study of the soil metagenome and the diversity therein. Each task within the project is designed to complement the other, providing new and detailed knowledge of the microbial community and assessing the shifts in activity, diversity and prevalence of phosphate-solubilising microbes in the overall context of the plots. Early trends have indicated that microbial isolates from the low input plots have a higher inorganic phosphate solubilising ability compared to isolates from the high input plots, an indication that the microbial community has developed towards a population with an enhanced phosphate-solubilising ability. The key issues of input levels, and the positive or negative aspects of reduced chemical inputs on a commercial crop production, will also be addressed, as will the potential of these strategies to reduce phosphate contamination of rivers and lakes without compromising agricultural yields. This is an issue that is currently being driven by policies such as the EU Water Framework Directive, the Nitrates Directive and the European Communities (Good Agricultural Practice for the Protection of Waters) Regulation. In this context, additional scientific studies are needed to underpin and inform the implementation of these polices in Ireland.

This project is funded by the Department of Agriculture, Fisheries and Food under the Research Stimulus Fund.

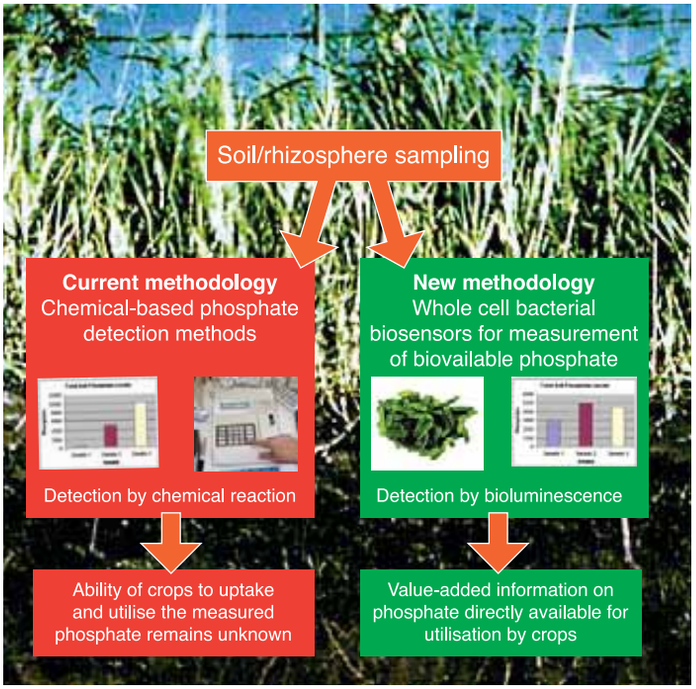
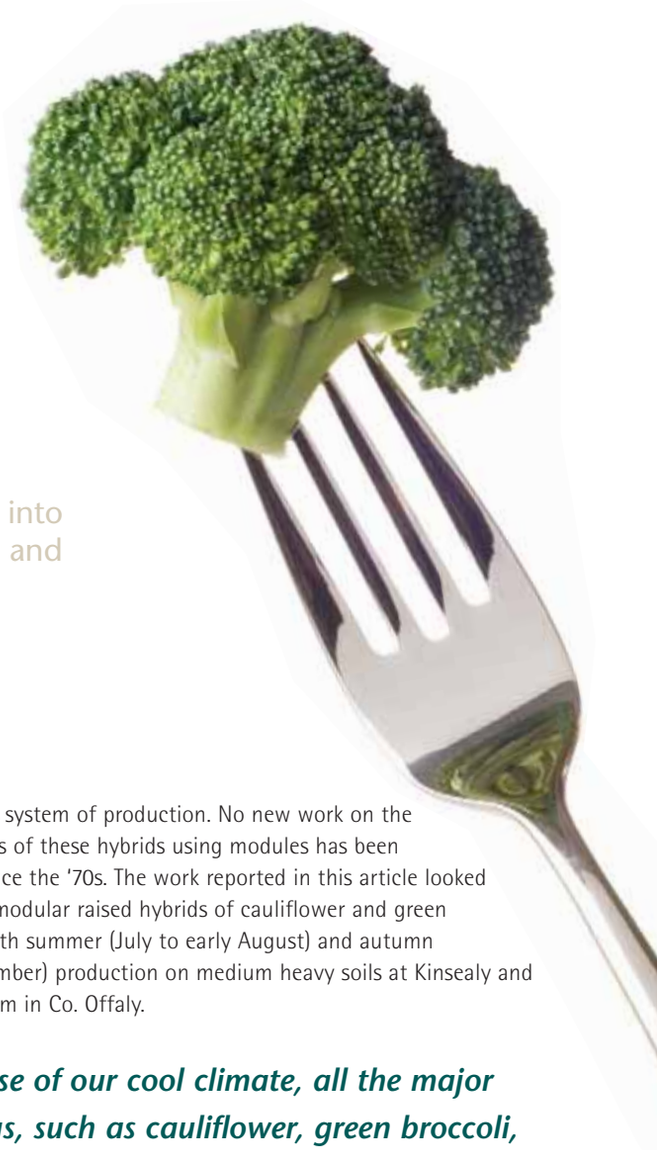


FIGURE 4: Whole-cell biosensors to detect and quantify bioavailable phosphate in soil samples; the basis of these biosensors is that a phosphate responsive promoter is fused to a reporter gene, expression of which can be easily detected and quantified. As part of this work, UCC will evaluate a number of reporter genes, including luciferase, autofluorescent proteins (AFPs) and a novel AFP, DSRed.T3_S4T, a powerful new reporter for biosensors.

Clockwise from top left: **Dr Olivia Rice** and **Dr Simon Miller** are post-doctoral researchers at the BIOMERIT Research Centre, University College Cork. E-mail: O.Rice@ucc.ie.
Patrick Browne and **Sagar Chhadra** are undertaking their PhD studies at University College Cork and Institute of Technology Carlow, respectively.
Dr David Dowling is Head of the School of Science at the Institute of Technology Carlow.
Dr Jimmy Burke is Head of the Teagasc Oak Park Crops Research Centre.
Dr John Morrissey is a lecturer in the Department of Microbiology at University College Cork.
Professor Fergal O'Gara is Head of the Department of Microbiology and Director of the BIOMERIT Research Centre at University College Cork.

Nitrogen requirements of brassicas



Given changing growing methods and the implications of the Nitrates Directive, BARRY MURPHY presents results of research into the nitrogen requirements of summer and autumn cauliflower and green broccoli, undertaken at Teagasc Kinsealy.

Irish vegetable production is worth around €50m at farm gate value, and brassicas, such as cauliflower and broccoli, make up a major portion of this. Irish outdoor vegetable production has been holding its own for a considerable time and accounts for about 70% of the home market over the major lines such as cabbages, broccoli and swedes. Because of our cool climate, all the major brassicas, such as cauliflower, green broccoli, sprouts, swedes and cabbage, grow very satisfactorily, with cauliflower and cabbages grown all year round in favourable frost-free coastal areas.

Until now, recommendations for nitrogen (N) were based on work carried out at Kinsealy in the 1960s and '70s on open-pollinated cultivars, mostly grown from direct drilling where crops were in the ground for an additional six to eight weeks. Because of recent advances in crop production, all the brassica vegetables, with the exception of swedes, are transplanted from plants raised in small 'modular' containers. All transplanted commercial crops now use hybrids, which mature more evenly from this method. Plants have a shorter growing cycle with this system of production. No new work on the N requirements of these hybrids using modules has been undertaken since the '70s. The work reported in this article looked at N rates on modular raised hybrids of cauliflower and green broccoli for both summer (July to early August) and autumn (August/September) production on medium heavy soils at Kinsealy and on a sandy loam in Co. Offaly.

Because of our cool climate, all the major brassicas, such as cauliflower, green broccoli, sprouts, swedes and cabbage, grow very satisfactorily, with cauliflower and cabbages grown all year round in favourable frost-free coastal areas.

TABLE 1: Effect of N rate on marketable yield (kg/plot) of green broccoli on both heavy and light soil types for summer and autumn production, 2002-2003.

	Heavy soil		Light soil	
kg N/ha	Autumn	Summer	Autumn	Summer
0	15.0	14.1	9.2	5.0
30	17.2	20.3	7.9	7.0
60	17.0	21.6	8.8	8.1
90	16.9	18.3	8.9	7.9
120	16.3	24.5	9.7	10.5
150	16.0	25.6	8.2	9.9
180	17.8	27.9	8.8	10.9
210	17.6	26.5	9.3	10.3
F-test	NS	*	NS	***

Table 2: Effect of N on wet rot and hollow stem of green broccoli (2002 and 2003)

	Wet rot		Hollow stem
N (kg/ha)	2002 (kg)[1]	2003[2]	2003[3]
0	3.43	0	25.2
30	4.35	1.0	24.6
60	3.74	1.0	27.2
90	2.89	1.0	24.6
120	4.46	1.4	32.6
150	5.78	2.2	35.8
180	4.98	3.6	34.0
210	5.29	2.2	33.0
F-test	*	*	*

[1] Heavy soil, summer [2] Sandy soil, autumn [3] heavy soil, August

T Horticulture

Summer and autumn cauliflower requires much more N than green broccoli.

Summer and autumn green broccoli

Results of green broccoli for both heavy (Kinsealy) and sandy loam soils (Birr) for summer and autumn cropping are shown in **Tables 1** and **2**. Crops for summer production were transplanted from modules in April, and in July for autumn cropping, with phosphorus and potassium adjusted according to a soil test.

Over 95% of all green broccoli grown in Ireland is for the fresh market, where produce is sold by grade and quality rather than yield.

For autumn production, there was no significant marketable yield response to applied N on both soil types. From observations during the crops cycle in the field, only the 0 and the 30kg N/ha rates could be discerned in some instances, depending on soil variation. Quality of produce in these plots suffered, especially on the lighter sandy soils in Birr. In view of these results, it is suggested that low rates of N of 60-90kg N/ha would only be required for optimum marketable yield for late August to November production.
In contrast, there was a marked response to applied N for summer cropping. There were significant and large marketable yield increases up to 120kg N/ha, and thereafter much smaller increases in yield up to 180kg N/ha. In the field, the 0, 30 and 60kg N/ha rates were usually clearly visible, with plots showing chlorosis and lack of vigour. Results clearly show (**Table 2**) the effect of high rates of N on broccoli quality, especially with regard to

TABLE 3: Effect of N rate on Class 1 grade and marketable yield and buttons of early summer cauliflower (cv. Nautilus), Kinsealy, 2005.

kg N/ha	No. of Class 1	Yield kg/plot (marketable)	Buttons (unmarketable)
0	20.3	24	20.5
60	30.2	54	8.0
120	27.3	57	7.5
180	28.8	63.3	7.8
240	32.3	77.5	5.6
300	23.1	68.2	5.0
F-test	***	***	***

TABLE 4: Effect of N rate on grade and yield of early autumn cauliflower (cv. Nautilus), Kinsealy, 2005.

kg N/ha	No. of Class 1	Yield kg/plot (marketable)	Buttons (unmarketable)
0	36	91.7	2.7
60	38.7	110.3	0.8
120	39.8	116.0	1.2
180	40.5	114.3	1.0
240	39.5	116.0	0.8
300	38.7	112.8	0.6
F-test	NS	*	NS

Irish vegetable production is worth around €50m at farm gate value.

wet rot or spear rot when the season was conducive to this disease. In 2002 and 2003, rates of 120kg N/ha and greater were associated with consistently high amounts of unmarketable wet rot. Hollow stem occurrence also increased following higher rates of N in some years, such as 2003.

Over 95% of all green broccoli grown in Ireland is for the fresh market, where produce is sold by grade and quality rather than yield. Crop losses from wet rot can be as high as 25-50% in some seasons, and losses from hollow stem can also be significant. For summer cropping, therefore, rates of 120kg N/ha are recommended.

Very low rates of N were always associated with lower grade produce and high amounts of buttons or undersized curds.

Summer and autumn cauliflower

The trials showed that summer and autumn cauliflower requires much more N than green broccoli. As with green broccoli, the response to N was much higher for summer cropping (July) than for autumn cropping (**Table 3**). In this series of trials, 240kg N/ha produced maximum yields. In contrast, autumn crops produced maximum yields at 120kg N/ha (**Table 4**).

Tip-burn in cauliflower can be troublesome. In some years, up to 50% of plants were affected by this disease at rates over 240kg N/ha. Very low rates of N were always associated with lower grade produce and high amounts of buttons or undersized curds.

It should be noted that as cauliflower crops are mostly grown for the fresh market, the maximum rates of N can be considerably reduced, as produce is not sold by weight alone, compared with crops grown for processing, where total weight yield is of much more importance.

Importance of results and expected benefits

These trials showed some very interesting findings. Cauliflower and green broccoli had different nitrogen requirements, with cauliflower being the heavier demander. Both required considerably less N for autumn production compared with summer cropping, enabling savings to be made. Results also showed several disadvantages of excess use of N – mainly accentuating wet rot and hollow stem of green broccoli, resulting in crop losses and, in the case of cauliflower, potentially high losses from tip-burn depending on the cultivar and season of production.

Correct N fertilisation, therefore, gives the highest quality and yield with minimal impact on the environment under the EU Nitrates Directive.

This research was funded under the National Development Plan.

Barry Murphy is a Research Officer in the Horticultural Development Unit, Teagasc, Kinsealy, Dublin 17. E-mail: barry.murphy@teagasc.ie.

Growing grass for greener grazers

NYNCKE HOEKSTRA and ROGIER SCHULTE explain the latest research at Johnstown Castle on grassland management for improved nitrogen efficiency of grazing cows.

Cut plot experiment at Johnstown Castle Research Centre.

Collecting dung samples from freshly dropped pats.

When cows are grazing pastures, they excrete nitrogen (N) in dung and urine patches, which can contribute to losses of N to water and air. In general, the N utilisation of grazing cows for milk production is often lower than 25%, which means that more than 75% of the N taken up through feed is excreted in dung and urine. In theory, the N utilisation by dairy cows can be as high as 45-50%. The upper limits on N use set in the Nitrates Directive, and the rapid increase in the cost of fertilisers, are strong incentives for farmers to optimise the use of N in order to maintain productivity at a minimum cost. The most important way to optimise the utilisation of N by cows and minimise the quantities excreted through urine is through manipulation of the diet. However, in Ireland, the diet consists mainly of grazed grass, and this proportion is increasing, as this is the most cost-effective feedstuff. Controlling the diet in a grazing situation represents a significant challenge, since it can only be manipulated through grassland management. For example, fertiliser N application increases the crude protein concentration in the herbage, while reducing the water-soluble carbohydrate (WSC) (sugar) concentration, increasing the length of the rotation period has a similar effect. Additionally, recent plant breeding developments in IGER (Institute of Grassland and Environmental Research) in the UK have resulted in grass cultivars with a higher sugar content. The rationale behind this is that the higher level of rapidly available energy (sugar) facilitates utilisation of N in the rumen, thereby limiting the loss of N from the rumen and subsequent urinary N excretion. The first experimental trials at IGER seem promising.

Therefore, researchers at Johnstown Castle Environment Research Centre embarked on a major study to investigate if the urine N excretion can be reduced through grassland management, while maintaining milk production. This programme combined small-scale cut plot experiments with large-scale field and animal experiments and modelling. The newly developed model allows us to assess the efficacy of different grassland management tools, manipulating the quality of the herbage intake during grazing and the subsequent cow N efficiency.

Crude protein concentration

One of the main outcomes from the model and field experiments is that the crude protein (CP) concentration of the herbage ingested during grazing is the main factor for improving bovine N efficiency (**Figure 1**). The optimum CP concentration is between 13% and 15% DM. At CP levels above 15%, the supply of N to the rumen is in excess of the energy supply and, therefore, the cow cannot fully utilise the protein. The bulk of this excess N is excreted through urine. At CP levels below 13%, the supply of N to the rumen is actually limiting milk production, resulting in lower N use efficiency.

Herbage management tools

How can we manipulate these herbage crude protein levels in the field? From the small-scale plot experiments and modelling, we established that both fertiliser N application rate and the length of the regrowth period are effective tools for manipulating the CP concentration of herbage ingested

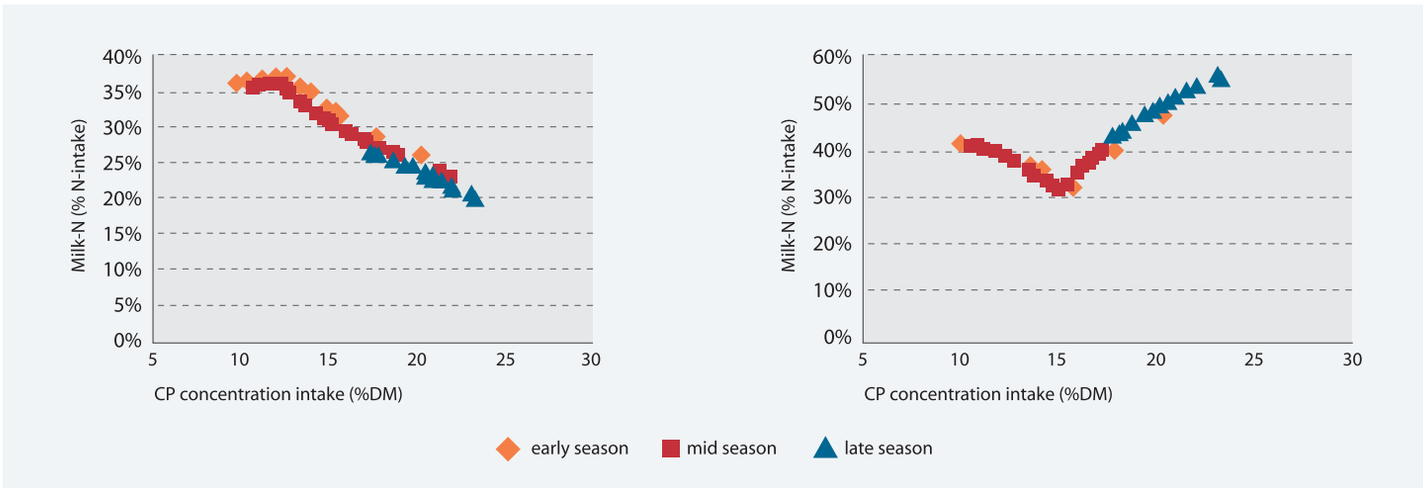


FIGURE 1: Modelled relation between the CP concentration in the intake and the percentage of N-intake excreted in: a) milk-N; and, b) urine-N during early, mid and late season.

during grazing. Lower N application rates and a longer regrowth period result in lower CP concentration in the ingested herbage. Our model suggests that N-utilisation for milk production can be increased from 23% to 37% during early and mid-season and from 21% to 26% during late season, by adjusting the N application rate (14 to 56kg N/hectare/rotation) and the length of regrowth period (three to seven weeks).

High sugar grass varieties

For the two cultivars that we compared (low sugar = Respect and high sugar = Aberdart), the high-sugar grass cultivar did significantly increase the WSC concentration in the ingested herbage by up to 40%, particularly during late season. However, this increase in WSC did not affect the predicted cow N efficiency. Apparently, the increase in the proportion of rapidly available energy in the rumen was not large enough to improve the N utilisation. This is in agreement with more recent publications on the effect of high sugar grasses on cow N utilisation.

Towards grassland management systems

This work is a first step in identifying to what extent the N efficiency of grazing cows can be manipulated through herbage management, and it has shown that both fertiliser N application rate and the length of regrowth period are important tools through their effect on the herbage protein concentration. However, in practice, these tools cannot be used independently, as they are strongly connected through their effect on herbage yield. Also, decisions made at the start of the year will affect herbage availability and quality later in the season. Therefore, there is a need to develop decision support systems for grassland management that will allow us to design herbage management systems to optimise N utilisation on a yearly basis, integrating both production and environmental objectives. One such strategy would be to minimise the second cut silage area, resulting in a build-up in grass cover for grazing. This would allow lower N application rates and longer rotation lengths during autumn, when the risk of N losses from urine to the environment is highest. The benefits for the farmer will be a reduction in the direct fertiliser cost, and compliance with the Nitrates Directive, whereas the environment will benefit through a reduced potential for greenhouse gas emissions and nitrate leaching.

This research was funded under the Teagasc core programme.

Nyncke Hoekstra is a Research Officer and **Rogier Schulte** is Head of the Agri-Environment Research Department in Teagasc, Johnstown Castle Environment Research Centre.
E-mail: rogier.schulte@teagasc.ie.

A soil geochemical atlas for Ireland

Our soil is an immensely valuable national resource. A collaborative research project, spanning 10 years, has culminated in the production of a comprehensive atlas on Ireland's soil composition.

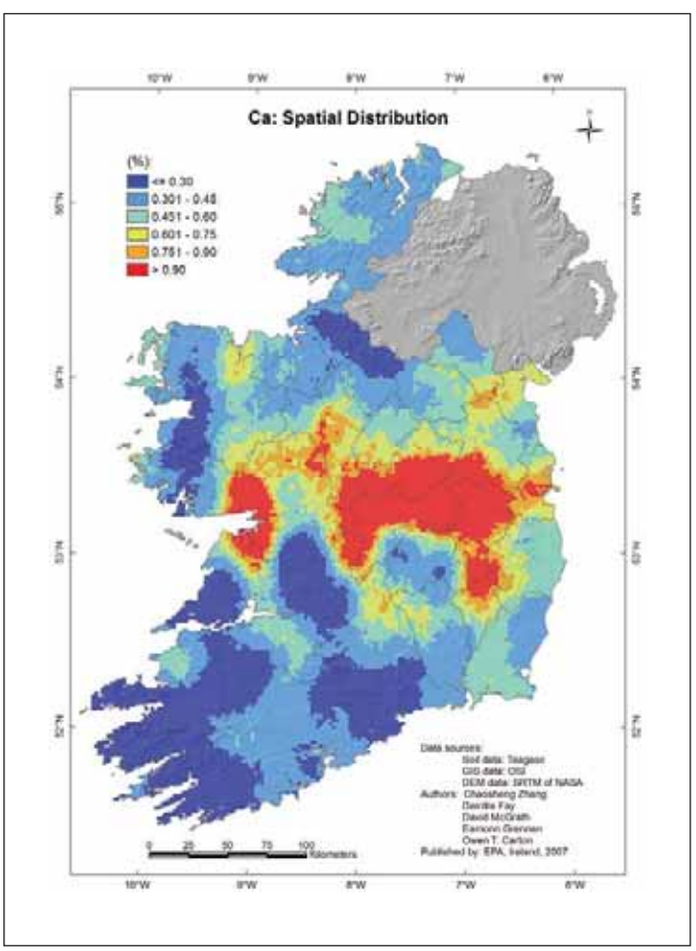
Iron accumulation in an Irish podzol soil.

Soils are dynamic systems that form the basis for services essential to our everyday lives such as the production of food and the filtration of drinking water. They form a versatile but often vulnerable skin on the earth's productive surface. Understanding soil systems is essential to their sustainable management, ensuring that they continue to perform their services for many years to come. In order to understand and manage soils, we need basic information on their chemical composition, physical properties, biological functions and their roles in the environments in which they occur.

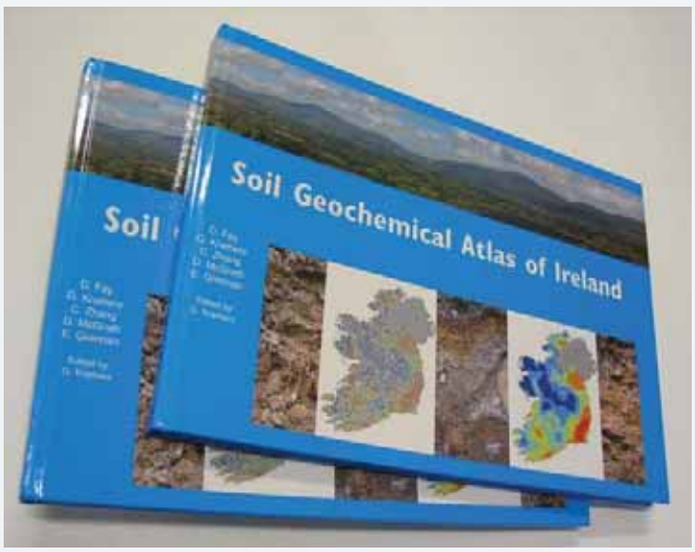
Between 1995 and 2006, a countrywide geochemical survey was conducted as part of the 'National Soil Database' project. The main objectives of this project were to generate a national database of soil geochemistry, produce data point and spatial distribution soil geochemical maps and interpret them, and establish a 'national soil archive'. The newly published *Soil Geochemical Atlas of Ireland* is one of the final outcomes of this project, and presents a user-friendly summary of national baseline soil geochemical data.

The atlas includes an introductory section with background information to aid in the interpretation of the maps. In this section, soils are discussed in general, as are the influences that have affected, and continue to affect, their chemical composition, such as geology, climate and land use. The main section of the atlas contains maps for each of the measured elements, and an interpretation of the findings with respect to underlying parent material, glacial geology, land use, and anthropogenic and climatic effects.

The publication of the atlas is timely against the background of a recent renewed interest in soil research in Ireland. This interest has been underpinned by the adoption of the 'Thematic Strategy on Soil Protection' by the European Commission (EC) in September 2006. This Strategy requires Member States to acquire a more comprehensive knowledge of their soils and soil quality, and lays the groundwork for a Soil Framework Directive in the future. In this context, this national atlas constitutes a valuable resource for soil scientists, policy makers, geologists, farmers, advisers, consultants or anyone interested in increasing their awareness of soils.

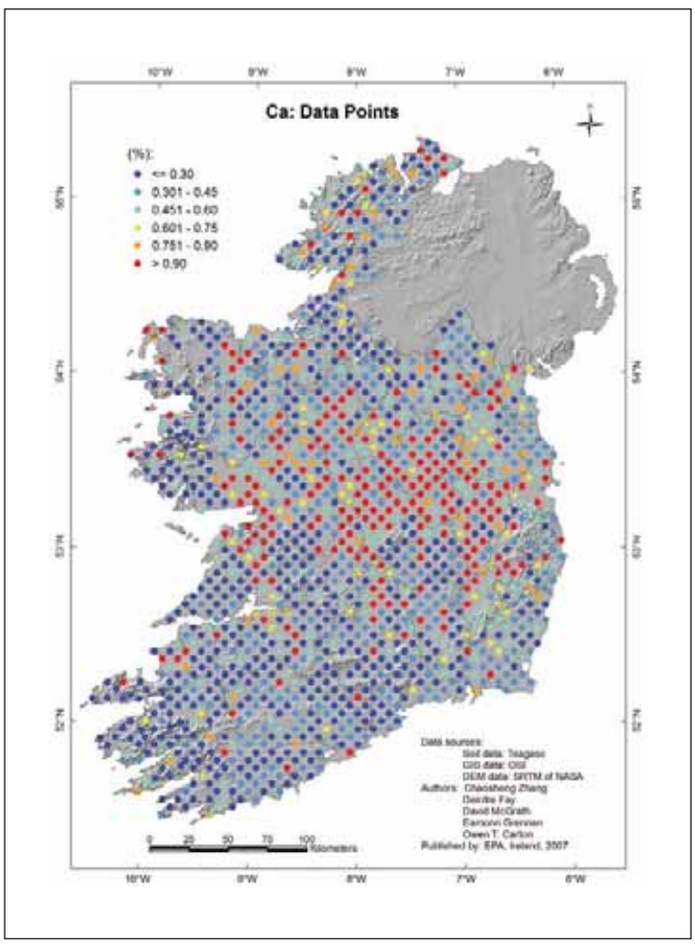


Map showing the spatial distribution of the calcium content in soils in Ireland (%).



The Soil Geochemical Atlas of Ireland.

An arable soil in Ireland.



Map showing the values for each sample point for the calcium content of the soil (%).

This project was funded by the EPA under the Environmental Research Technological Development and Innovation (ERTDI) programme. The atlas is available from Teagasc, Johnstown Castle Environmental Research Centre, for €10. The authors of the atlas were: Deirdre Fay, Gaelene Kramers (Editor), Chaosheng Zhang, David McGrath and Eamonn Grennan.

Clockwise from top left: **Gaelene Kramers** and **Dr Deirdre Fay** worked on this project as Research Officers in the Agri-Environment Department at Teagasc, Johnstown Castle, Wexford. Gaelene is currently a Walsh Fellow at Johnstown Castle working on preferential flow in Irish soils. E-mail: gaelene.kramers@teagasc.ie.
Dr Chaosheng Zhang is a lecturer in GIS at National University of Ireland, Galway.
Dr David McGrath is a retired Research Officer from the Agri-Environment Department at Teagasc, Johnstown Castle, Wexford.
Eamonn Grennan is a lecturer at the Institute of Technology, Sligo, specialising in geology, soil science and mineral resources.





Disability on Irish farms – a real service/support issue

SHANE WHELAN is carrying out the first ever Walsh Fellowship study on the incidence and implications of disability on Irish farms.

Farm modifications facilitate continuing to work on the farm.

Farmers operate within hazardous environments while conducting their day-to-day tasks, potentially resulting in accident, injury or disability. The acquisition of disability, whether from a farm accident, ill health, or genetic sources, can be a major life-changing event for the farmer, the farm family and, indeed, the farm business. The agricultural sector reported the highest incidence of disability relative to any other (CSO, 2002), yet there is relatively little research on agriculture-based disability.

In 2007, a supplementary survey of the Teagasc National Farm Survey (NFS) identified that almost 7.6% (about 8,500) of Irish farm operators reported disability. Illness/disease was identified as the primary cause of disability, with arthritis (31.4%), back problems (17%) and heart circulatory problems (12.5%) being the most frequently reported disabilities. Farm operators reporting disability typically operated smaller farm enterprises relative to non-disability farms, with almost 48% operating less than 20 hectares. The lowest incidence of disability was found among specialist dairy (3.8%) and tillage (4.0%) enterprises, with the highest incidence among cattle specialists (9.1%).

While the incidence of disability was lower among dairy and tillage enterprises, this may not always have been the case. As part of my Walsh Fellowship examining the impact of disability among farm operators on the farm business, it was found that farm operators primarily make operational changes, such as a change in farming enterprise (**Figure 1**), rather than structural modification to farm buildings, facilities or machinery, following disability. Exiting dairy and tillage enterprises, in particular, can have implications on the family farm income (FFI), as these enterprises have traditionally been the most profitable in recent years. In 2001, the NFS identified that farms reporting farm operator disability experienced lower FFI (€24/hectare) relative to non-disability farms (**Table 1**). Declining farm returns in recent years have forced many farm operators to engage in off-farm employment (OFE). Farm operators reporting disability, however, report a lower incidence of OFE relative to the total farm population (9.1% vs. 42% [NFS,2006]), with almost one in five farm operators ceasing OFE following the acquisition of disability. Discontinuation of OFE can further precipitate FFI decline, but it can also place additional pressures on the farm business to provide sufficient returns to maintain an adequate standard of living. In such circumstances, the availability of quality services/supports to assist farm operators is essential for farm sustainability.

The provision of services/supports to farm operators reporting disability is, however, largely insufficient across the entire service/support spectrum, from when farm operators first experience disability right through to retirement (**Figure 2**). Current service/support provision often leads to frustration, as family members have to make considerable personal sacrifices to keep the farm functional. One farm operator reporting disability expressed his frustration when he stated:

"I spent 10 months in hospital in Dublin. My son gave up his job to look after the farm as my wife spent a lot of time with me. He had to return to work, as I could no longer afford to pay him the minimum wage to meet his own commitments. I feel that farmers in my position get no assistance from any organisation. We are left to muddle away as best we can."

In light of service/support inadequacies, farm operators experiencing disability may be forced to exit farming. With an increasing age profile in modern-day agriculture, this is particularly unfortunate. Disability has traditionally been perceived as a problem associated with old age, yet this study found that the average age of farm operators experiencing disability was only 52 years, with 82% below the age applicable for the Early Farm Retirement Scheme when disability was first experienced (mean=39 years).

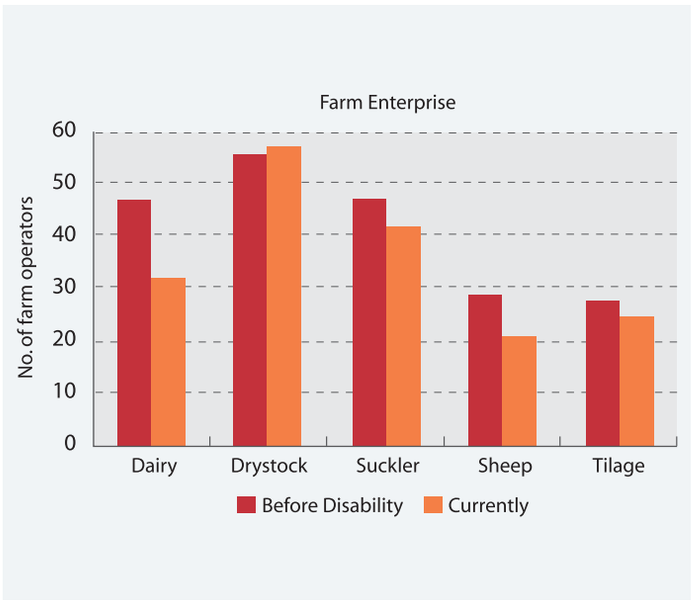


Figure 1: Distribution of farm enterprise type engaged by farm operators before and after experiencing disability. (n=95). Note: respondents can be entered across more than one enterprise type as Figure 1 does not infer specialist farming enterprises as per NFS.

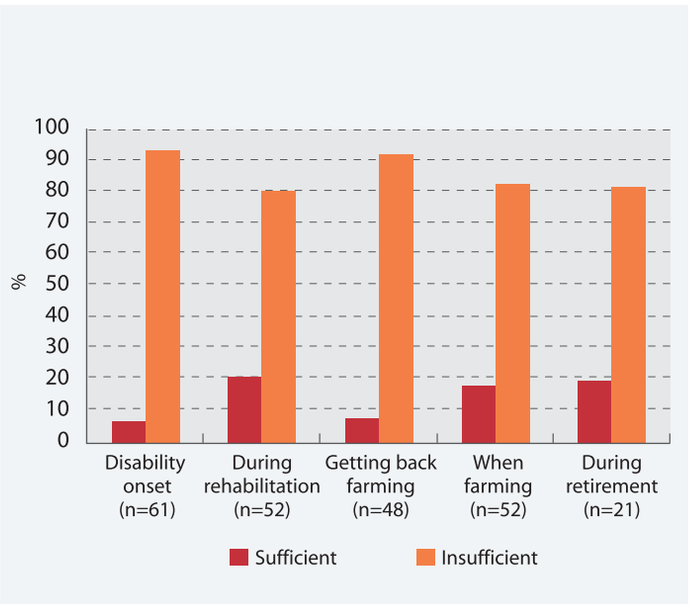


Figure 2: Perceived sufficiency of services/supports provided to farm operators reporting disability.

Conclusion

Farm operators experiencing disability experience the same external pressures as all farmers, but they may also require additional assistance following disability acquisition so that they can identify strategies that will allow them to continue farming and obtain an adequate standard of living. With a personal determination to continue farming, coupled with an adequate support system, many farm operators adjust following disability and are among the most progressive farm operators in operation. Others, however, while having the same personal desire to continue farming, may not have the required resources or support networks and, as a result, may experience considerable difficulties. Appropriate quality services/supports need to be available in such circumstances, so that these farm operators can reach their full potential and continue successfully in production agriculture.

Table 1: Business parameters on farms reporting disability and on farms not reporting disability in 2001.

	Farm operator with disability	Farms where disability was not reported
Family Farm Income (FFI) (€)	13,733	16,162
Size of farm (ha)	31.7	35.3
FFI per ha (€)	433.7	457.8
Total farm gross margin (€)	26,148	31,383

Source: McNamara et al., *2007.*

References and further reading

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Shane Whelan is a Teagasc Walsh Fellow based at Teagasc Rural Economy Research Centre (RERC), Kinsealy, and the School of Agriculture, Food Science and Veterinary Medicine, University College Dublin. E-mail: shane.whelan@teagasc.ie.

The current Walsh Fellowship is being conducted under the supervision of Dr Dermot Ruane (UCD), John McNamara (Kildalton College, Teagasc), Anne Kinsella (Teagasc RERC, Athenry) and Dr Angela McNamara (National Rehabilitation Hospital).

Situation and outlook for Irish agriculture

The Rural Economy Research Centre held its annual 'Situation and Outlook' conference in Dublin in December 2007. ANNE KINSELLA, Rural Economy Research Centre, Athenry, summarises the main presentations.

Irish farmers faced mixed fortunes in 2007. Dairy and tillage farmers will remember 2007 as the year when the prices of milk and cereals turned the corner. With market prices for beef and lamb remaining almost static, drystock farmers did not fare as well. All farmers, but especially pig and poultry producers, incurred higher input prices, especially for concentrates and energy. The Nitrates Directive, REPS, cross compliance and good farming practice have resulted in increased farm investment. Research by production economists from the Rural Economy Research Centre provided key indicators of performance at aggregate and enterprise level at the recent 'Situation and Outlook in Agriculture 2007/2008' conference. The financial performance of the main farm enterprises was examined, mainly using National Farm Survey (NFS) data, with estimates provided for the current year and forecasts for the coming year. The outlook and forecasts for the dairy, beef, sheep and tillage sectors in 2008 will be critical to making informed planning decisions for the short to medium term. Accurate and up-to-date data on agricultural outputs, inputs and policy changes are required by farmers, farm planners and the agribusiness sector in planning their business, while income estimates for 2007 provide a base for production intentions in 2008.

Farm incomes 2006 (Liam Connolly, Anne Kinsella and Brian Moran)

The NFS showed that average Family Farm Income declined to traditional levels in 2006, following a boost in 2005 that was due to increased Direct Payments (DPs) arising from an administrative overlap in the shift to the Single Farm Payment (SFP). Average farm income declined from €22,500 in 2005 to €16,700 in 2006, which was still 7% above 2004 levels. Farm income on full-time farms was €34,500 and on part-time farms was €7,900. Dairy farms account for almost 60% of full-time farms. DPs accounted for one-third of farm output and 98% of farm incomes in 2006. Farmers are continuing to invest in their farms, with average net new investment estimated at €5,989 per farm in 2006, which is broadly similar to the previous year. On 58% of all farms the farmer and/or the spouse had an off-farm job, while on 82% of farms, the farmer and/or spouse had another source of income – employment, pension or social assistance.

Total production costs on dairy farms in 2007 are expected to be up about 3% on 2006.

Investment in agriculture 2007/08 (Liam Connolly, Michael Cushion and Gerry Quinlan)

Teagasc carried out a survey on the NFS sample to determine farmers' actual investment expenditure in the current year (in this case 2007) and to ascertain farmers' investment intentions for the coming year (2008). Results are compared to investment plans at the same time last year, i.e., planned investment for 2007 versus planned investment for 2008. In late 2007, over 32,540 farmers stated that they planned to invest an average of €34,500 per farm in 2008, giving a total investment of €1,124m. Last year's survey results showed a total investment of €1,154m.

Farm buildings accounted for the bulk of planned farm investment in both years, but there was a decline of €30m, or 3%, in total planned investment in 2008 compared to 2007. Planned investment in farm buildings in 2008 was €912m, or 81% of total investment, showing a decline of €36m on that planned for 2007.

Dairy farmers accounted for the bulk of planned investment (54% in 2008 and 48% in 2007), with the cattle systems accounting for 26% and 31% in 2008 and 2007, respectively. Actual farm investment seldom turns out as planned, and in 2007 the actual investment by farmers was higher than planned, i.e., farmers actually invested a total of €1,390m, while planned investment for 2007 was €1,154m.

Dairying 2007/08 (Trevor Donnellan, Thia Hennessy and Paul Smyth)

Milk prices reached almost 40 cent per litre in September and the average price for 2007 is estimated to be approximately 32 cent per litre, more than 25% higher than the average 2006 price. Feed costs increased considerably in 2007, but the volumes fed were down on the previous year. Total production costs on dairy farms in 2007 are expected to be up about 3% on the 2006 levels. With substantial increases in milk price and only marginal increases in costs, net margins on dairy farms are expected to increase from 7 cent per litre in 2006 to almost 13 cent in 2007, an 85% increase. The outlook for 2008 remains positive, albeit not as good as 2007. Butter and powder prices have already begun to fall in recent months. Supply is expected to respond to recent high prices, with supply growth forecast for both the US and New Zealand. Furthermore, it is increasingly likely that the EU milk quota will increase by between 2 and 3% next year. It is estimated that milk prices will fall by about 7% in 2008. Feed prices are expected to stabilise, but energy, fuel and fertiliser costs are all expected to increase in 2008, pushing production costs up 4% relative to 2007. Net margins for 2008 are estimated to be 10 cent per litre, an approximate 23% decline on the current year, but up 40% on the 2006 levels.

Cattle 2007/08 (Liam Dunne)

For over a decade, both the level and stability of cattle enterprise margins were becoming increasingly dependent on DPs. The decoupling of the animal-based DPs in 2005 greatly increased the transparency of the margins that cattle farmers derive from the market. It was only in 2007 that the full significance of the scale and vulnerability of this margin became obvious. An administrative overlap for DPs in 2005 resulted in the inclusion of the final portion of the 2004 coupled payments, and a consequential increase in cattle enterprise margins for that year. Increases in cattle prices in 2005 and 2006 further masked both the scale and volatility of the historically poor market-based margins. Since decoupling, a significant realignment of cattle cohort prices has occurred, as the capitalised value of the animal-based DPs was 'washed out' from the prices of young animals. This had a negative impact on the margins for cattle breeders but a positive effect on the margins for farmers involved in cattle finishing. 2007 was the first year since decoupling in which Irish cattle farmers were fully released from the knock-on impacts of animal-based DPs, but simultaneously experienced a year-on-year decline in cattle prices. The overall impact is an estimated decline in excess of 10% on the rather modest (market) margin of €230 per hectare achieved by farmers in the NFS in 2006. Due to the continued turbulence in commodity prices and exchange rates, forecasting cattle margins is particularly problematic. A recovery in cattle margins to about the 2006 level is anticipated for 2008, driven by the combination of an increase in cattle prices and realignment of the input mix in response to changing costs.

T Economics

A combination of high weaning rates and good stocking rates is essential.

Increased production is likely to lead to a reduction in Irish cereal prices in 2008.

Sheep 2007/08 (Anne Kinsella)

The decline in the national sheep flock is accelerating, declining to 35,277 flocks in 2006, a 33% decline since 1993. Average flock size was 102 ewes in December 2006. Although numbers have been falling, they do not indicate any consolidation in the sheep sector, or any shift to larger, more commercial flocks. Some 44% of flocks have less than 50 ewes, while the number of large flocks fell slightly. Since 2000, the size of the Irish breeding flock has fallen by 1.27 million head. The resultant de-stocking owing to the SFP introduction may lead to less efficient farmers leaving the system and so prove beneficial in removing poorer quality stock, as farmers focus more on breeding potential.

Gross margins for both early- and mid-season lamb producers are estimated to increase in 2007 and the forecast for 2008 is a slight increase for mid-season producers, while early lamb gross margins will remain relatively static. Gross margins for the Hill-Blackface system will remain relatively static for 2007 and 2008. A combination of high weaning rates and good stocking rates is essential to achieving acceptable returns. This is supported by NFS data on the top third of mid-season lamb producers. This group of producers are performing well, with gross margin per hectare of €785, compared to an average of €380, but even this group still have considerable scope to improve their weaning and stocking rates. The top third of mid-season producers have a weaning percentage of 136 and are producing 300kg of lamb carcass per hectare. In the long run, the lamb trade must reach or go beyond the €100/head threshold if business is to be viable at farm level.

Tillage 2007/08 (James Breen and Fiona Thorne)

The prices received and gross margins earned by Irish cereal farmers in 2006 were up on the 2001-2005 average. Market reports indicate that 2007 cereal prices in Ireland were up on 2006 prices by between 65 and 75%. This increase in Irish cereal prices is due to a variety of factors, some national but predominantly international. These factors include the recent reduction in global ending stocks; world wheat ending stocks in 2006 were 15% below the 2004 figure. Demand from US bio-ethanol producers has increased by over 350% from 2001 to 2007. Production in Australia has been seriously affected by drought and forecasted production for the coming harvest has been reduced significantly. These factors have combined to increase world demand and, as a result, world prices have increased. While, on the domestic front, the area of Irish cereals produced over the past three years has been running about 6% below the average area for 2000-2004, the price increases have increased gross margins per hectare in 2007 for Irish cereal crops; for example, winter wheat gross margins in 2007 are estimated to be approximately 60% higher than in 2006.

However, increased production is likely to lead to a reduction in Irish cereal prices in 2008, with prices forecast to be 20% below their 2007 level. This is still 40-50% higher than in 2006 depending on the crop type. Furthermore, direct costs are expected to increase significantly and seed prices are estimated to increase by over 20%. Fertiliser, energy and oil prices are also expected to increase. With the increase in direct costs and decrease in prices, 2008 gross margins per hectare are forecast to be similar to those earned in 2006. The higher prices and gross margins earned in 2007 may lead to land price inflation. However, given the forecasted reduction in prices, and increase in total direct costs for 2008, any inflation in land rental values could seriously undermine farm profitability.

This article was co-authored by (clockwise from top left) **James Breen** (economics of cereal production), **Liam Connolly** (farm incomes and farm investment), **Dr Liam Dunne** (economics of beef production), **Dr Thia Hennessy** (economics of dairying), and **Anne Kinsella** (economics of sheep production), production economists in the Rural Economy Research Centre. The names given in individual sections are the researchers that carried out the work in these areas.
E-mail: anne.kinsella@teagasc.ie.





T Comment

Buffers and stress tests

LIAM DUNNE argues that there is a compelling case for grain-exporting nations to agree that a minimum global grain stock be maintained as a buffer against market volatility.

Buffers are useful mechanisms for dampening fluctuations, while stress tests measure the sensitivity of the fluctuations to external pressures. Both are useful tools for muffling the impact of volatile changes. Various types of buffers and stress tests are a normal part of the business activities of farmers, bankers, scientists and engineers. With the recent volatility in the world food markets, perhaps buffers and stress tests should also play a greater role in the future collective armoury of policy makers, consumers and taxpayers.

Traditionally, farmers used a mix of enterprises to provide a buffer against individual product price fluctuations, and thereby reduced the need for stress testing their incomes in response to a sudden change in the price of an individual crop or animal product. Over the years the incomes of Irish farmers have been greatly increased through commercialisation, specialisation and increased scale. However, this has also increased their income exposure to the consequences of market volatility for both product prices and input costs, especially concentrate feed.

Market volatility

The EU shift to freer trade over the last decade has further exposed the market component of Irish farm incomes to international commodity price fluctuations. This exposure became particularly evident for Irish dairy and cereal farmers in 2007. Fortunately, on that occasion, it was a sharp if sudden increase in prices, rather than an unwelcome price reduction, which will undoubtedly arise in the future. In recent months various explanations for the unexpectedly large price increases have been advanced. These included a combination of the ongoing shift to western-type diets in China, the diversion of grain to bio-energy production in the US, and drought in a number of the larger grain-producing countries, like Australia.

It is highly improbable that ongoing shifts in human diets and bio-energy manufacture and use could occur in a matter of months. Furthermore, even allowing for the many technological advances in farming over the years, large-scale droughts in some regions of the world and their food supply consequences are still a fairly routine occurrence.

While many of the supply and demand factors outlined above are to some extent involved in the current market volatility, perhaps they are only the more obvious symptoms in the current fog in market developments. Could there be a more fundamental cause for sudden and sharp increases in grain and milk prices?

Buffering capacity

Over the last decade there has been a gradual world shift to freer trade and this greatly eroded the volume of publicly financed buffer stocks that were traditionally available in more protected markets. While the added demand for grain from China and for bio-energy fuel were largely predictable and planned, the price impact of a significant reduction in weather-induced supplies was essentially underestimated, especially since it was combined with much reduced buffer stocks.

The ripple effect of this sudden and sharp increase in grain prices has affected concentrate feed prices and the economics of intensive livestock farming, such as pigs, poultry, intensive grain-fed dairying and cattle production. This will ultimately result in reductions in the supplies of these products and later cause an increase in their prices. But the response time and the amplification of the level of response will vary from product to product, reflecting both the production structure and the inherent biology of individual crop and livestock systems.

Livestock farmers who can afford to absorb the short-term income losses will eventually benefit from the increase in prices that results from the commodity shortages arising from the reductions or even liquidations of some herds. Unchecked, this cycle of booms and busts could continue unabated and, as past experience indicates, it is often augmented by speculators attempting to obtain short-term benefits from opportunistic gains in volatile food markets.

Meanwhile, consumers must absorb increases in food prices, which they are then likely to seek to recover through higher wage demands, thus feeding into cost increases in the economy in general. There will be many individual gains and losses but, ultimately, there is little overall inherent merit in volatile food markets.

Income protection

In the pre-CAP reform era, short-term fluctuations in consumer food prices and the incomes of Irish farmers were protected by the EU market-support system. This system of import levies and export subsidies (which was occasionally reversed when needed), combined with intervention purchases, mitigated the upward and downward effects of the volatility in world food commodity prices.

The EU shift to freer trade has greatly reduced this level of market and market-related income protection. Therefore, the prices received by Irish

T Comment

farmers can now fluctuate in response to world markets and, fortunately on this occasion, it is an upward price movement. Furthermore, as past experience in both the beef and milk sectors shows, once EU intervention stocks are dissipated, the prices received by farmers in Ireland move upwards to a greater extent than those of other member states.

Therefore, in the present market circumstances, Irish dairy and cereal farmers are benefiting from this twin price impact. But for how long will it last? Replenishing world grain stocks usually requires two to three good grain harvests, but during this period grain prices tend to fluctuate considerably in response to weather patterns and crop yield forecasts. In the past, the speed of rebalancing of the market was often facilitated at the expense of the dissipation of a portion of the livestock herd, especially in the centrally planned countries.

The need to dissipate the livestock herd to save on expensive grain imports and hard currency may now not arise in the oil-rich countries. Consequently, it may take longer to rebuild international grain stocks.

For Irish farmers, this could provide a longer window before prices revert towards their previous levels. However, farmers need to be very cautious about future commodity prices if they are planning a major investment in production capacity. Where a large investment is being undertaken by individual farmers, stress testing the outcome is a prerequisite to prudent planning and management.

This is particularly the case on farms where all or most of the household income is derived from farming, as there is no alternative income buffer should prices decline sharply.

The four Fs

From an international perspective, the rebuilding of buffer stocks assumes an added urgency. Since cereals are the basic world food source, the erosion of grain stocks has very serious economic and even ethical consequences. It brings the price competition between their alternative uses into sharp focus as:

- human **food**;
- animal **feed**;
- bio-energy **fuel**; and,
- land use competition with **fibre** products, including forestry.

There are serious differences in the capacity of each of the first three market segments to pay for the higher prices arising once supplies are limited. In essence, the poor man's predominantly cereal-based food diet is a very weak competitor for the rich nations' capacity to pay extra for cereals to feed their pigs, poultry, dairy cows and cattle, much less their bio-energy fuel needs, especially in a period when mineral oil prices are also increasing. The fundamental question is, can the four Fs be accommodated in a more balanced market mechanism?

Reserve buffer

Production records show that there can be large annual weather- and disease-induced swings in the size of grain crops in most of the major grain-producing and -exporting nations: China, Russia, the US, Canada, Australia, Argentina and the EU.

Economists generally argue that the market is the most efficient method of rectifying imbalances between supply and demand and, in a free and open market, any impending imbalances between supply and demand should normally be signalled and reflected well in advance through futures trading and related price movements. Furthermore, economists consider crop or income insurance the most efficient option for protecting farm incomes from extreme market price volatility for both their outputs and inputs. However, recent experience suggests that the futures market was rather slow and deficient in responding to the consequences of the gradual rundown of buffer stocks and the impending market imbalances for both grain and milk.

Alternatively, the economic and social impact of extreme volatility in annual grain supplies could be greatly reduced through the use of adequate buffer stocks, but these are, of course, expensive to finance and maintain on an ongoing basis. Since the main beneficiaries from the shift to freer trade in agricultural and non-agricultural products are the major grain-exporting countries, most of which are in the first world, it is reasonable to expect that they should be primarily responsible for the financing of such stocks.

A recent international meeting of central bankers agreed arrangements to stabilise currency exchange rates and general trading arrangements. Similar international schemes exist in relation to minimal reserve oil stocks. Is it too much to request that an equivalent arrangement be established for a much more fundamental and essential commodity like food?

For example, individual countries could contribute financially towards an internationally agreed minimum global reserve grain buffer, the cost of which might be allocated via some mechanism related to their share in production, consumption and trade of the four Fs outlined earlier. To minimise cost, the actual buffer stocks might be stored in the lowest cost country, but financed by an agreed international fund. The resulting reduction in food market volatility would be beneficial to both food producers and consumers.

Since most countries are now part of the WTO, and the aim of this organisation is to facilitate freer trade, why not have the creation, management and financing rules for the minimum world grain buffer stock part of the next WTO agreement? Also, the actual day-to-day management of these buffer stocks and related finances, plus physical storage, could be operated through a mechanism similar to those currently used for carbon trading.

Apart from the social and ethical benefits of reducing the extreme volatility of world grain prices, a grain buffer that stabilises grain and food prices also helps to stabilise farmers' output prices and related input (feed) costs, general wage demands and knock-on cost increases in industry and society in general.

Dr Liam Dunne is a Principal Research Officer in the Rural Economy Research Centre, Teagasc Kinsealy.
E-mail: liam.dunne@teagasc.ie.

T Events

Science Events

February

14 February — *Green Isle Hotel, Naas Road, Dublin*

National Potato Conference

Marking the 'International Year of the Potato', special emphasis will be placed on the marketing and nutritional value of the potato at the conference. Topics covered will include: an international marketing perspective; the nutritional benefits; weed control; brown rot disease in Ireland; and, an industry debate on 'The Potato in Ireland'. There is also a potato cooking demonstration by award winning chef Neven Maguire.
michael.hennessy@teagasc.ie
www.teagasc.ie

19 and 21 February — *Spring Hill Hotel, Kilkenny (19); Athlone Springs Hotel (21)*

National Sheep Conferences

All the major players in the sheep industry, and an international expert on sheep breeding, will outline the way forwards to profitable and sustainable sheep farming.
michael.p.mchugh@teagasc.ie

22 February — *Clayton Hotel, Galway*

National Rural Development Conference

Entitled 'Embracing Change', the core themes of the conference are: key drivers of rural change and Teagasc's response; investigating change through research; how Teagasc and other stakeholders are responding to change with advice, training and support; future rural development challenges; and, critical issues for rural communities.
marian.moloney@teagasc.ie or register online at
www.teagasc.ie/events/2008/ruraldevconf/

24-27 February — *Falls Hotel, Ennistymon, Co. Clare*

Farming for Conservation – Supporting the Future

With eminent national and international speakers, this three-day international conference will present case studies in 'farming for conservation', field trips to areas where this practice is being undertaken, and will look at potential models for supporting and delivering farming for conservation.
Tel Conference Connections: 065-6825700
www.burrenlife.com

28 February — *Ashtown Food Research Centre, Dublin 15*

Fruit for the Nation

This workshop will address some of the approaches needed to deliver high quality fruit and fruit products at lower prices using consumer driven and responsive supply chains. It will focus on the role of fruit in promoting good health and identify opportunities for improving production and distribution practices.
www.relayresearch.ie

29 February — *National Botanic Gardens, Glasnevin, Dublin 9*

AGMET Conference

AGMET is the joint working group of applied agricultural meteorology. This year's conference in entitled 'Harnessing the Irish climate for energy' and will explore wind energy, bioenergy, marine renewable energy and solar energy. Postgraduate and post-doctoral researchers will also make oral and poster presentations in the areas of climate and energy.
sarah.oreilly@met.ie
www.agmet.ie

March/April

6 March — *The Westbury Hotel, Dublin 2*

International new products forum

This forum will provide a showcase of innovative new food and drink products from around the world.
www.leatherheadfood.com/inpf

12 March — *Veterinary Science Centre, UCD*

Pathogenic *E. coli*: threat, prevalence and detection

This workshop will be of interest to food safety researchers, public health professionals, microbiologists and QA staff in the agricultural and food industry.
info@relayresearch.ie
www.relayresearch.e

12 and 13 March — *Tullamore Court Hotel, Tullamore, Co. Offaly*

Agricultural Research Forum

Professor Patrick Cunningham, Chief Scientific Adviser to the Government, will deliver a keynote address on the topic of science policy. This meeting presents new scientific information relating to agricultural science (including animal and crop science, molecular biology and biotechnology), environmental and soil science, food science, agri-economics and forestry. The forum provides an opportunity for scientists, specialists, advisers and others working in the above areas to interact and exchange views.
michael.diskin@teagasc.ie
www.agresearchforum.com

27 March to 9 April — *Teagasc colleges*

Careers Open Days

See website for details. *www.teagasc.ie*

May

1 May — *Johnstown Castle, Wexford*

Slurry Open Day

The morning will see the launch of the new 'Green Book' for nutrient advice, which has been updated in line with the latest research findings and changes in legislation, including the Nitrates Directive. In the afternoon there will be information for farmers and advisers on nutrient management, including a live demonstration of splash plate/trailing shoe machines for slurry application and the effects of these machines on grass quality.
stan.lalor@teagasc.ie

8 May — *Grange Beef Research Centre*

Grange Beef Research Centre Open Day

edward.oriordan@teagasc.ie
www.teagasc.ie

30 May — *Dublin Castle*

Teagasc 2030 International Foresight Conference

This conference will celebrate 50 years of agricultural and food research, and present the results of the Teagasc Foresight exercise. With a panel of eminent international speakers, the keynote address will be given by Dr Gale Buchanan, Under-Secretary for Research, Education and Economics, United States Department of Agriculture.
eilish.cray@teagasc.ie
www.teagasc.ie

June

20 June — *Teagasc, Athenry*

FarmFest 08

Teagasc's major outdoor event of 2008. FarmFest 2008 will particularly focus on emerging areas such as food, sustainability and the environment, and REPS. All the main farm enterprises will be featured, including bioenergy, forestry, artisan foods, tourism, sports horses and organic farming.
michael.diskin@teagasc.ie
www.teagasc.ie

August

5-9 August — *University College Dublin*

42nd Congress of the International Society for Applied Ethology

The ISAE provides technical evidence on topics relating to animal behaviour and animal welfare, contributing to policy and regulations at national, European and international level.
laura.boyle@teagasc.ie
www.isae2008.com

24-27 August — *University College Cork*

International Agricultural Biotechnology Conference

The theme for this year's conference is 'Agricultural biotechnology for a competitive and sustainable future'. The conference is the largest agricultural biotech conference in the world and provides a unique opportunity for Irish academia and business sectors to discuss the issues, options and challenges being met by the biotechnology industry.
Tel: 01-2062900
info@platinumone.ie
www.abic.ca/abic2008.html

Leading the knowledge-based development of Ireland's Farming and Food Industry

Teagasc, the Agriculture and Food Development Authority, generates and applies new knowledge for the sustainable development of agriculture and the food processing industry to enable it to respond profitably to consumer demands and requirements and contribute to a vibrant rural economy and society.

Through the continuing development of Centres of Excellence in biotechnology, Teagasc will implement new research strategies based on scientific excellence, to underpin the long term knowledge needs of the agri-food industry.

Teagasc research science focuses on:

- Enhancing competitiveness through innovation in sustainable agricultural production and the food-processing sector
- Strengthening our capacity in molecular biology and gaining an increased understanding of living organisms with a view to increasing their application in the agri-food industry
- Providing sound scientific basis for decision-makers in protecting the integrity of the food chain, protecting the rural environment and addressing the concerns of the consumer
- Analysing and projecting the impact of policies for the agri-food sector
- Nourishing links with academic institutions through the Walsh Fellowship Postgraduate Programme

To deliver our ambitious scientific programme,
Teagasc needs to continuously attract and recruit the best and brightest people.

Details of opportunities are available on
www.teagasc/careers.ie

NDP
National Development Plan 2007 - 2013
Transforming Ireland

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