





## Herd health

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## Animal Health Ireland

### Herd health prompts concern over international competitiveness

More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

**Irish Farmers Journal (Animal Health Supplement), 15 March 2008**

Health problems adversely affect both on-farm profitability and international competitiveness. Farmers with high SCC problems can lose €10-40K each year, primarily through reduced production and increased culling costs. The UCD Herd Health group recently calculated losses of €140K/year on one farm in Leinster. However, international competitiveness is the greater concern, as it affects on-farm profitability in the longer-term. International competitiveness is affected by both standards (what farmers are required to do) and quality (what farmers achieve). In the area of animal health, standards in Ireland are high, but quality is variable. Quality is a relative term, and Ireland's performance must, and will, be judged against the performance of key competing nations. A range of issues have been addressed (or are now being tackled) by key competitors, including mastitis, fertility, lameness, Johne's disease, IBR, BVD etc.

What is herd health? It concerns the development and implementation of national and on-farm strategies to address specific herd health challenges; those issues that are likely to impact on on-farm profitability and international competitiveness in 5 to 10 years time. The critical ingredients to success include long-term planning, commitment, national cooperation, long-term funding and the best-available technical advice. It is much more than just laboratory testing and vaccination, although these may play a role in some issues.

Health problems (for example, mastitis, fertility, IBR, BVD, Johne's disease) are issues for industry (farmers, processors), not government. In a modern society, the role of government is to support public goods and services (hospitals, schools, the gardai, public transport links etc), which are institutions available to all and funded through compulsory taxation. The benefits from improved herd health will mainly flow to industry rather than the general public.

Herd health is being proactively addressed in a number of countries (particularly in northern Europe and Australasia), with important lessons for Ireland. These countries each have whole-of-sector organisations (such as the Swedish Dairy Industry, the Dutch Dairy Board, Dairying Australia, Meat and Livestock Australia) with broad-ranging national responsibility for national development, policy, animal health, national and international marketing, research etc. Each of these organisations is run and funded by industry, generally through an annual levy on farmers and processors. Government's role (including funding) in these sectors is very limited; under international law, they are obliged to play a regulatory role, and in several countries also contribute in the area of research. These organisations are leading international efforts in innovative, successful herd health programmes. For example, Sweden and Denmark have virtually eradicated BVD, with Switzerland now following suit. The Danes, Dutch and Australians have each been tackling Johne's disease (JD) for the last 10-15 years, and from 2011 the Dutch Dairy Board will no longer pick up milk from high-risk JD farms. Costing the industry approximately €10 million in 2008, this strategy is being taken to enhance the international competitiveness of Dutch dairy product into the future, particularly with infant formula. Dairy Australia has supported the development and operation of national programmes to address mastitis (Countdown Downunder) and fertility (InCalf) concerns, with considerable success.

Ireland cannot keep up with international progress in product quality, unless it moves to address a range of health concerns. There are a broad range of issues to address, including the fragmented nature of industry, long-term industry funding, structures to support long-term planning and implementation, etc. Over the last four years, there have been discussions about the establishment of a national herd health initiative, but progress has been slow. We need to act soon, to maximise both the standards and quality of livestock products from Irish farms into the future.

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## A case for increased private sector involvement in Ireland's national animal health services

More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

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Non-regulatory animal health issues, such as Johne's disease, infectious bovine rhinotracheitis (IBR) and mastitis will become increasingly important, with ongoing globalisation of markets in animals and animal products. In response, Ireland may need to broaden the scope of its national animal health services. However, there have been concerns about the respective roles and responsibilities (both financial and otherwise) of government and industry in any such moves. This paper argues the case for increased private sector involvement in Ireland's national animal health services, based both on theoretical considerations and country case studies (the Netherlands and Australia). The Dutch and Australian case studies present examples of successful partnerships between government and industry, including systems and processes to address non-regulatory animal health issues. In each case, the roles and responsibilities of government are clear, as are the principles underpinning government involvement. Furthermore, the roles and responsibilities (financial and otherwise) of the Dutch and Australian industry are determined through enabling legislation, providing both legitimacy and accountability. There are constraints on the use of EU and national government funds to support non-regulatory animal health services in EU member states (such as Ireland and the Netherlands).

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## Setting priorities for non-regulatory animal health in Ireland: results from an expert Delphi Study and a farmer priority identification survey

More, S.J.<sup>1</sup>, McKenzie, K.<sup>2</sup>, O'Flaherty, J.<sup>3</sup>, Doherty, M.L.<sup>4</sup>, Cromie, A.R.<sup>5</sup>, Magan, M.J.<sup>3</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> UCD Geary Institute, <sup>3</sup> Animal Health Ireland, <sup>4</sup> UCD School of Agriculture, Food Science and Veterinary Medicine,

<sup>5</sup> Irish Cattle Breeding Federation Society Ltd.

Agriculture is a very important contributor to the Irish economy. In Ireland, national animal health services have been a government, rather than an industry, responsibility. In 2009, Animal Health Ireland (AHI) was established to provide a partnership approach to national leadership of non-regulatory animal health issues (those not subject to national and/or EU regulation). The objectives of this study were to elicit opinion from experts and farmers about non-regulatory animal health issues facing Irish livestock industries, including prioritisation of animal health issues and identification of opportunities to maximise the effective use of AHI resources. The study was conducted with experts using Delphi methodology over 3 rounds, and with farmers using a priority identification survey. Non-regulatory bovine diseases/conditions were prioritised by both experts and farmers based on impact and international competitiveness. For each high priority disease/condition, experts were asked to provide an assessment based on cost, impact, international perception, impediment to international market access and current resource usage effectiveness. Further information was also sought from experts about resource allocation preferences, methods to improve education and coordination, and innovative measures to improve prevention and management. There was close agreement between responses from experts and dairy farmers: each gave highest priority to 3 biosecure (bovine viral diarrhoea [BVD], infectious bovine rhinotracheitis [IBR], paratuberculosis) and 4 non-biosecure (fertility, udder health/milk quality, lameness, calf health) diseases/conditions.

Beef farmers also prioritised parasitic conditions and weanling pneumonia. The adverse impact of biosecure diseases is currently considered relatively minor by experts, but would increase substantially in time. There are already substantial costs to farms and agribusiness from non-biosecure diseases/conditions. Experts preferred an equal allocation of resources between these biosecure and non-biosecure diseases/conditions, with emphasis on adopting/adapting international models, education and awareness-raising. The results from this study provide robust insights about non-regulatory animal health priorities in Ireland, as perceived by experts and farmers, using methodologies that are both transparent and inclusive. They have already been extremely influential in shaping national policy, as a foundation for interdisciplinary (and multi-agency) cooperation, as a contribution to efforts to encourage stakeholder responsibility-taking, and to ongoing development of postgraduate and undergraduate veterinary education in Ireland.

## Animal Health Ireland: shaping the future of non-regulatory animal health in Ireland through national coordination and partnership

More, S.J.<sup>1</sup>, O'Flaherty, J.<sup>2</sup>, Doherty, M.L.<sup>3</sup>, Downey, L.<sup>3</sup>, McKenzie, K.<sup>4</sup>, Magan, M.J.<sup>2</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> Animal Health Ireland, <sup>3</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>4</sup> UCD Geary Institute

Ireland has made substantial progress in regulatory animal disease control, through a range of government-led national programmes. In contrast, progress on a range of non-regulatory animal health issues have suffered from an absence of national leadership and management. This paper describes the establishment and early activities of Animal Health Ireland, a recently-established organisation that seeks to shape the future of non-regulatory animal health in Ireland through national co-ordination and partnership.

## Food chain control – pre-harvest phase

More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

A global approach is needed, from farm to table, to ensure that food for humans is safe to eat. Controls at the first stage of the food chain, the pre-harvest phase, are a critical part of this broader approach. In this paper, attention is paid to three broad components of food chain control at this stage, including the safety of animal feeds, animal health, and traceability. With each of these components, a range of examples are used to highlight key points.

## Fertility

### Oestrous synchronisation in cattle – current options following the EU regulations restricting use of oestrogenic compounds in food-producing animals: a review

Lane, E.A.<sup>1</sup>, Austin, E.J.<sup>2</sup>, Crowe, M.A.<sup>2</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine

**Animal Reproduction Science 109, 1-16 (2008)**

Oestrous synchronisation is an important strategy to improve reproductive management of cattle. The use of oestradiol-17 $\beta$ , and its related ester derivatives, in food-producing cattle for the purposes of oestrous synchronisation is prohibited in the European Union since October 2006; a serious limitation in the implementation of large-scale use of cost effective synchronisation regimens in both dairy and beef herds. This has obvious consequences within the EU and also in other countries that have restricted the use of oestradiol following the EU ban. Oestrous synchronisation is an important facilitator for the use of artificial insemination, a necessary part of any national herd genetic improvement scheme. Presently, only 35% of the Irish dairy herd is bred by artificial insemination; and facilitation rather than restriction is required to increase this percentage. Ideally synchronisation of oestrus should increase submission rates, improve or at least not affect conception rates, and thus, increase overall pregnancy rate at the end of the breeding season. This should reduce the proportion of cows to be culled. This paper aims to review the oestrous synchrony options available in EU countries and other countries affected by the European ban on oestrogenic compounds being used for oestrous synchrony protocols. Currently, the options available for oestrous synchronisation are generally not as effective, efficient or cost effective as those that incorporated use of oestrogenic compounds.

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### Key factors affecting dairy cow fertility in Ireland

Lane, E. A.<sup>1</sup>, Crowe, M.A.<sup>2</sup>, Wickham, B.<sup>3</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>3</sup> Irish Cattle Breeding Federation Society Ltd.

Reproductive targets must be achieved to ensure long-term economic viability of intensively managed dairy herds. Many studies have highlighted the costs associated with poor fertility. Herd management can be effectively facilitated by use of integrated computerised programmes for fertility, health and production. Large and expanding herds may certainly benefit from use of these computerized packages. The analysis of herd management records allows for accurate assessment of the current status of the herd, a crucial decision making tool to implement effective change. Monitoring of such changes to ensure their effectiveness is essential to the success of any programme, while, participation in discussion groups, allows for peer comparisons, a key factor in motivating herd management change. This programme of work aims to i) evaluate the reproductive efficiency of the national dairy herd utilizing the Irish Cattle Breeding Federation's (ICBF) database, ii) determine the key drivers of lowered fertility in the national herd, iii) correlate production and management strategies with reproductive performance, and iv) monitor the impact of changes in herd management on the reproductive performance of Irish dairy herds.

## Milk quality

### Global trends in milk quality: implications for the Irish dairy industry

More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

**Irish Veterinary Journal 62 (supplement), 5-14 (2009)**

The quality of Irish agricultural product will become increasingly important with the ongoing liberalisation of international trade. This paper presents a review of the global and Irish dairy industries; considers the impact of milk quality on farm profitability, food processing and human health; examines global trends in quality; and explores several models that are successfully being used to tackle milk quality concerns. There is a growing global demand for dairy products, fuelled in part by growing consumer wealth in developing countries. Global dairy trade represents only 6.2% of global production and demand currently outstrips supply. Although the Irish dairy industry is small by global standards, approximately 85% of annual production is exported annually. It is also the world's largest producer of powdered infant formula. Milk quality has an impact on human health, milk processing and on-farm profitability. Somatic cell count (SCC) is a key measure of milk quality, with a SCC not exceeding 400,000 cells/ml (the EU milk quality standard) generally accepted as the international export standard. There have been ongoing improvements in milk quality among both established and emerging international suppliers. A number of countries have developed successful industry-led models to tackle milk quality concerns. Based on international experiences, it is likely that problems with effective translation of knowledge to practice, rather than incomplete knowledge per se, are the more important constraints to national progress towards improved milk quality.

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### Milk quality in Ireland during 2003 to 2007: a critical review of national policy and performance

More, S.J.<sup>1</sup>, Clegg, T.A.<sup>1</sup>, O'Grady, L.<sup>2</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine

Ireland is an important player in the world dairy trade and the world's leading producer of infant nutrition products. This paper presents an overview of national milk policy and of objective measures of milk quality in Ireland during 2003 to 2007. Relevant legislation and legislative enforcement are reviewed. An analysis was undertaken of somatic cell count (SCC) results from all milk-recorded herds in Ireland during 2003 to 2007. Additional data were obtained from unpublished government reports. A high percentage of herds have high SCC results, with results fluctuating seasonally. The percentage of herds defined as 'problematic' is heavily influenced by legislative interpretation. There are a range of factors to consider when addressing these concerns including an increased focus on competitive advantage, a shift in focus from input- to output-based standards, and review of current approaches to national governance of milk quality issues.

## Farm management factors associated with bulk tank total bacterial count in Irish dairy herds during 2006/2007

Kelly, P.T.<sup>1, 2</sup>, O'Sullivan, K.<sup>3</sup>, Berry, D.P.<sup>1</sup>, More, S.J.<sup>4</sup>, Meaney, W.J.<sup>1</sup>, O'Callaghan, E.J.<sup>1</sup>, O'Brien, B.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine,

<sup>3</sup> UCC Department of Statistics, <sup>4</sup> UCD CVERA

**Irish Veterinary Journal 62, 36-42 (2009)**

Research has shown that total bacterial count (TBC), which is the bacterial growth per ml of milk over a fixed period of time, can be decreased by good hygiene and farm management practices. The objective of the current study was to quantify the associations between herd management factors and bulk tank TBC in Irish spring calving, grass-based dairy herds. The relationship between bulk tank TBC and farm management and infrastructure was examined using data from 400 randomly selected Irish dairy farms where the basal diet was grazed grass. Herd management factors associated with bulk tank TBC were identified using linear models with herd annual total bacterial score (i.e., arithmetic mean of the natural logarithm of bulk tank TBC) included as the dependent variable. All herd management factors were individually analysed in a separate regression model that included an adjustment for geographical location of the farm. A multiple stepwise regression model was subsequently developed. Median bulk tank TBC for the sample herds was 18,483 cells/ml ranging from 10,441 to 130,458 cells/ml. Results from the multivariate analysis indicated that the following management practices were associated with low TBC; use of heated water in the milking parlour; participation in a milk recording scheme; and tail clipping of cows at a frequency greater than once per year. Increased level of hygiene of the parlour and cubicles were also associated with lower TBC. Herd management factors associated with bulk tank TBC in Irish grazing herds were generally in agreement with most previous studies from confinement systems of milk production.

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## Farm management factors associated with bulk tank somatic cell count in Irish dairy herds

Kelly, P.T.<sup>1, 2</sup>, O'Sullivan, K.<sup>3</sup>, Berry, D.P.<sup>1</sup>, More, S.J.<sup>4</sup>, Meaney, W.J.<sup>1</sup>, O'Callaghan, E.J.<sup>1</sup>, O'Brien, B.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine,

<sup>3</sup> UCC Department of Statistics, <sup>4</sup> UCD CVERA

**Irish Veterinary Journal 62 (supplement), 45-51 (2009)**

The relationship between bulk tank somatic cell count (SCC) and farm management and infrastructure was examined using data from 398 randomly selected, yet representative, Irish dairy farms where the basal diet is grazed grass. Median bulk tank SCC for the farms was 282,887 cells/ml ranging from 82,209 to 773,028 cells/ml. Two questionnaires were administered through face-to-face contact with each farmer. Herd-level factors associated with bulk tank SCC were determined using linear models with annual somatic cell score (i.e., arithmetic mean of the natural logarithm of bulk tank SCC) included as the dependent variable. All herd level factors were analysed individually in separate regression models, which included an adjustment for geographical location of the farm; a multiple regression model was subsequently developed. Management practices associated with low SCC included the use of dry cow therapy, participation in a milk recording scheme and the use of teat disinfection post-milking. There was an association between low SCC and an increased level of hygiene and frequency of cleaning of the holding yard, passageways and cubicles. Herd management factors associated with bulk tank SCC in Irish grazing herds are generally in agreement with most previous studies from confinement systems of milk production.

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## Spatial trends in milk somatic cell count in the Republic of Ireland from 2003 to 2007

Kelly, P.T.<sup>1,2</sup>, Collins, D.M.<sup>3</sup>, More, S.J.<sup>3</sup>, Berry, D.P.<sup>1</sup>, Cromie, A.<sup>4</sup>, O'Brien, B.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine,

<sup>3</sup> UCD CVERA, <sup>4</sup> Irish Cattle Breeding Federation Society Ltd.

Ireland produces approximately 5,157 million litres of milk annually which was estimated to be worth €1.4 billion to the Irish economy in 2007. However, milk somatic cell count (SCC) has increased in Ireland in recent years with adverse effects on economic returns both on- and post-farm. Mapping technology may assist in a multi-stranded national approach to tackling this issue, enabling policy-makers to identify geographical regions of high SCC, and facilitating the strategic allocation of finite resources, such as extension services. The objectives of this study were to describe the spatial distribution of herd SCC in milk-recording dairy herds throughout Ireland, to examine if these SCC values cluster, and to determine whether there has been a change in the spatial pattern of these SCC values over time. Herd-year geometric mean SCC values were available for 4,314 milk-recording herds during 2003 to 2007. Each herd was assigned an X and Y coordinate (location on map) based on the centroid of the largest farm fragment. A range of mapping and analysis tools were used including point and kernel density and clustering analysis methods. The south of the country had the greatest density of milk recording herds. Approximately 60% of all herds in the study were from four counties (Cork, Kerry, Limerick and Tipperary). There was an increase in the average bulk tank SCC from 110,264 cells/ml in 2003 to 118,782 cells/ml in 2005, followed by a decrease to 108,454 cells/ml in 2007. Between 2006 and 2007 SCC decreased in the northeast, southeast and west of the country and an increased in the south. There was no spatial clustering of high SCC scores (i.e., SCC on one farm was not related to SCC on other farms), consistent with mastitis being a herd- as opposed to an area-based problem.

## The relationship between somatic cell count and parity, stage of lactation, month of calving and age of calving

Kelly, P.T.<sup>1,2</sup>, More, S.J.<sup>3</sup>, Berry, D.P.<sup>1</sup>, O'Brien, B.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>3</sup> UCD CVERA

Grazed pasture constitutes the basal diet of dairy cows in Ireland, with 66% of dairy cows calving between February and April. There is a gap in knowledge of cow factors associated with SCC in a grass based production system. Thus, the objective of the current study was to investigate how SCC differs across parity, stage of lactation, month of calving and age at calving centred within parity within a seasonal calving system where cows are at pasture for the main part of the year. A total of 506,517 test day records from 740 milk recorded herds between 2002 and 2005 were used in this study. Differences in SCC among the factors under investigation were determined using mixed models with cow included as a random effect. The first 305 days post-calving were divided into ten stages of lactation in 30 day increments starting at 5 days in milk (DIM). SCC increased with parity from 97,000 cells/ml in parity 1 to 199,000 cell/ml in parity 6 which could be due to an increased risk of infectious pathogens entering the udder and causing mastitis. SCC decreased between the period 5 to 35 DIM and 36 to 65 DIM, and increased thereafter. The rate of increase in SCS from mid to late lactation was greatest in older parity animals. Cows calving in the months of January and September had lower average SCC. The results from this study can be used in the development of strategies and decision support tools to help benchmark and predict SCC in grass based seasonal production systems.

## Association between milk somatic cell count and cow milk yield for different cow parities in a grass based system

Kelly, P.T.<sup>1,2</sup>, O'Sullivan, K.<sup>3</sup>, Berry, D.P.<sup>1</sup>, More, S.J.<sup>4</sup>, O'Brien, B.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine,

<sup>3</sup> UCC Department of Statistics, <sup>4</sup> UCD CVERA

Subclinical mastitis is one of the most costly diseases of dairy cattle. The cost of this problem may have been over-estimated in the past, as a consequence of the dilution effect of milk yield on somatic cell count (SCC). Some adjustment for the effect of dilution has recently been made, but without considering differences between parities. There are three objectives in the current study: 1) to investigate the association between SCC and milk yield within a seasonal grass based production system, 2) calculate the dilution estimates for each individual parity and 3) use these dilution estimates to investigate the dilution effect of milk yield on SCC. A total of 235,163 test day records from 23,791 cows in 366 Irish milk recorded herds between the years 2003 and 2005 were included in analysis. The association between SCC and milk yield was investigated using two models: 1) the association between both SCC and log<sub>e</sub> SCC and milk yield was determined, and 2) four dilution estimates were used to adjust SCC to account for the dilution of SCC by milk yield. A negative association was observed between both SCC and log<sub>e</sub> SCC and milk yield. When there was no pre-adjustment of SCC for milk yield, a test day milk loss of 1.43, 2.08, 2.59, 2.56 and 2.62 L was associated with an increase of SCC category from <51 to >400 in parity 1 to 5 animals, respectively. Additionally, two of the dilution estimates had similar trends in milk loss due to SCC to when there was no dilution estimate used. Alternatively, for the pre-adjustment of SCC that multiplied SCC by the mean test day milk yield as a proportion of the test day milk yield, there was an increase in test day milk yield with increasing SCC category. The results from this study can be used to more-accurately calculate the economic implications of SCC.

## The relationship between milk somatic cell counts and herd size in Ireland – a retrospective cohort study

Canty, M.J.<sup>1</sup>, Binns, S.H.<sup>2</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> Consultant veterinary epidemiologist

Mastitis is a multi-factorial disease with a long history and results in the impairment of cow welfare due to pain, and has been recognised as a welfare problem in dairy cows. Typically milk somatic cell counts (SCC) are used as an indicator of udder health reflecting the level of inflammation within the udder. SCCs are one of the most important indicators of milk quality, reflecting not only the health status of the udder, but are also the key component of national and international regulation of milk quality. In 2006, the Irish dairy industry produced 5.2 million tonnes of milk, of which approximately 85% was exported as high quality products. SCCs affect the processing potential of milk. EU Council Directive 92/46/EEC requires that raw milk has SCC < 400,000 cells/ml and dairy products sold within the EU must meet these standards. This project will try to determine the relationship between milk somatic cell counts and herd size in Ireland based on data provided by the Irish Cattle Breeding Federation (ICBF).

## Development of a HACCP-based approach for the control of mastitis in dairy cows

Beekhuis-Gibbon, L.<sup>1</sup>, O'Grady, L.<sup>1</sup>, More S.J.<sup>2</sup>, Whyte, P.<sup>1,3</sup>, Doherty, M.L.<sup>1</sup>

<sup>1</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>2</sup> UCD CVERA, <sup>3</sup> UCD Institute of Food and Public Health

Hazard Analysis and Critical Control Points (HACCP) is a systematic, preventative approach that has been developed to increase levels of product safety assurance and which is now widely applied to the dairy processing as well as the retail and catering sectors. A novel approach based on a deconstruction of the infectious process in mastitis was used to develop a generic HACCP-based system to prevent and control mastitis in dairy herds. The approach involved the creation of an Infectious Process Flow Diagram, which was then cross-referenced to two production process flow diagrams of the milking process and cow management cycle, respectively. The generic HACCP plan developed in this study is suitable for customizing and implementation on specific farms. The approach described, offers the potential of a logical, systematic approach to mastitis control that could be used as a template for the control of other infectious diseases of the dairy cow.

## Evaluation of the implementation of a HACCP-based approach for the control of mastitis on Irish dairy farms

Beekhuis-Gibbon, L.<sup>1</sup>, Devitt, C.<sup>2</sup>, O'Grady, L.<sup>1</sup>, More, S.J.<sup>3</sup>, Whyte, P.<sup>1,4</sup>, Redmond, B.<sup>2</sup>, Doherty, M.L.<sup>1</sup>

<sup>1</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>2</sup> Research consultant, <sup>3</sup> UCD CVERA, <sup>4</sup> UCD Institute of Food and Public Health

As described in an associated paper, a generic HACCP-based programme was developed for the control of mastitis on dairy farms. Subsequently, the programme was customized for, and implemented on, a number of collaborating farms in Ireland, following an initial epidemiological investigation. The aims of the of the present study were to implement customized HACCP-based mastitis control programs on six participating dairy farms, to critically evaluate and obtain feedback from farmers of the actual implementation of the HACCP-based programs, and to obtain sociological insights of farmers into factors associated with the implementation of this program.



*Milking parlour. Photograph by S.J. More.*

## Johne's disease

### Risk factors for the introduction and within-herd transmission of *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection on 59 Irish dairy herds

Cashman, W.<sup>1</sup>, Buckley, J.<sup>2</sup>, Quigley, T.<sup>3</sup>, Fanning, S.<sup>4</sup>, More, S.J.<sup>5</sup>, Egan, J.<sup>6</sup>, Berry, D.<sup>7</sup>, Grant, I.<sup>8</sup>, O'Farrell, K.<sup>1</sup>

<sup>1</sup> Private consultant, <sup>2</sup> Cork County Council, <sup>3</sup> SafeFood, <sup>4</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>5</sup> UCD CVERA,

<sup>6</sup> Central Veterinary Research Laboratory, Department of Agriculture, Fisheries and Food, <sup>7</sup> Teagasc Moorepark Dairy Production Research Centre,

<sup>8</sup> Institute of Agri-Food and Land Use, Queen's University, Belfast, Northern Ireland

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Since 1994, Irish cattle have been exposed to greater risks of acquiring *Mycobacterium avium* subspecies *paratuberculosis* (MAP) infection as a consequence of the importation of over 70,000 animals from continental Europe. In recent years, there has been an increase in the number of reported clinical cases of paratuberculosis in Ireland. This study examines the prevalence of factors that promote the introduction and within-herd transmission of *Mycobacterium avium* subspecies *paratuberculosis* (MAP) on selected Irish dairy farms in the Cork region, and the association between these factors and the results of MAP screening tests on milk sock filter residue (MFR). A total of 59 dairy farms, selected using non-random methods but apparently free of endemic paratuberculosis, were enrolled into the study. A questionnaire was used to collect data about risk factors for MAP introduction and transmission. The MFR was assessed on six occasions over 24 months for the presence of MAP, using culture and immunomagnetic separation prior to polymerase chain reaction (IMS-PCR). Furthermore, blood samples from all entire male and female animals over one year of age in 20 herds were tested by ELISA. Eighteen (31%) farms had operated as closed herds since 1994, 28 (47%) had purchased from multiple sources and 14 (24%) had either direct or indirect (progeny) contact with imported animals. Milk and colostrum were mixed on 51% of farms, while 88% of farms fed pooled milk. Thirty (51%) herds tested negative to MFR culture and IMS-PCR, 12 (20%) were MFR culture positive, 26 (44%) were IMS-PCR positive and seven (12%) were both culture and IMS-PCR positive. The probability of a positive MFR culture was significantly associated with reduced attendance at calving, and with increased use of individual calf pens and increased (but not significantly) if multiple suckling was practised. There was poor agreement between MFR culture and MFR IMS-PCR results, but moderate agreement between MFR culture and ELISA test results. This study highlights a lack of awareness among Irish dairy farmers about the effect of inadequate bio-security on MAP introduction. Furthermore, within-herd transmission will be facilitated by traditional calf rearing and waste management practices. The findings of viable MAP in the presence of known transmission factors in non-clinically affected herds could be a prelude to long-term problems for the Irish cattle and agri-business generally.

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## Demographics of cattle positive for *Mycobacterium avium* subspecies *paratuberculosis* by faecal culture, from submissions to the Cork Regional Veterinary Laboratory

Richardson, E.K.B.<sup>1</sup>, Mee, J.F.<sup>1</sup>, Sánchez-Miguel, C.<sup>2</sup>, Crilly, J.<sup>1</sup>, More, S.J.<sup>3</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> Cork Regional Veterinary Laboratory, Department of Agriculture, Fisheries and Food, <sup>3</sup> UCD CVERA

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The demography of bovine infections caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) in Ireland is poorly defined. The objective of this study was to describe the demographics of cattle positive to MAP on faecal culture, based on submissions to the Cork Regional Veterinary Laboratory (Cork RVL) from 1994 to 2006. The study focused on all available faecal samples from adult cattle with non-responsive chronic diarrhoea that were submitted by private veterinary practitioners to Cork RVL for MAP culture. For each MAP-positive by faecal culture animal, data were collated from Cork RVL and Cattle Movement Monitoring Scheme (CMMS) records. Johne's disease (JD) was confirmed in 110 animals from 86 herds by the Cork RVL between 1994 and 2006, with a rate of positive cases between 15% and 18% over last four years of the study. Two breeds (Holstein/Friesian or Limousin) made up 78% of submissions. Movements were assessed for the 57 study animals with available movement information, 90% died within one year of the test and 26% tested positive in the herd they were born into. The study provides preliminary information about movement trends and demographics of animals with MAP positive submissions. Although the study area is restricted, it includes the most intensive (and economically-important) dairy region in Ireland. The demographics of JD infection from the study area are in agreement with international reports. Further work is required to determine demographic trends, incidence and prevalence of JD throughout Ireland. It is hoped this work may contribute to the development of a surveillance strategy for MAP by regional veterinary laboratories.

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## Direct and indirect effects of Johne's disease on farm and animal reproductivity in an Irish dairy farm

Richardson, E.K.B.<sup>1</sup>, More, S.J.<sup>2</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD CVERA

**Irish Veterinary Journal 62, 526-532 (2009)**

Johne's disease (JD) is caused by infection with the organism *Mycobacterium avium* subspecies *paratuberculosis*, leading to chronic diarrhoea and ill thrift in adult cattle. JD is considered to adversely affect farm performance and profitability. This retrospective case study was undertaken on a single commercial dairy herd in the south west of Ireland. Animal production records were interrogated to assess the effect of JD on milk yield (total kg per lactation), somatic cell count (the geometric mean over the lactation), reasons for culling, cull price and changes in herd parity structure over time. JD groups were defined using clinical signs and test results. One control animal was matched to each case animal on parity number and year. Specific lactations (clinical, pre-clinical and test-positive only) from 1994 to 2004 were compared between JD case and control cows. A significantly lower milk yield (1259.3 kg/lactation) was noted from cows with clinical JD in comparison to their matched control group. Clinical animals had an average cull price of €516 less than animals culled without signs of clinical disease. In contrast, little effect was noted for sub-clinical infections. These direct effects of JD infections, in combination with increased culling for infertility and increasing replacement rates, had a negative impact on farm production. Results from this study provide preliminary information regarding the effects of JD status on both herd and animal-level performance in Ireland.

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## Prevalence and distribution of paratuberculosis (Johne's disease) in cattle herds in Ireland

Good, M.<sup>1</sup>, Clegg, T.A.<sup>2</sup>, Sheridan, H.<sup>1</sup>, Yearsely, D.<sup>3</sup>, O'Brien, T.<sup>3</sup>, Egan, J.<sup>3</sup>, Mullowney, P.<sup>1</sup>

<sup>1</sup> Department of Agriculture, Fisheries and Food, <sup>2</sup> UCD CVERA, <sup>3</sup> Central Veterinary Research Laboratory, Department of Agriculture, Fisheries and Food

**Irish Veterinary Journal 62, 597-606 (2009)**

A simple random survey was conducted in Ireland during 2005 to estimate the ELISA-prevalence of paratuberculosis, commonly called Johne's disease (JD), in the cattle population. Serum samples were collected from all 20,322 females/breeding bulls over 12 months of age in 639 herds. All samples were tested using a commercially available absorbed ELISA. The overall prevalence of infected herds, based on the presence of at least one ELISA-positive animal, was 21.4% (95% CI 18.4%-24.9%). Herd prevalence levels amongst dairy herds (mean 31.5%; 95% CI: 24.6%, 39.3%) was higher than among beef herds (mean 17.9%; 95% CI: 14.6%-21.8%). However, the animal level prevalence was similar. The true prevalence among all animals tested, was calculated to be 2.86% (95% CI: 2.76, 2.97) and for animals  $\geq 2$  yrs, it was 3.30% (95% CI: 3.17, 3.43). For animals in beef herds, true prevalence was 3.09% (95% CI: 2.93, 3.24), and for those in dairy herds, 2.74% (95% CI: 2.59, 2.90). The majority of herds had only one ELISA-positive infected animal. Only 6.4% (95% CI 4.7%-8.7%) of all herds had more than one ELISA-positive infected animal; 13.3% (CI 8.7%-19.7%) of dairy herds ranging from two to eight ELISA-positive infected animals; and, 3.9% beef herds (CI 2.4%-6.2%) ranging from two to five ELISA-positive infected animals. The true prevalence of herds infected and shedding *Mycobacterium avium* subspecies *paratuberculosis* is estimated to be 9.5% for all herd types; 20.6% for dairy herds; and 7.6% for beef herds. If ELISA positive animals  $< 2$ -years-of-age are excluded, the true herd prevalence reduces to: 9.3% for all herd types; 19.6% for dairy herds; and 6.3% for beef herds based on a test specificity (Sp) of 99.8% and test sensitivity (Se) (i.e., ability to detect culture-positive, infected animals shedding at any level) of 27.8-28.9%.

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*Farming in Ireland. Photograph by S.J. More.*

## Genetic variation in serological response to *Mycobacterium avium* subspecies *paratuberculosis* and its association with performance in Irish Holstein-Friesian dairy cows

Berry, D.P.<sup>1</sup>, Good, M.<sup>2</sup>, Mullowney, P.<sup>2</sup>, Cromie, A.R.<sup>4</sup>, More, S.J.<sup>3</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> Department of Agriculture, Fisheries and Food,

<sup>3</sup> UCD CVERA, <sup>4</sup> Irish Cattle Breeding Federation Society Ltd.

**Journal of Dairy Science, in press**

Paratuberculosis, also referred to as Johne's disease, is a contagious and chronic disease in ruminants caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP). Few estimates of the genetic variation in measures of susceptibility to MAP are available in the literature and even less have attempted to elucidate the genetic associations between measures of susceptibility to MAP and performance in dairy cattle. The objectives of this study were to estimate the genetic variation in serological response to MAP in 4,789 Holstein-Friesian dairy cows from 44 Irish dairy herds, and to quantify its genetic association with performance traits measured in the first three lactations of genetically related animals. Univariate mixed linear and threshold animal models were used to estimate variance components and genetic correlations were estimated using bivariate sire linear mixed models; MAP serological response was treated as a continuous variable and dichotomous variable. The prevalence of MAP in the sample population was 4.8%. This figure cannot be extrapolated to the national dairy herd as the sample population was biased towards herds with increased likelihood of MAP infection. Estimates of heritability for MAP serological response varied from 0.07 to 0.14 depending on the model of analysis and whether serological response was treated as continuous or binary; standard errors varied from 0.024 and 0.062. Genetic correlations between MAP serological response and lactation milk, fat and protein yield were negative although not always more than two standard errors from zero; stronger negative genetic correlations were evident in older parity animals. Serological response to MAP was not genetically correlated with milk fat concentration but was positively genetically correlated with milk protein concentration and negatively correlated with calving interval. Positive genetic correlations existed between MAP serological response and somatic cell count but the correlations were not greater than two standard errors from zero. There was little or no genetic association between serological response to MAP and survival. Results from this study corroborate previous international suggestions that selection for reduced serological response to MAP is possible, although this does not necessarily imply a concurrent selection for either reduced prevalence of clinical disease or increased resistance to MAP infection.

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## A case-control study of risk factors for paratuberculosis (Johne's disease) in Irish dairy herds

Barrett, D.J.<sup>1</sup>, Mee, J.F.<sup>2</sup>, Mullowney, P.<sup>3</sup>, Good, M.<sup>3</sup>, McGrath, G.<sup>4</sup>, Clegg, T.A.<sup>4</sup>, More, S.J.<sup>4</sup>

<sup>1</sup> Sligo Regional Veterinary Laboratory, Department of Agriculture, Fisheries and Food, <sup>2</sup> Teagasc Moorepark Dairy Production Research Centre,

<sup>3</sup> Department of Agriculture, Fisheries and Food, <sup>4</sup> UCD CVERA

This paper reports a case-control study of herd and management factors associated with the introduction and transmission of paratuberculosis in dairy herds in Ireland. Data were gathered by telephone interview. Case herds were selected on the basis of having one or more positive faecal cultures for *Mycobacterium avium* subsp. *paratuberculosis* (MAP). Control herds were selected from herds seronegative for MAP in a national sero-survey. Control herds were matched to case herds by the year of diagnosis of MAP in the case herds. Factors relating to disease history, herd size, neonatal feeding and management and grassland management were found to be significant ( $p < 0.05$ ) in the univariate analysis. In the multivariate exact logistic analysis, in comparison to control herds the case herds were more likely to have imported cattle from continental Europe, were more likely to have experienced herd depopulation as a result of a regulatory disease outbreak, and were larger in size. With the imminent abolition of milk quotas in the European Union, many Irish dairy herds will be undergoing expansion. Such herdowners need to be aware of paratuberculosis, and take precautions to avoid its introduction and spread. Herdowners unaware of their infection status need to establish it. Where infection is present, management practices must be put in place to control it.

## Genetic associations between Johne's disease and susceptibility to *Mycobacterium bovis* and *Mycobacterium avium* subsp. *avium* in Irish Holstein Friesian dairy cows

Bermingham, M.L.<sup>1</sup>, More, S.J.<sup>2</sup>, Good, M.<sup>3</sup>, Cromie, A.R.<sup>4</sup>, Mullowney, P.<sup>3</sup>, Higgins, I.M.<sup>2</sup>, Berry, D.P.<sup>1</sup>

<sup>1</sup> Teagasc Moorepark Dairy Production Research Centre, <sup>2</sup> UCD CVERA, <sup>3</sup> Department of Agriculture, Fisheries and Food,

<sup>4</sup> Irish Cattle Breeding Federation Society Ltd.

Johne's disease in cattle is caused by *Mycobacterium avium* subsp. *paratuberculosis* (MAP). A recent study has demonstrated that significant genetic variation exists for susceptibility to MAP infection in Irish Holstein Friesian dairy cows. Nevertheless, data on Johne's disease occurrence is not collected routinely on Irish dairy farms. The objective of this study was to estimate the genetic associations between resistance to MAP infection and measures of susceptibility to *M. bovis* and *M. avium* infection. Serological response to MAP was used as a measure of cow susceptibility to Johne's disease. The single intradermal comparative tuberculin test was used as a measure of susceptibility of cows to *M. bovis* and *M. avium* infection. A total of 4,581 cow serological response to MAP records, 19,663 *M. bovis*-PPD responsiveness records and 15,824 *M. avium*-PPD responsiveness records were available for inclusion in the analysis. Genetic and residual (co)variance components between serological response to MAP and susceptibility to *M. bovis*-PPD and *M. avium*-PPD responsiveness were estimated using bivariate linear animal models. Serological response to MAP was strongly positively genetically correlated ( $0.84 \pm 0.20$ ) with susceptibility to *M. avium*-PPD responsiveness. Susceptibility to *M. avium*-PPD responsiveness was not genetically correlated ( $0.03 \pm 0.32$ ) with serological response to MAP. The results from study suggest that selection for reduced *M. avium*-PPD responsiveness may indirectly increase resistance to MAP infection within the national Holstein Friesian dairy herd.

## Infectious Bovine Rhinotracheitis (IBR) / Bovine Viral Diarrhoea (BVD)

### Herd and within-herd BoHV-1 prevalence among Irish beef herds submitting bulls for entry to a performance testing station

O'Grady, L.<sup>1</sup>, O'Neill, R.<sup>2</sup>, Collins, D.M.<sup>3</sup>, Clegg, T.A.<sup>3</sup>, More, S.J.<sup>3</sup>

<sup>1</sup> Department of Agriculture, Fisheries and Food, <sup>2</sup> Central Veterinary Research Laboratory, Department of Agriculture, Fisheries and Food, <sup>3</sup> UCD CVERA

**Irish Veterinary Journal 61, 809-815 (2008)**

Infectious bovine rhinotracheitis (IBR), caused by bovine herpes virus 1 (BoHV-1), may result in various clinical consequences, including severe respiratory disease and conjunctivitis, venereal disease and reduced reproductive performance and abortion. This paper presents the serosurveillance findings from an intake of bulls into a performance testing station in Ireland during November 2007. The herd and within-herd BoHV-1 prevalence in 53 Irish beef herds and the risk factors for infection in these herds were determined, among bulls entering a beef performance testing station in Ireland. BoHV-1 status was determined for 41 herds, of which 30 (73.2%) herds were infected and the mean within-herd BoHV-1 prevalence was 28 ( $\pm 20$ )%. Multivariate exact logistic modelling revealed increasing numbers of contiguous herds and decreasing percentage of males within the herd as significant risk factors associated with infected herds. These findings highlight the high prevalence of BoHV-1 infection in those Irish beef herds that submitted bulls to this performance testing station, and raise concerns regarding IBR control nationally.

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### To determine the prevalence of Bovine Virus Diarrhoea virus (BVDv) infection and Infectious Bovine Rhinotracheitis (IBR) and to establish associations between seroprevalence and cattle herd productivity in the Republic of Ireland

Cowley, B.<sup>1</sup>, Clegg, T.A.<sup>2</sup>, More, S.J.<sup>2</sup>

<sup>1</sup> Intervet/Schering-Plough Animal Health, <sup>2</sup> UCD CVERA

Infectious diseases such as Bovine Virus Diarrhoea (BVD) infection and Infectious Bovine Rhinotracheitis (IBR) have been identified as key influences in the future success of the Irish dairy and beef industries. Anecdotal evidence suggests that the prevalence of these diseases is high though limited published data exist on national seroprevalence for either disease in either the dairy or beef sector. The objective of this study is to evaluate the seroprevalence of BVD and IBR in dairy and beef cows in the Republic of Ireland. It is also proposed to determine associations between seroprevalence and production, farm location and farm management strategies.

## Leptospirosis

### Seroprevalence of leptospirosis in Irish beef/suckler herds

Ryan, E.<sup>1</sup>, O'Grady, L.<sup>2</sup>, More, S.J.<sup>3</sup>, Doherty, M.L.<sup>2</sup>, Leonard, N.<sup>2</sup>

<sup>1</sup> Private veterinary practitioner, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>3</sup> UCD CVERA

The objectives of this study were to establish the herd seroprevalence of leptospirosis in unvaccinated suckler/beef herds in the Republic of Ireland, and to establish the individual animal seroprevalence in the Irish suckler/beef breeding stock population. For the purpose of herd selection, the country was divided into six groups with approximately equal numbers of suckler cows, based on the CMMS data from 2000. Herds were then selected at random, from sera that were made available from the Department of Agriculture National John's Disease screening study, while aiming to have a roughly equal quantity of herds in each group. In each herd, the number of eligible animals (N; females and entire bulls > 1 year old) to be tested in each herd was calculated as follows:

- Herd Size < 20, N = all eligible animals ;
- Herd Size ≥ 20, N = 20 (animals chosen at random).

Animals were tested using the Linnodee monoclonal antibody capture ELISA. Initial results were as follows:

- The number of unvaccinated herds tested was 299. Based on the sensitivity and specificity of the ELISA, it was determined that a cut-off of 4 positive animals per herd was required to categorise a herd as positive. This resulted in 276 positive herds (276/299) = 92.3%.
- The total number of unvaccinated individual animals tested was 5054. Of this total, there were 2472 animals positive using the Linodee ELISA (2472/5054) = 48.9%.

### Evaluation of the risk factors for leptospirosis in Irish suckler/beef herds

Ryan, E.<sup>1</sup>, O'Grady, L.<sup>2</sup>, More, S.J.<sup>3</sup>, Doherty, M.L.<sup>2</sup>, Leonard, N.<sup>2</sup>

<sup>1</sup> Private veterinary practitioner, <sup>2</sup> UCD School of Agriculture, Food Science and Veterinary Medicine, <sup>3</sup> UCD CVERA

The objectives of this study were to establish the epidemiological risk factors affecting herd seroprevalence to *Leptospira hardjo* in unvaccinated suckler/beef herds in the Republic of Ireland. Questionnaires were posted to the herd owners of all those herds sampled in the seroprevalence study. These questionnaires aimed to determine whether the herd was vaccinating for leptospirosis, as well as posing a number of questions concerning disease history on-farm; animal details in the herd; the presence of a stock bull; access to watercourses; the presence of sheep on the farm; biosecurity in the herd and details on animal housing. In order to fully determine the vaccination status of each herd, follow-up telephone questionnaires were undertaken for those herds that did not return a completed questionnaire. Questionnaires were returned from 136 unvaccinated herds. Questionnaire results were completed to varying degrees making statistical analysis more difficult. The only risk factor that affected herd seroprevalence to *Leptospira hardjo* with statistical significance was herd size. Larger herds were associated with a significantly increased herd seroprevalence.

## A detailed farm investigation

A randomised controlled study to determine the effect of location on growth, haematological parameters, serum biochemistry, nutritional and endocrinological status, immune function and disease status in housed weanling cattle between January and May 2007

Lane, E.A.<sup>1</sup>, Canty, M.J.<sup>1</sup>, Clegg, T.A.<sup>1</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

Long-term problems of cattle performance have been observed on a farm (the 'index farm') in Co. Kilkenny, Ireland. The objective of this study was to identify, if possible, any underlying mechanisms of poor animal performance on this farm, thereby providing possible clues for the ongoing problems that were, or still are, being observed. Some 46 cattle were enrolled in the study from the index farm and a further 31 control cattle were sourced from a farm in Co. Meath. These cattle were divided into five separate treatment groups, each being supplied with defined feed and water combinations. The index farm cattle had lower initial weights than the control cattle but were matched in all other respects. Three of these groups were based on the index farm and two were resident on a control farm located approximately five km away. Throughout the study, the animals were weighed, bled and assessed at regular intervals. An extensive battery of laboratory testing was undertaken to assess factors that could potentially be linked to poor growth, including nutrition (energy status, an assessment of elemental status), disease and immunity (serology, serum biochemistry, general immune status) and endocrine parameters associated with growth. Analysis of feed and water was also conducted. The animals were vaccinated, and treated for internal parasites, at the start of the study. All cattle performed well throughout the study period, thereby limiting the ability of this study to identify any causes of the ongoing intermittent poor performance problems. During January to May 2007, the index farm and control cattle achieved ADGs of 0.66 and 1.00 kg/day, respectively. Among the many parameters assessed, few significant differences were identified within and between groups. Mineral deficiencies/imbances had been identified in the past, and were comprehensively assessed and described in this study. At the start and throughout the study, the cattle from the index farm were selenium (Se) deficient. Selenium also decreased among the control cattle, reaching the threshold for Se deficient status towards the end of the study. Results from this study indicated that Se deficiency may be a contributor to the ongoing performance problems on the farm. IGF-1, a principal mediator of growth hormone in animals, was markedly lower in the index sourced cattle at the start of the trial, though the concentrations increased in both groups throughout the period. Cadmium (Cd) was measured in cattle towards the end of the study, the significance of which is uncertain.

## An evaluation of underlying performance mechanisms in an experimental group of animals kept on the index farm from January 2007 to April 2008

Lane, E.A.<sup>1</sup>, Canty, M.J.<sup>1</sup>, Clegg, T.A.<sup>1</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

Long-term problems of cattle performance have been observed on a farm (the 'index farm') in Co. Kilkenny, Ireland. The objective of this study was to determine whether periods of poor weight gain or weight loss, if observed, were associated with changes in haematological parameters, essential element status, or exposure to heavy metals. Cattle (n = 10) sourced off farm were moved to the index farm in January 2007 (Day 0; 16/01/2007) and kept there until April 2008 (day 469; 29/04/2008). Blood-samples were collected by jugular venepuncture and cattle were weighed on Days 0, 112, 154 (blood-sample only), 203, 231, 259, 287, 315, 357, 386, 413, 442 and 469 relative to the start of the study. Weight gains were intermittent during the period of observation: very good ADGs were observed during the initial housing period (January to May 2007; 0.96 kg/day), very poor during summer grazing (May to October 2007, 0.13 kg/day) and good during the subsequent housing period (October 2007 to April 2008, between 0.55 and 1.2 kg/day). During the

summer grazing period, the cattle experienced a coincident reduction in weight gain, which is suggestive of a single insult over a defined period of time. At this time, there was no overt evidence of disease in these cattle. Adequate ADGs during summer 2007 have been reported elsewhere in Ireland. Selenium concentrations declined during the study period and were considered to be deficient from October 2007 to January 2008. However, the concentrations improved on winter feeding and returned to normal by February 2008. Copper (Cu) concentrations declined after cattle were introduced onto the index farm, and were considered deficient from May 2007 until the end of the study. In this study, essential element deficiencies were again identified as potential contributors to the ongoing performance problems on the index farm. A single Cd peak was measured in cattle during this study, the significance of which is uncertain but subject to further study.

## An assessment of responsiveness of calves from the index farm, with known essential element deficiencies to selenium supplementation, May 2007 to April 2008

Canty, M.J.<sup>1</sup>, Lane, E.A.<sup>1</sup>, Clegg, T.A.<sup>1</sup>, Sharpe, A.<sup>2</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> Central Veterinary Research Laboratory, Department of Agriculture, Fisheries and Food

Long-term problems of cattle performance have been observed on a farm (the 'index farm') in Co. Kilkenny, Ireland. Earlier studies have indicated that selenium (Se) deficiency may be contributing to this problem. The aims of this study were to evaluate the efficacy of different forms of selenium supplementation to maintain the Se status and performance of animals, and to compare the performance of Se supplemented animals with un-supplemented animals moved to an unaffected farm. In a randomised controlled study Friesian cross calves (n = 42) were assigned to one of four groups; *Tx1OnFC* 2ml sc injection sterile water, remained on the index farm, n = 11. *Tx2BVP* sc injection BVP Barium Selenate LA® (1 mgSe/kg LBW), remained on the index farm, n = 10. *Tx3Vital* im injection of Vital® (68mgVit E/ml & 1.5mgSe/ml) at 2ml/45kg LBW, remained on the index farm, n = 11. *Tx4OffFC* 2ml sc injection of sterile water, animals remained on the index farm for 41 days, moved to unaffected farm for 125 days, subsequently returned to the index farm, n=9. All animals had normal Se and GPx concentrations at the start of the study on Day 0, however, Se and glutathione peroxidase GPx concentrations declined in all groups until Day 307 and Day 280, respectively. Se concentrations were below normal (120 µg/kg) in *Tx1OnFC* and *Tx3Vital* at 13 of the 21 sampling points, and in 7 of the 21 sampling point in *Tx4OffFC*, following their return to the index farm. *Tx2BVP* had higher Se and GPx concentrations compared with *Tx3Vital*, however, neither form of Se supplementation was sufficient to overcome the poor average daily gains (ADG) on the index farm. Following acclimatisation, *Tx4OffFC* animals, moved to the unaffected farm had improved ADG and normal Se concentrations, but both declined upon return to the index farm. The Se deficit status of the index farm was confirmed by the movement of animals off, and subsequently back to the index farm, confirming the localised nature of the deficiency. Selenium supplementation had a positive impact on blood Se status, but was not sufficient to overcome the shortfall in animal performance, suggesting that Se deficiency may be just a component of a more complex interaction. In support of this view, marginal to deficient concentrations of Cu and iodine (I) were also observed in all groups. The presence of radiodense growth retardation lines is consistent with poor calf growth, but does not provide any definitive insight into the cause of the problem. Two patterns of Cd excess were observed during this study: a large Cd peak and background Cd exposure. The significance of these findings is uncertain but subject to further study. Understanding the potential complex interaction between element excesses and deficiencies on the index farm could prove important.

## A survey of essential elements and heavy metals in a small area encompassing the index farm, April and September 2007

Canty, M.J.<sup>1</sup>, McCormack, S.<sup>2</sup>, Lane, E.A.<sup>1</sup>, Collins, D.M.<sup>1</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> Teagasc Johnstown Castle Research Centre

Many ruminants are solely or mostly dependant for all their nutrients, including essential elements, on the quality of the forage available to them, either in its natural state or conserved as hay or silage. Shortfalls in animal performance, principally stunted growth and ill-thrift in growing cattle but also poor body condition and reduced milk yield in adult cattle, has also been observed on a farm (index farm) in Castlecomer, Co. Kilkenny, Ireland. A soil and herbage survey was carried out over two time periods, April 2007 and September 2007, in a 2.5 sq km grid incorporating sampling points on the index farm (at its centre) and on 27 other farms in the area. In this study, we sought to determine the nutrient and heavy metal status of soil and herbage in the sampling area, and to relate the concentrations reported with their potential to impact on animal performance. Low soil pH and high soil liming requirements were identified within the sampling area and on the index farm, noting that soil pH greatly influences nutrient uptake by plants from soil, and subsequently nutrient availability to grazing animals. Calcium (Ca), copper (Cu), selenium (Se) and zinc (Zn) concentrations were low in soils and herbage in the sampling area and on the index farm. These conditions are not dissimilar to those found on other farms in Ireland. Fluoride (F) was detected in 61 of the 97 herbage samples in April 2007, but only four exceeded 40 mg/kg (the maximum tolerable level) for cattle. No measurement of Cd was undertaken in herbage samples. In soil samples, Cd was below the level of detection for the test used (<0.1 mg/kg) in over 90% of samples tested, and those where Cd was reported, the maximum Cd concentration was 0.72 mg/kg, within the typical range for Irish soils (0.1 to 1 mg/kg). Mineral imbalances (Ca, Cu, Se and Zn) in pastures caused by low soil mineral status, exacerbated by low soil pH, could hinder optimal animal performance in the region.

## Kidney cadmium concentrations in cattle from the index farm, 2003-2005 and 2009

Canty, M.J.<sup>1</sup>, Lane, E.A.<sup>1</sup>, More, S.J.<sup>1</sup>

<sup>1</sup> UCD CVERA

Of all animal tissues, livers and kidney constitute a special dilemma in that they have a tendency to bioaccumulate toxic metals such as arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg). Maximum concentrations (ML) for Hg, Pb, Cd and tin (Sn), but not As, in foodstuffs are set by European Commission Regulations. The aims of this study were 1) to determine the concentrations of As, Cd, Pb and Hg in the livers and kidneys of nine cows from the index farm and 2) to combine the kidney Cd results from these 5 cows with those reported in an earlier Department of Agriculture, Fisheries and Food (DAFF) report (n = 14 animals), and describe the trend in kidney Cd concentrations on the index farm over time. Arsenic, Pb and Hg concentrations in livers and kidneys were within normal range for animal health purposes for the nine cows. Kidney Cd concentrations in six of the nine cows exceeded the normal range for animal health purposes (0.05-1.5 mg/kg) and seven of the nine exceeded the ML permitted for human consumption (1 mg/kg). When kidney Cd results from the nine cows (2009) were combined with results (n = 14) from a previous investigation (2003-2005), 8 of the 23 (37.8 %) kidneys had Cd concentrations above 1.5 mg/kg, the upper limit of the normal range for animal health. Kidney Cd concentrations appear to increase in animals with increasing time spent on the index farm. Based on current knowledge, exposure at this level is not associated with adverse effects in terms of animal health or performance.

## An epidemiological evaluation of all relevant data gathered to date and an assessment of hypotheses that could plausibly be associated with poor animal performance on the index farm

More, S.J.<sup>1</sup>, Lane, E.A.<sup>1</sup>, Canty, M.J.<sup>1</sup>, McGrath, G.<sup>1</sup>, Sheridan, M.<sup>2</sup>

<sup>1</sup> UCD CVERA, <sup>2</sup> Department of Agriculture, Fisheries and Food

Long-term problems of cattle performance were observed on a farm (the 'index farm') in Co. Kilkenny, Ireland. In recent years, a number of investigations have been conducted. The objectives of this paper are to critically evaluate all relevant data, and to assess hypotheses that could plausibly be associated with these problems of animal performance. A number of general hypotheses were developed, each potentially associated with case development, including hypotheses specific to the index farm (health, management, genetics, nutrition) and broader hypotheses (element imbalances). Each hypothesis was then assessed by considering all available sources of data, taking account of data validity and precision, and using the Bradford-Hill criteria for evidence of causation during decision-making. A number of essential element deficiencies have been identified in soil, herbage and cattle on the index farm, including calcium, copper, selenium and zinc. Observed soil conditions (low pH, high liming requirements) are known to adversely affect the availability of essential elements. The deficiency in cattle was not responsive to Se supplementation, consistent with an aetiology more complex than Se alone. A number of animal health concerns were identified on the index farm prior to 2007, with adverse effects on animal performance. Since 2007, however, the potential for such effects has been substantially reduced, following the introduction of robust preventive measures and as a consequence of intensive veterinary supervision by the project team and the farmer's own private veterinary practitioners. There is evidence of elevated background concentrations of Cd among cattle on the index farm. However, these concentrations are not of toxicological significance based on currently knowledge, and would not be expected to adversely affect animal health. Fluorine is present intermittently, but not at concentrations considered detrimental to animal health. A number of factors have been described that undoubtedly have some influence on the performance of cattle on the index farm. However, no comprehensive understanding has yet been established to fully explain the epidemiological presentation of cases, in particular the localisation of cases to the index farm and the temporal distribution of periods when negative performance was recorded.