Theme A – Plant and Animal Health

Lay Summaries of Projects

January 2024

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1. Plant Disease

JHI-A1-1: Understanding of the principal drivers of pest and disease incidence, severity, and spread in Scotland, and the factors currently limiting effective disease control

PI: Peter Skelsey (peter.skelsey@hutton.ac.uk)

This project will generate new knowledge on the epidemiology of key pests and diseases affecting Scottish agriculture and develop new predictive tools and decision support systems for improved management. The key drivers of this research are:

- Increasing incidence and diversity of endemic, emerging, and re-emerging pests and diseases
- Need to develop new, sustainable integrated pest management policies and procedures.

JHI-A1-2: Development and implementation of tools, strategies, and stakeholder engagement to understand threats and improve disease management in practice

PI: Alison Lees (alison.lees@hutton.ac.uk)

The project aims to mitigate threats posed to key crops by new, emerging and endemic pests and pathogens, to protect Scotland's industries and to deliver integrated and sustainable crop protection strategies for Scottish growers.

2. Animal Disease

MRI-A2-1: Development and use of advanced in vitro culture systems to interrogate host-pathogen interactions in livestock species

PI: Tom McNeilly (tom.mcneilly@moredun.ac.uk)

This project develops a range of advanced laboratory-based systems to investigate how production- and welfare-limiting diseases of Scottish livestock establish infections in their hosts. This work underpins the development of novel vaccines and diagnostic tests by identifying the animals' response to disease and its initiation of protection as well as providing new methods for pathogen isolation and identification.

MRI-A2-2: Role of transmission and pathogen components in virulence and disease pathogenesis for important endemic diseases of livestock in Scotland

PI: David Longbottom (david.longbottom@moredun.ac.uk)

Investigation of how pathogens responsible for key welfare and production-limiting diseases of Scottish livestock are distributed or transmitted to their host animal, determining the key pathogens that are important for infection and disease, and how they interact with the host immune system.

The key drivers for this research are:

- Limitations in our understanding of environmental sources of pathogens and transmission to livestock
- Identifying the key components of pathogens responsible for causing disease
- Determining how the animal's immune defences respond to the infecting pathogens
- Approaches that will underpin future research to develop new or improved methods for diagnosing, controlling, treating or managing infections and disease

MRI-A2-3: Novel diagnostic tools for improved control, monitoring and prevention strategies for the key endemic diseases of livestock in Scotland

PI: Stew Burgess (stewart.burgess@moredun.ac.uk)

This project aims to develop novel tools and technologies for the improved control and prevention of endemic diseases of livestock in Scotland. These include reproductive failure, lungworms, Johne's disease, sheep scab, bovine viral diarrhoea (BVD) and bovine respiratory disease (BRD). The key drivers for this research are:

- Addressing issues regarding the accuracy and specificity of current endemic disease diagnostics
- Horizon scanning for new and emerging infections and improving our ability to develop tools to detect resistance to drugs used to control disease in livestock
- Exploitation of novel technologies to further the development of new and improved diagnostic platforms.

MRI-A2-6: Novel vaccines to combat significant endemic diseases of livestock in Scotland: Gastrointestinal nematode parasites of ruminants

PI: Alasdair Nisbet (Alasdair.nisbet@moredun.ac.uk)

This project will develop highly effective, optimised, safe, novel vaccines for the control of the most production- and welfare-limiting diseases of Scottish livestock caused by parasitic worms (gastrointestinal nematodes GIN). The key drivers for this research are:

- The limitations of the current chemotherapeutics; reduced efficacy (via anthelmintic resistance) and the effects of residues on environment, operator and food safety;
- The potential for vaccines to overcome these limitations and to provide increased productivity and efficiency in livestock production with the economic, food security and environmental benefits which accrue from that.

MRI-A2-7: Novel vaccines to combat significant endemic diseases of livestock in Scotland: Vaccines for reproductive diseases

PI: Frank Katzer (frank.katzer@moredun.ac.uk)

This project will develop highly effective, optimised, safe and novel vaccines for the control of the most important pathogens (*Chlamydia abortus* and *Neospora caninum*) causing reproduction losses in sheep and cattle, respectively, in Scotland. The key drivers for this research are:

- The limitations and safety concerns of the current life 'attenuated' vaccine for the protection of sheep from abortions caused by *Chlamydia*;
- The lack of a vaccine that protects cattle from abortions caused by *Neospora caninum* infection.

MRI-A2-8 Novel vaccines to combat significant endemic diseases of livestock in Scotland: Vaccine Delivery Platforms

PI: William T. Golde (William.golde@moredun.ac.uk)

This project will develop next generation vaccines for bovine respiratory disease (BRD) that will be delivered by safe and efficacious viral vaccine vectors such as adenovirus, the potential for using these vaccine vectors in a next generation sheep scab vaccine, and using plant virus vectors to produce virus-like particles (VLPs) which will be surface decorated or filled with the new vaccine antigens permitting more stable and efficacious delivery of gastrointestinal nematode (GIN) antigens identified in MRI-A2-6. BRD continues to be a significant problem for farmers is spite of commercially available vaccines. Sheep scab is a difficult economic and welfare issue facing sheep flocks across Scotland and GIN's continue to be a significant issue in ruminants given increasing antihelminth resistance.

New vaccine technologies have the potential to induce more robust and longer lasting immune responses in vaccinated animals, thereby improving animal welfare and productivity of the farming enterprise. The key drivers for this research are:

• The limited duration of immunity of present vaccine formulations
• The potential for next generation vaccines to induce broader and longer lasting immunity by the capacity to target more aspects of immune responses with viral vaccine vectors
• The opportunity to compare different vaccine delivery systems for efficacy in ruminants.

MRI-A2-9: The role of wildlife and livestock in the emergence and persistence of zoonosis in Scotland, and novel interventions

PI: David Griffiths (david.griffiths@moredun.ac.uk)

This project will investigate the spread of zoonotic pathogens, to improve our understanding of zoonotic diseases present in Scotland and provide improved control strategies for ticks and tick-borne diseases. The key drivers of the research are:

• The need to respond to the increased frequency of zoonotic diseases in livestock and wildlife (including tick-borne, food and water-borne diseases) requiring development of new approaches to understand their prevalence and distribution
• The loss of efficacy of current tick control interventions and the possibility to develop new tools to reduce the spread of tick-borne diseases.

MRI-A2-10: Ticks and zoonotic tick-borne pathogens (TBP's) in Scotland: evaluating risks for humans and livestock

PI: Mara Rocchi (mara.rocchi@moredun.ac.uk)

Investigation of the spread of tick-transmitted zoonotic pathogens, to generate knowledge directly applicable to management of green spaces and wildlife. The project will assess potential practical solutions to the increase in spread of vectors (ticks) and associated diseases.

RI-A2-1: Harnessing the gut microbiome to strengthen livestock resilience against carriage and infection by pathogens

PI: Alan Walker (alan.walker@abdn.ac.uk)

Infectious diseases, particularly when caused by antibiotic-resistant pathogens, are major problems in farmed animals. New treatments are urgently needed to reduce infections. We aim to address this by harnessing the animal intestinal microbiome to boost their defence. We will screen our diverse gut bacterial culture collections to identify health-associated microbes with potent activity against pathogens, including antibiotic resistant strains.

RI-A2-2: Identifying selective cofactors that contribute to the role of the intestinal microbiome as a reservoir of multiple resistance genes transmissible to pathogenic bacteria

PI: Karen Scott (K.Scott@abdn.ac.uk)

It is vital to understand the contribution of resident intestinal bacteria to the environmental flow of antimicrobial resistance genes. We will isolate resistant commensal bacteria from diverse sources, assess the co-carriage of heavy metal resistance genes on mobile genetic elements, compare identical resistance genes between non-harmful and pathogenic bacteria, and investigate the impact selective pressure has on gene evolution and transfer.

SRUC A2-2: Research into zoonoses and emerging diseases to protect public health and animal health in Scotland as seen on Researchfish

PI: Scott Lawton (scott.lawton@sruc.ac.uk)

This project will focus on understanding the risk of emerging vector-borne zoonoses that could affect human and animal health in Scotland and improving our understanding of the transmission of two bacteria which cause food-borne zoonoses in Scotland. Data generated in this project will inform control strategies and be able to provide mitigation which could break transmission chains, improve animal welfare and production, and save human life.

SRUC-A2-3: A system understanding of the flow of AMR from livestock production to the environment and humans: informing antimicrobial stewardship and optimal use

PI: Mike Hutchings (mike.hutchings@sruc.ac.uk)

Antimicrobial resistance is found wherever antimicrobials are used, yet antimicrobials are often the last line of defence in protecting animal health and welfare. Understanding the relationship between antimicrobial use in livestock and resistance (presence of resistance genes in bacteria, and ability to survive in the presence of antimicrobials) will inform stewardship and optimal use strategies that extend the useful lifespan of antimicrobials.

SRUC-A2-4: Achieving improvements in the health of Scottish livestock through increased uptake of biosecurity practices uptake of biosecurity practices: towards a farmer-centric approach based on Socio-Epidemiological Model

PI: Kate Lamont (kate.lamont@sruc.ac.uk)

Use of a holistic framework that combines data from epidemiology, applied agricultural economics, and behavioural science in a multi-disciplinary approach to biosecurity in three case studies. This will enable better understanding of: farmers, their context, and the factors that influence their behaviour and choices; the impact of different biosecurity choices on disease burdens; the potential for influencing decisions through communicating disease predictions; barriers to uptake of biosecurity practices, which of these can be influenced, and what might be effective in incentivising uptake by different types of farmers in different contexts.

SRUC-A2-5: Sheep and Cattle traceability: the impact of environmental and other factors in Scotland on ear tag loss

PI: Sam Beechener (sam.beechener@sruc.ac.uk)

The aim of this project is to identify the causes of ear tag losses for sheep and cattle in Scotland.

- Ear tag loss incurs costs to individual farmers and there is a range of impacts to animal health and welfare.
- There is a lack of evidence about missing ear tags in sheep and cattle.
- This project aims to support prevention of tag loss and to improve retention rates by identifying factors which cause tag loss and reasons for missing ear tags on different farm settings in sheep and cattle.

SRUC-A2-6: Camelids and Cervids – understanding the structure of the sectors in Scotland

PI: Madeleine Henry (madeleine.henry@sruc.ac.uk)

This project aims to better understand the demographics, management approaches, structure, and key health and welfare considerations within two Scottish livestock sectors – camelid species (South American Camelids) and cervid species (predominantly farmed deer). It will explore with stakeholders the preparedness of each sector for the potential introduction of Identification, Registration and Movement recording (IRM), including any perceived barriers or incentives to uptake. The key drivers for this research are:

- National and international policy around identification and registration of livestock species, including in relation to conditions laid out within the EU Animal Health Law (Regulation (EU) 2016/429)
- Effective management and control of infectious livestock disease, which can best be achieved with reliable data on number and location of relevant animals around Scotland, and knowledge of how these animals interact within and between livestock sectors.

3. Animal Welfare

MRI-A3-1: Precision livestock tools to improve sheep welfare

PI: Fiona Kenyon (Fiona.kenyon@moredun.ac.uk)

This project will investigate the use of practical methods (including technologies such as wearable sensors or strategic use of diagnostics) to assess and improve sheep welfare. The main areas targeted will be diseases that induce negative-welfare, such as roundworms, sheep scab and mastitis. The key drivers are:

- Changes livestock sector which include the tendency towards larger farms, with more animals but fewer people to care for these animals. This can lead to increased difficulties in effective detection of welfare issues. Data-driven decision support tools could help improve early detection of any welfare issues

- Recent developments in technology and diagnostics, which offer opportunities to develop innovative tools to provide livestock keepers with non-labour-intensive options to monitor welfare in their animals.

SRUC-A3-2: EU Exit – challenges and opportunities for animal welfare

PI: Rick D'Eath (rick.death@sruc.ac.uk)

Animal welfare standards have been influenced by EU-level agreements and exit from the EU has potential to affect animal welfare. Incentives provided by agricultural subsidy are now determined by Scottish Government, and UK trade deals could affect farm economics and animal welfare through competition via cheap imports or new export opportunities. We aim to support and inform Scottish Government policy making by:

- Evaluating differences in welfare standards between Scotland and potential trading partners.
- Monitoring emerging areas and recommend policy priorities for maintaining or improving welfare
- Providing evidence in support of maintaining or improving welfare standards
- Evaluating, updating and standardising welfare measurement methods.

SRUC-A3-3 Solutions to improve laying hen welfare

PI Vicky Sandilands (Vicky.sandilands@sruc.ac.uk)

With the phase-out of remaining cages by 2025, we address welfare solutions for egg-laying hens in barns and free range. We investigate breeding for duller beaks or diet changes to reduce feather pecking, develop evidence-based advice for producers to reduce keel-bone fractures, and investigate the feasibility of alternative house designs (e.g. verandas) to address welfare concerns when free range birds must be confined for biosecurity.

SRUC-A3-4: Influencing human behaviour to improve animal welfare

PI: Lesley Jessiman (lesley.jessiman@sruc.ac.uk)

Changing human behaviour is central to achieving SG's goal of having the highest possible standards of welfare. The project will address this by enhancing understanding of behaviour, and by developing and assessing human behaviour change interventions to improve animal welfare across different stakeholder groups (e.g. stock-people, consumers, public) and animal species (e.g. farm animals, companion animals).

SRUC-A3-5: Practical on-farm solutions for welfare and sustainability: solutions to chronic problems

PI: Marie Haskell (marie.haskell@sruc.ac.uk)

Livestock husbandry faces a significant number of challenges with respect to sustainability. Ensuring high standards of animal welfare is a fundament aspect of sustainability. But significant problems remain that require specific chronic welfare problems.

This includes:

- Understanding how to achieve and promote appropriate body condition in beef cattle
- Using technology to reduce tail-biting and other damaging behaviour in pigs
- Promoting the dissemination of alternative farrowing systems for pigs
- Evaluation of the effectiveness of methods to reduce the pain associated with
- management procedures
- Understanding cow-calf systems in dairy cattle and investigating routes to improve welfare in non-replacement dairy-origin calves.

SRUC-A3-6: Practical on-farm solutions for welfare and sustainability: Practical methods to promote and evaluate positive animal welfare (PAW)

PI: Emma Baxter (emma.baxter@sruc.ac.uk)

Providing environmental enrichment (EE) aims to allow animals to gain positive experiences by engaging in and completing rewarding behaviours. However, uncertainties exist surrounding EE use for farmed species including how to assess use of EE in practice and whether EE has other benefits such as promoting greater resilience including decreasing disease susceptibility. This work seeks to address these uncertainties. Engaging with stakeholders and using welfare assessment tools, such as qualitative behavioural assessment (an animal-centric welfare indicator) will determine levels and effectiveness of EE. This will provide information on practical welfare improvements helping create 'good life' environments for farm animals.