FoodBioSystems DTP - PhD Project Advertisement

Project title:
FBS2021-23-Morgan: Exploiting plant diversity and phenology for livestock health under climate change

Lead supervisor:

Professor Eric Morgan, Queen's University Belfast, Biological Sciences

Email: eric.morgan@qub.ac.uk

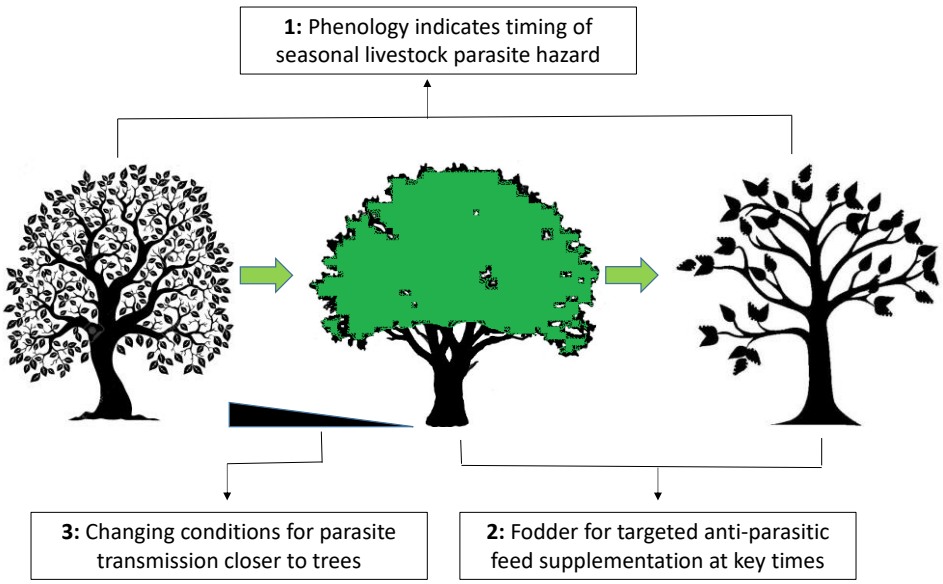
Co-supervisors:

Dr Sokratis Stergiadis, University of Reading

Dr Katerina Theodoridou, Queen's University Belfast

Dr Aurélie Aubry, AFBI

Project description:



This project addresses the potential ecosystem services provided by plant biodiversity to ruminant grazing systems in the UK, specifically through enhanced and sustainable parasite control. Three distinct but complementary hypotheses will be examined: (i) the timing of phenological events in plants, such as flowering, is correlated with seasonal parasite risk, and can hence be used to indicate optimal times of intervention; (ii) feeding on a wider range of plants can help to control parasites and enhance nutrition through secondary metabolites; and (iii) altered microenvironments around some plants change conditions for parasite transmission.

It is already well known that many plants contain secondary metabolites that are 'bioactive' in ruminants, especially condensed tannins, which increase protein availability while suppressing parasite establishment in the gut and inhibiting

larval development in faeces. These benefits are beginning to be realized on commercial farms, although mainly using a limited range of sown species, and in a non-targeted way as alternative swards for general grazing. Targeted application, for example using medicinal paddocks or cut-and-carry of selected forages, could enhance effectiveness. Moreover, a wider range of plant species should be evaluated, especially those that also offer other ecosystem services. The project will include chemical analysis of native meadow and tree species common in UK farm landscapes, and bioassays for effects against parasites. Trees are included because they have potential to increase carbon sequestration and biodiversity, and decrease flooding and run-off of nutrients and pollutants from farmland, while enabling continued grazing in silvo-pastoral systems. Interest in this approach is increasing and deeper understanding of benefits for parasite control would be timely. Results will calibrate feed basket formulation for targeted tree fodder supplementation at key times of parasite risk (e.g. summer coppice or pollard for early season parasite suppression; fallen leaves for removal of late-season drug-resistant worms). Selected mixes will be evaluated for digestibility and emissions in rumen simulators, and for palatability in feeding trials.

As well as impacting parasites within the host, plants also affect parasite transmission through structural and micro-climatic influences on the rhizosphere, soil surface and sward. This will be investigated by field and microcosm experiments of parasite infective stage availability in different situations, e.g. with increasing proximity to selected plants. Correlations between plant phenology and parasite challenge will be investigated, initially using existing data from plant phenology databases and veterinary laboratory diagnoses of the spring scour worm, *Nematodirus battus*. This parasite emerges in response to spring soil temperature and disease risk is increasingly variable under climate change. A strong correlation between the timing of emergence and disease challenge would enable risk periods to be identified from observation, provided the relevant plants are present, again illustrating the potential value of plant biodiversity for parasite control. If database analysis provides promising results, a network of farmers will be recruited to trial this approach to targeted parasite control.

Because both parasite challenge and plant phenology are highly seasonal, there is potential to optimize plant choice and timing of application for maximum effect. Following characterization of the impacts of key plants on parasite transmission, this knowledge will be extended to include epidemiological modelling of parasite dynamics. Hence, livestock movement under varying climatic conditions, and targeted application of selected forages (in time and to more heavily infected or affected individuals), will be incorporated into existing models of parasite dynamics, to determine the most effective strategies now and under climate change. Model predictions will be compared with observed parasite infection data in sheep and cattle grazed on multi-species swards and agro-forestry platforms (ash, apple and willow) in Northern Ireland at CASE partner AFBI. There is potential to include grazing behavior in this component, using biologgers and geo-positioning trackers. Stakeholder engagement will include evaluation of the opportunities and constraints for targeted plant-based parasite control on commercial farms in the UK.

Training opportunities:

The student will receive training in disciplinary and cross-disciplinary skills in parasitology, predictive biology, ecology, biochemistry, physiology and nutrition. The student will learn to run parasite transmission models developed within the lead supervisor's group, and adapt them to their specific research questions. This will proceed in parallel with the experimental work and data collection. Following collection and pre-processing of plant materials, placements in Reading to analyse samples will include training in biochemistry, specifically thiolysis, and digestive physiology using the RUSITEC rumen simulation system. Laboratory analysis in QUB will also include bioassays of plant extract efficacy bioassays using nematode eggs and larvae (development, survival and motility), providing transferable skills in diagnosis of infection in livestock and drug efficacy screening, and field experiment design and analysis. Transferable skills training includes mandatory courses and further skills development in statistical analysis and scientific presentation. Interaction with stakeholders will provide transferable experience in developing sustainable solutions to industry problems.

Student profile:
This project would be suitable for students with an upper second class degree in biology, chemistry, nutrition, agriculture, veterinary or animal science or a closely related subject. A MSc in a relevant subject would be an advantage. Evidence of interest in sustainable livestock production under climate change would be an advantage.

References:

Vercruysse (2018) Parasitology 145,13
Hoste (2015) Vet.Parasitol. 212,5
Gethings (2015) Parasitology 142,1306
Rose (2015) Ecol.Model. 297,232
www.scops.org.uk
www.cattleparasites.org.uk

Funding Note

This project is part of the FoodBioSystems BBSRC Doctoral Training Partnership (DTP), it will be funded subject to a competition to identify the strongest applicants.
The studentship is open to UK and international students (including EU countries) however due to funding rules, no more than 30% of the projects can be allocated to international students.
The funding will include a tax free stipend (minimum £15, 285 per year), support for tuition fees at the standard UK rate (currently £4,407 per year) and a contribution towards research costs. **Please note** that the host universities have not yet confirmed the level of fees charged to international students funded by the DTP. Fee levels may vary across the institutions. This information will be shared on the FoodBioSystems DTP website as soon as it becomes available.

To apply

Please go to FoodBioSystems DTP website for information on how to apply for this studentship. The closing date for applications will be 8 February 2021.