The effects of integrating trees and hedges into pasture based livestock systems on the transmission of gastrointestinal nematodes

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INTRODUCTION

Trees and hedges are increasingly being integrated into farming systems due to the wide range of benefits they provide. These include environmental benefits including improved soil health, increased carbon sequestration (Olaya-Montes et al. 2021), reduced soil erosion, reduced flooding and increased biodiversity, as well as benefits to livestock for example via providing shelter from wind, shade to reduce heat stress, a biosecurity barrier between holdings, and modification of the environment to make it less suitable for diseases such as liver fluke foot rot (Soil association 2019). They can also provide direct financial benefits to the farm via provision of a woody crop or additional products such as fruit or nuts.

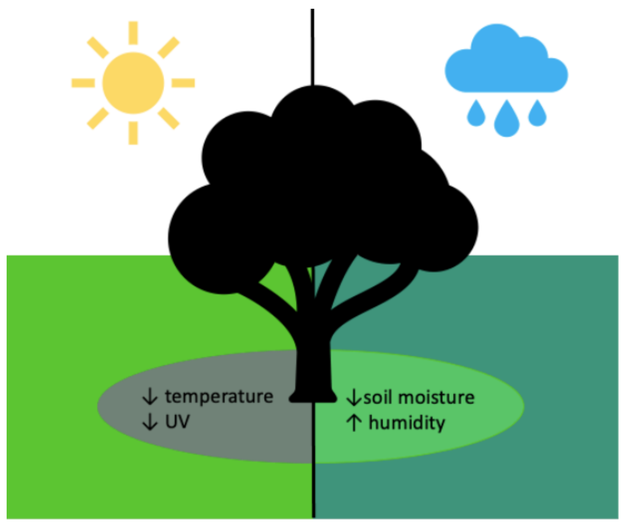
The effect of these systems on transmission of gastrointestinal nematodes, however, has not been ascertained. There are mutiple ways in which this can be affected:
- Trees and hedges alter the environmental conditions in fields (Gliessman 1990), which will alter the microclimate arround the free-living stages of gastrointestinal nematodes
- Livestock will change their behaviour in relation to trees and hedges depending on the weather conditions,
Increased temperatures and reduced rainfall in summer months in recent years in response to climate change has lead to increasing numbers of droughts. Throughout droughts trees can provide a source of fodder for a prolonged period due to their ability to access water from deeper underground than pasture plants. They can also help prevent flooding subsequent to drought when the ability of pasture soil to absorb water is reduced, by increasing the permeability of the soil. In this way they can be used to help mitigate some of the negative effects of climate change on animal production.which will change the distribution of faeces (and thus parasite) deposition, as well as changing their grazing patterns
- Direct browsing on hedges and trees without parasite contamination may alter exposure rates

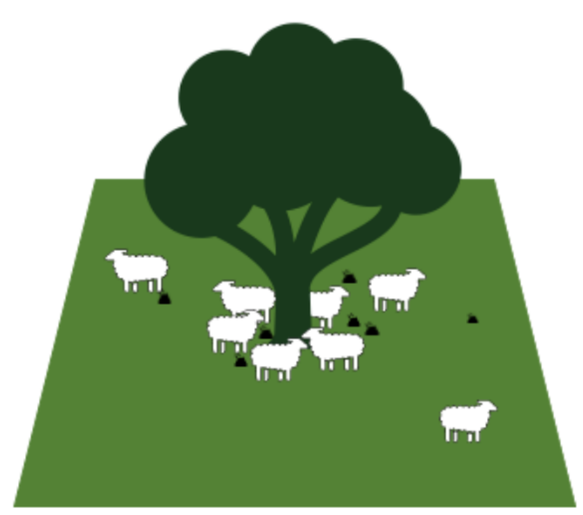
OBJECTIVE

The aim of this work is to determine how trees and hedges in pasture based systems affect the risk of parasite transmission to livestock.

This information can then be used to help in the design of agroforestry systems for integration onto farms, as well as the use of these areas in rotational grazing systems. This feeds into the overall aim of the project in supporting sustainable parasite management

CONCEPT





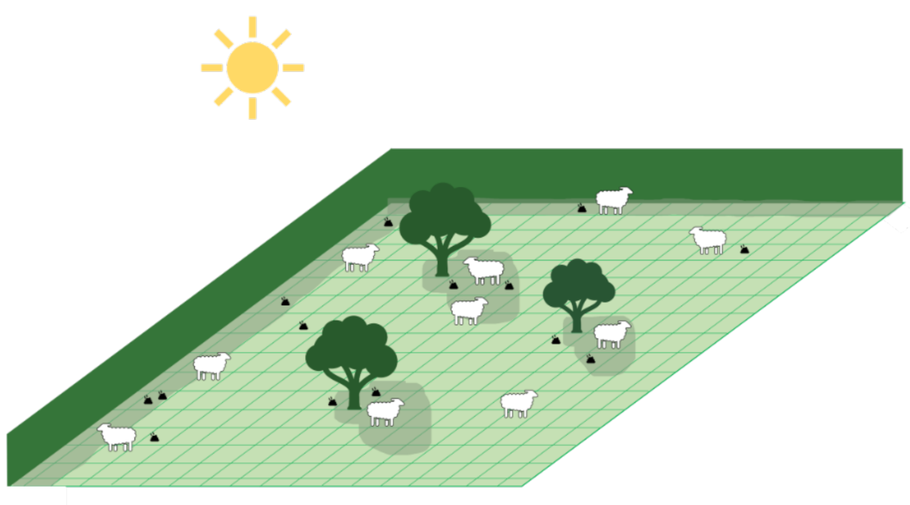
Shade produced by trees will decrease the temperature beneath them. This will have different effects at different temperatures since multiple parameters in the free-living stages of the parasite lifecycle are temperature dependent
- At moderate temperatures reducing the temperature will slow down the development rate of the parasite
- At high temperatures where development rate is naturally suppressed reducing the temperature will increase the development rate
- At all temperatures a reduction will result in a lower temperature dependent mortality rate
The reduction in light exposure will also change the level of dessication of the faeces

The extensive root systems of trees are very efficient at absorbing moisture from the soil and preventing water logging of fields even after heavy rain. Along with the sheltering effect of the tree canopy this will reduce the soil moisture levels underneath the tree which may affect the motility of the larvae and the movement on pasture.

Conversely there will be increased humidy as the canopy reduces evaporation which may increase the duration of moisture retention after the cessation of rainfall.

Clustering of livestock around trees an hedges, particularly in hot, or cold and windy weather, will lead to increased deposition of faeces, and thus nematode eggs in these areas. These areas will thus have a higher level of parasite contamination than the rest of the field. If animals are also grazing in these areas then they will have a higher exposure to parasites.
However, sheep have been shown to exhibit avoidance of faeces when feeding (Hutchings et al., 2001), and this may cause these areas to be grazed less, and grazing to be more focused on the non-contaminated areas away from trees. These areas have a lower worm burden, and therefore result in lower levels of exposure of the animals. In addition to this the increase in trampling of grass in areas of high use under trees may redirect the grazing attention to elsewhere on the pasture.
Livestock also browse directly from trees and hedges so at times when pasture is poor they may interact more with these features (Vandermeulen et al. 2018). This may also have a displacement effect on parasite transmission as they will be grazing on uncontaminated tree fodder rather than contimainated pasture

METHODS



The interaction between these different factors will be explored by the use of spatial models.

These will incorporate animal movement and the spatial distribution of faeces, as well as different environmental inputs in relation to trees and hedges, and open pasture, which will feed into the models of parasite development.
These will be run using a gridded system across a field. The diagram shows a conceptualisation of the design.

Field data will be collected on the environmental variables for input into the model, including ground temperature rainfall levels, as well as spatial faecal deposition. Pasture larval counts will also be completed for validation.

REFERENCES

Hutchings et al. 2001 Animal Behaviour, 62, 955–964 10.1006/anbe.2001.1837
Gliessman 1990, Agroecology: Researching the Ecological Basis for Sustainable Agriculture 10.1007/978-1-4612-3252-0_1
Olaya-Montes et al. 2021 Land Degradation & Development 32:13, 3720-3730 10.1002/ldr.3832
Soil association 2019, The Agroforestry Handbook: Agroforestry for the UK
Vandermeulen et al. 2018. Agroforestry systems 92. 10.1007/s10457-016-0041-x