

# Biotic interactions of trees in the agroecosystem and their impact on arable crop yield and yield resilience

Colin R Tosh, Organic Research Centre, Trent Lodge, Stroud Road, Cirencester, Gloucestershire, GL7 6JN



## Introduction

Most agroforestry modelling to date<sup>1,2</sup> has considered how trees compete with arable crops for non-living currencies such as light, water, and nutrients. Trees also interact with living parts of the agroecosystem and here I consider how these interactions impact yield of the arable crop growing beside trees in agroforestry systems.

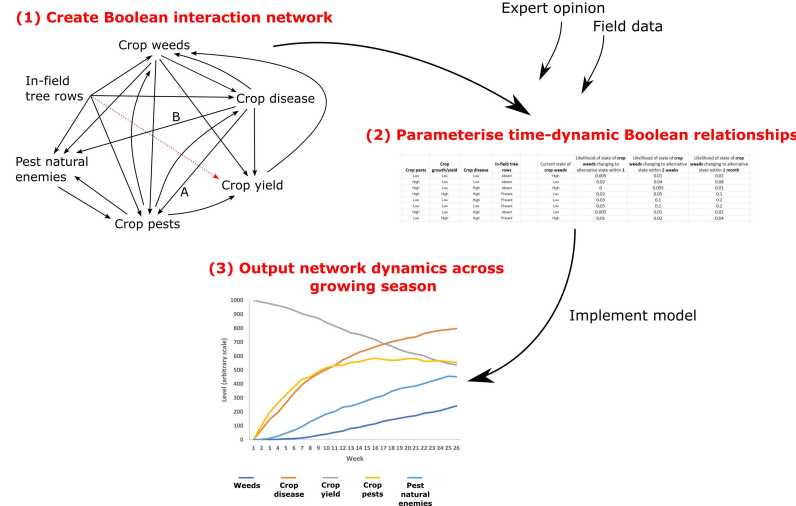
## Methods

I use a modelling method originally developed to model gene regulatory networks<sup>3</sup>. An interaction network is constructed between trees, crop weeds, crop disease, crop yield, crop pests, and pest natural enemies. Each component can only exist in one of two states (high/low, good/bad etc.). Field data supplemented with expert opinion is used to parameterise the model and, when implemented, the model outputs the dynamics of each network component across the growing season (Figure 1).



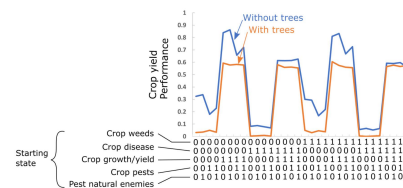
Apple-oilseed rape agroforestry. Copyright: David Rose

## Methods: Figure 1

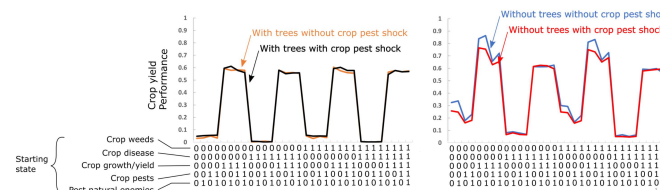


## Results: Figure 2

### Trees reduce arable crop yield overall



### Trees increase arable crop yield resilience to pest and disease attack



## Results

Results are preliminary: only a few experts have parameterised the model and no field data has been used. Preliminary results suggest that trees, through their biotic interactions in the agroecosystem, may reduce arable crop yield overall but tend to protect yield against biological shocks such as sudden pest and disease outbreaks (Figure 2).

## Conclusion

Trees and their understory may slightly reduce arable yield through introducing low levels of weeds, pests and plant disease. Increased resilience of yield to pests and disease in the presence of trees may be explained by trees and their understory acting as a source of pest natural enemies.

Future work will investigate these potential mechanisms for effects, will incorporate a greater range of expert opinion into the model, and will also use field data to parameterise the model.

## References

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- Reyes, F. et al. 2021. Agriculture, 11(4), p.356.
- Shmulevich, I. et al., 2002. Bioinformatics, 18(2), pp.261-274.