

NIAB

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Fostering Populations Of Arbuscular Mycorrhizal Fungi Through Cover Crop Choices and Soil Management

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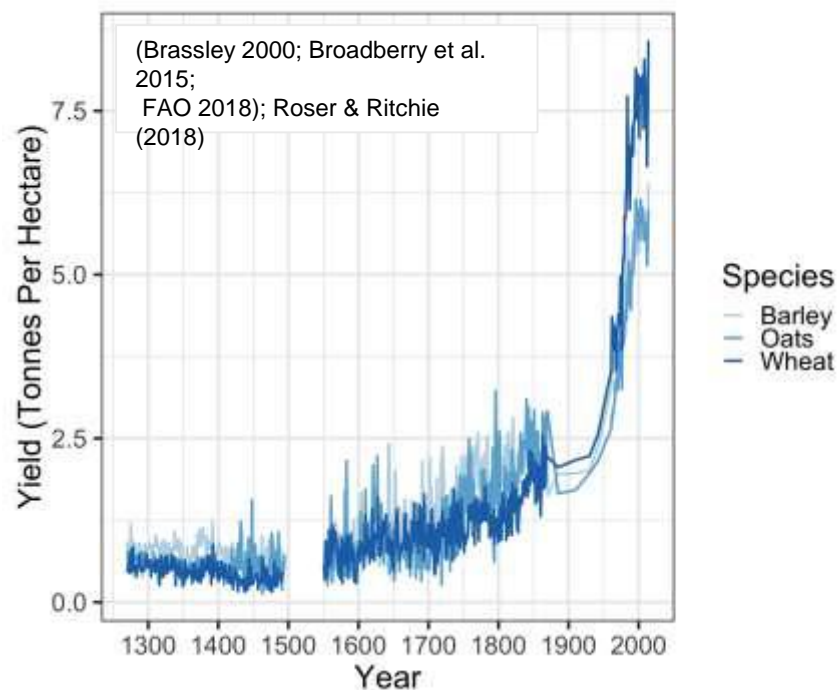


#NORFOLKFARMING



Background

- **3.2 million hectares** of cereal crops producing **23 million tonnes** of yield per year (UK)
- Agricultural legislation to improve:
 - Biodiversity
 - Water and air quality
 - Soil health
 - Climate change mitigation



Soil Health



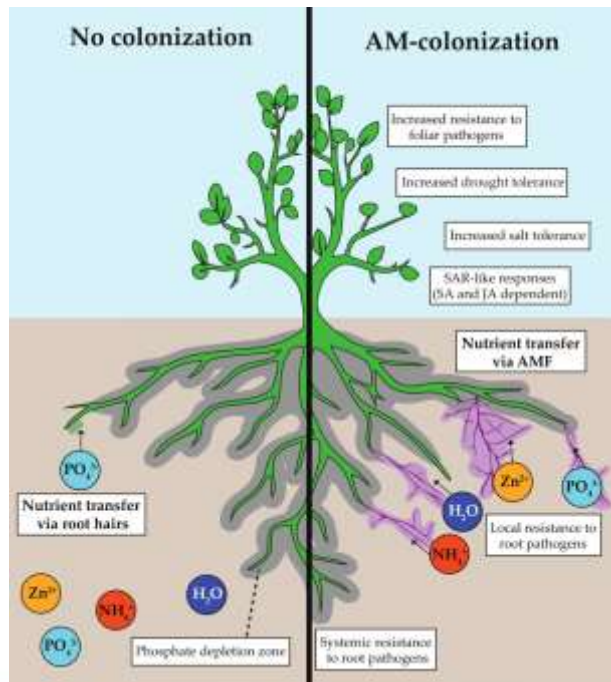
‘The capacity of soil to function as a vital living system, **within ecosystem and land-use boundaries**, to sustain biological productivity, maintain or enhance the quality of air and water, and promote plant, animal and human health’

(Doran et al. 1996; Doran 2002)

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Background and benefits of Arbuscular Mycorrhizal Fungi (AMF)

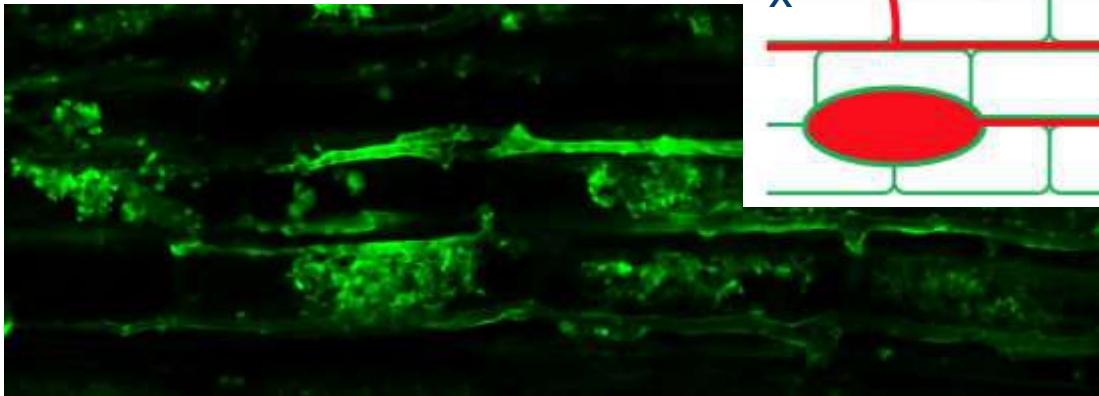
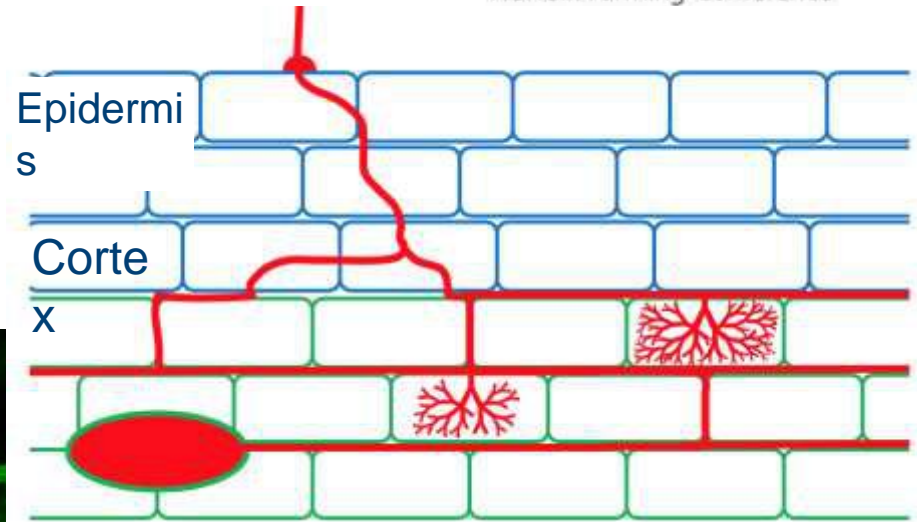


(Jacott et al. 2017)

- Symbiosis with **~80%** extant land plant species
- Linked to colonisation of land by plants **~460mya**
- Exchange of **nutrients** for **sugars and lipids**
- Around 200 known species (estimated 2000)



Arbuscular Root Morphology



AMF in Agriculture

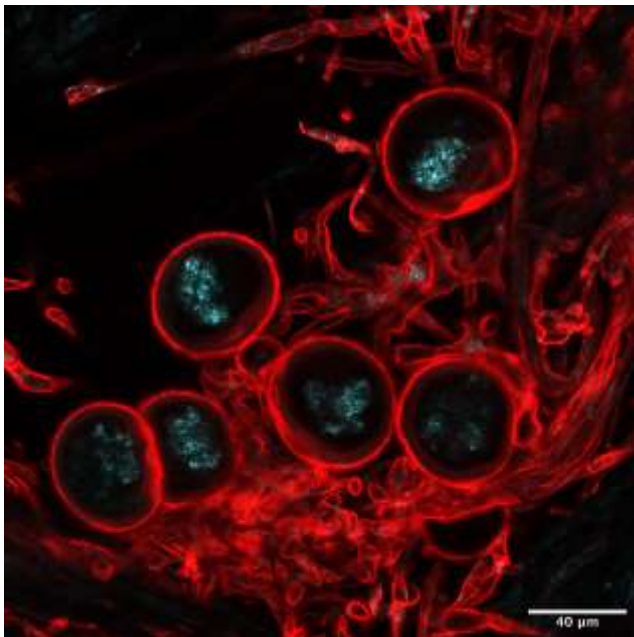
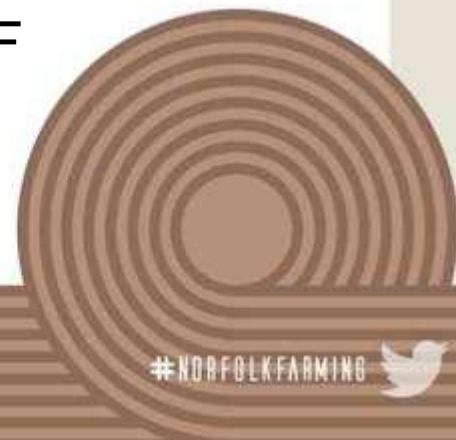
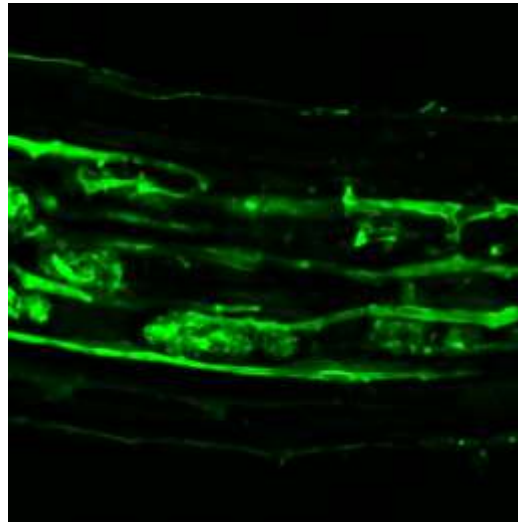


Image: Mieke Jürgens

- Colonisation by AMF resulted in:
 - 35% increased **biomass** (Van Geel et al. 2016)
 - 23% increase in **yield** (Lekberg and Koide 2005)
- Some common farm practice can be detrimental to AMF populations



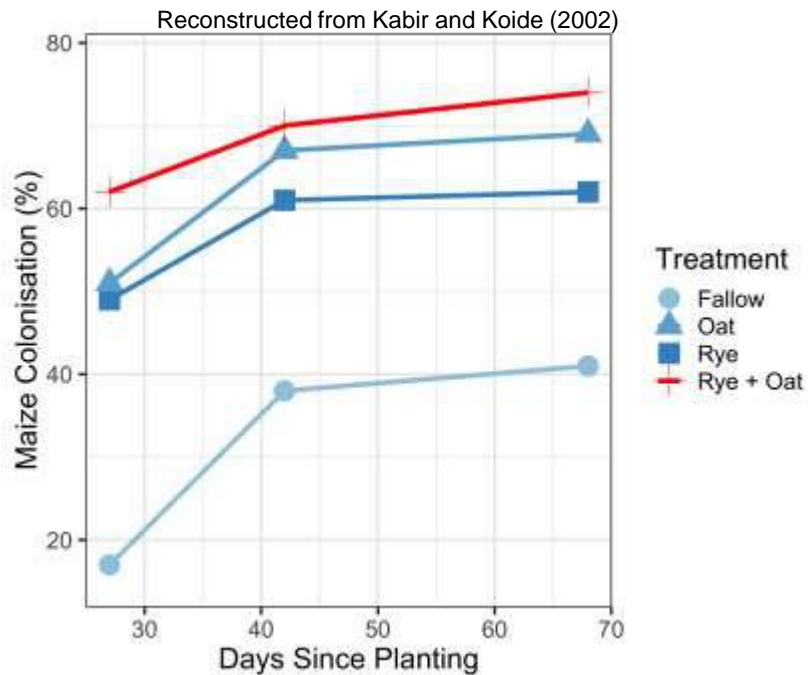
Cover Crops and AMF



Common cover crops which **do not** interact with AMF:
Brassicas including Radish, Buckwheat, etc.



Cover Crop AMF Meta Analysis – Bowles et al. (2017)



- Cover crops **increased colonisation** of summer cash crops by **28.5%**, compared to fallow
- **Legumes** most effective at increasing cash crop colonisation
- Even **non-AMF CCs** increased summer cash crop colonisation

PhD Hypotheses



1. The use of **cover crops** promote the **establishment**, and **maintenance** of a **diverse** range of arbuscular mycorrhizal fungi in an agricultural context.
2. Increasing **diversity** and **abundance** of arbuscular mycorrhizal fungi improves **soil health**, crop growth, and yield.



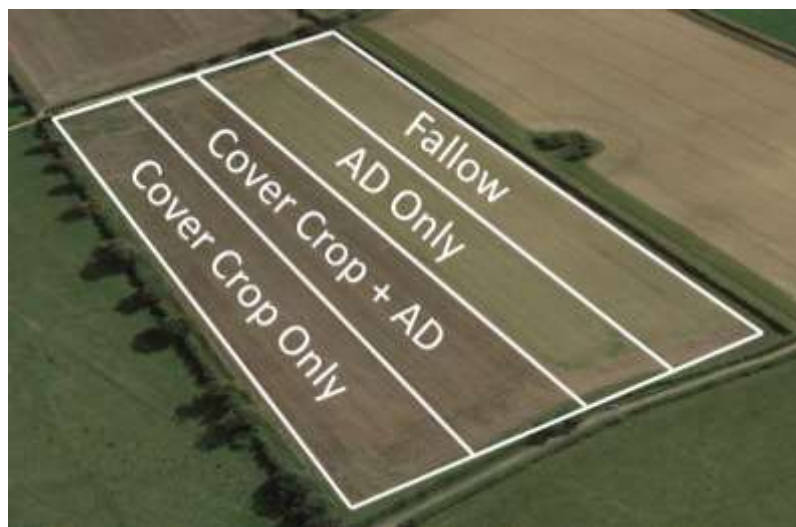
Innovative Farmers Experiment



- Use of farm produced **anaerobic digestate** as a soil amendment
- Using **cover crops** to stabilise soil N, reduce **nitrification** and **leaching**
- Economic and environmental goals
- Subset of 4 of the original 7 IF sites



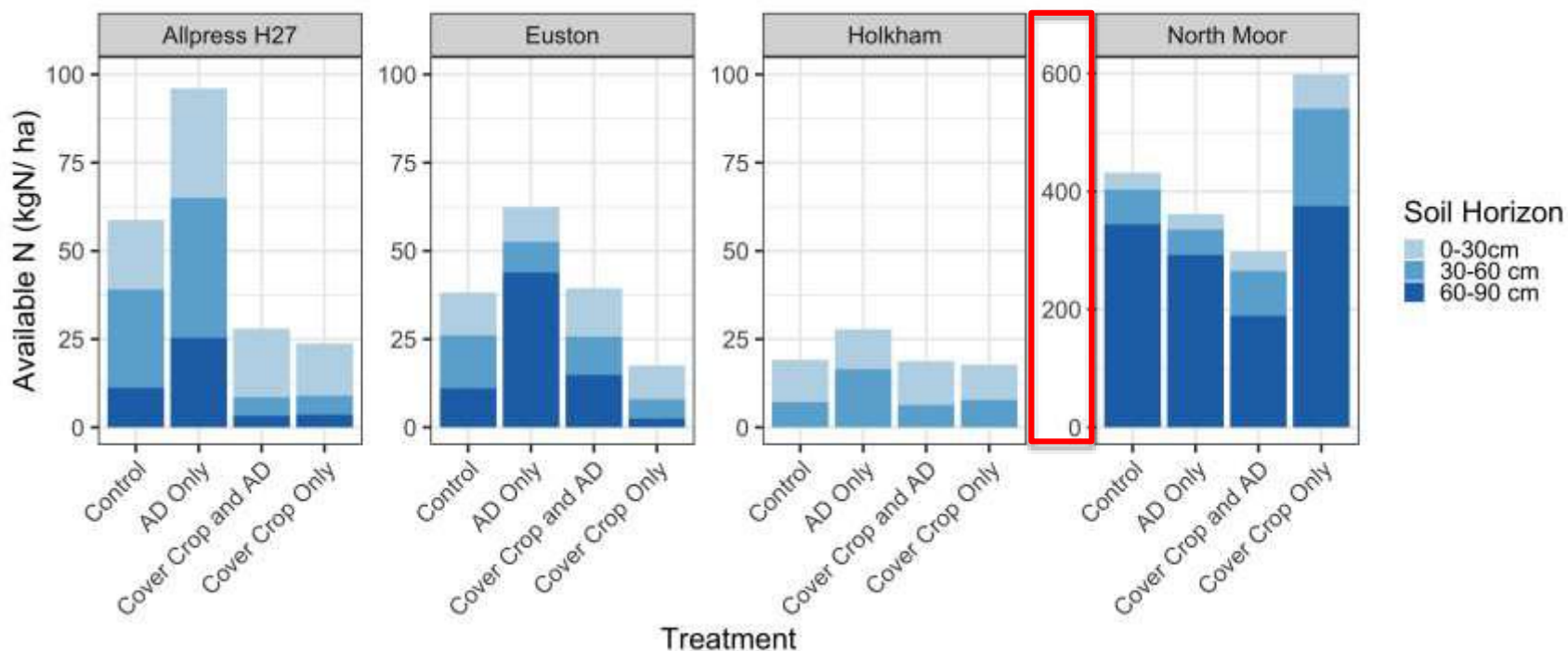
Experimental Design



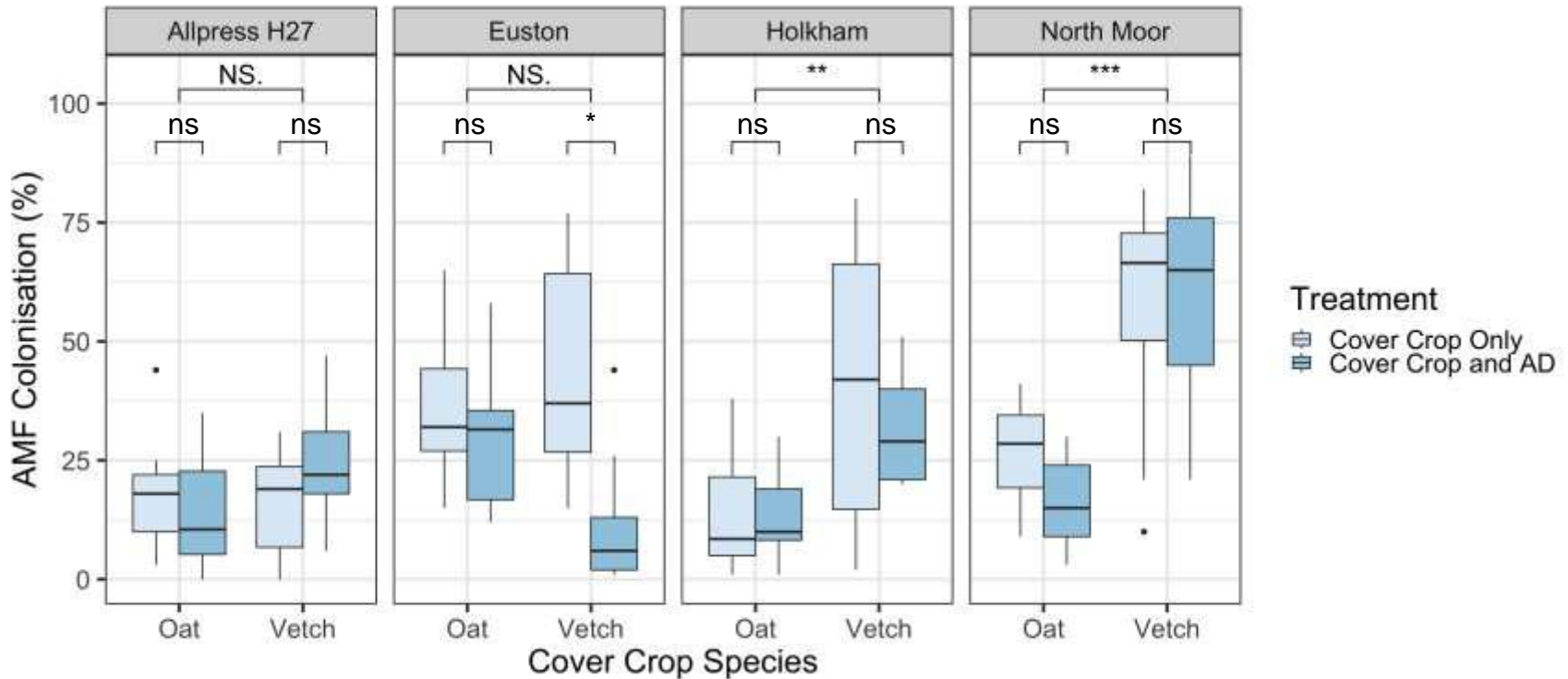
- Radish, oat, vetch, (and buckwheat) cover crop
- Maize cash crop
- AMF **inoculant** treatment, containing:
 - *Funneliformis mosseae*
 - *Funneliformis geosporum*
 - *Claroideoglossus claroideum*
 - *Rhizophagus irregularis*
 - *Glomus microaggregatum*



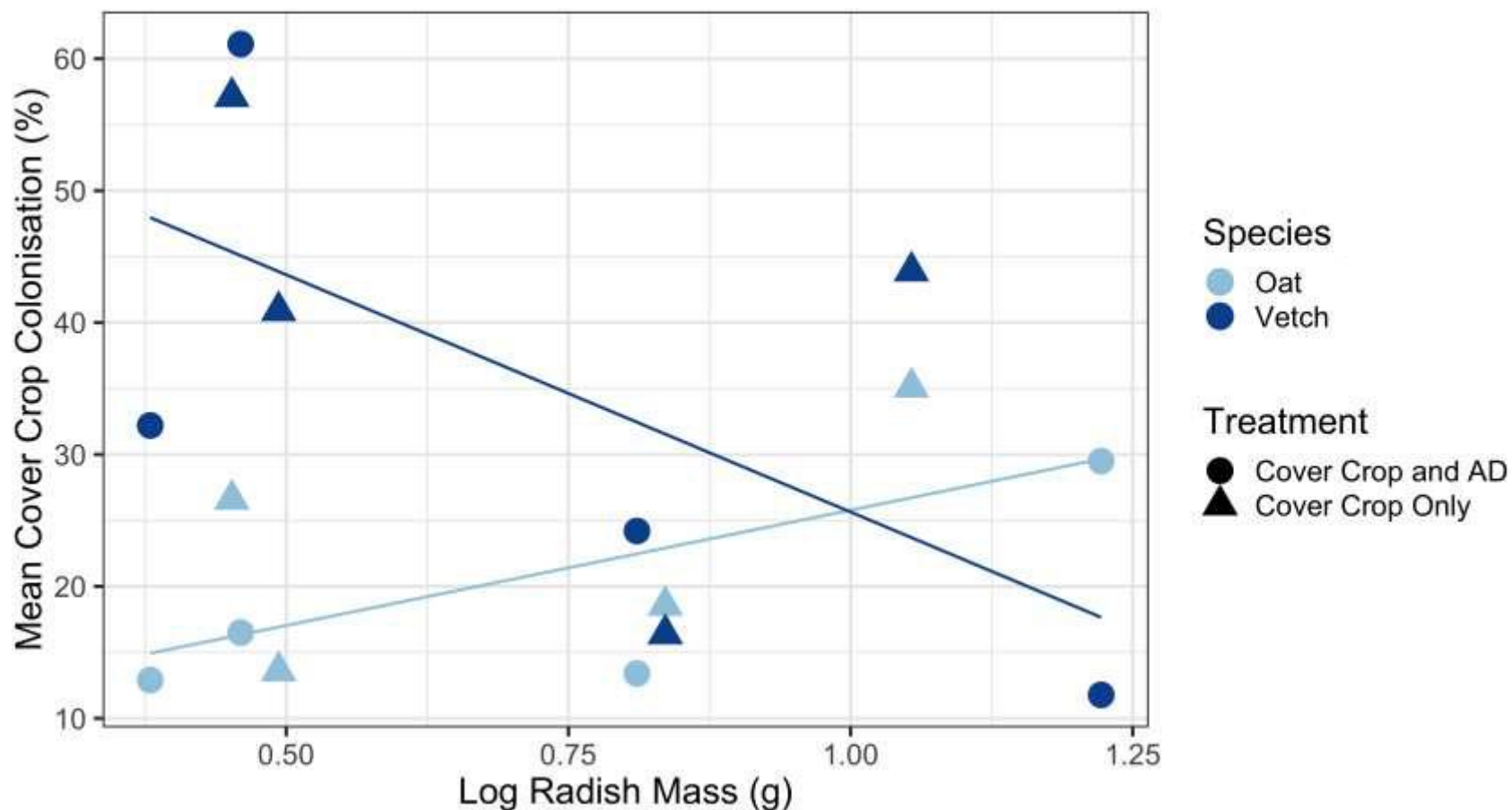
Results - Soil Available N



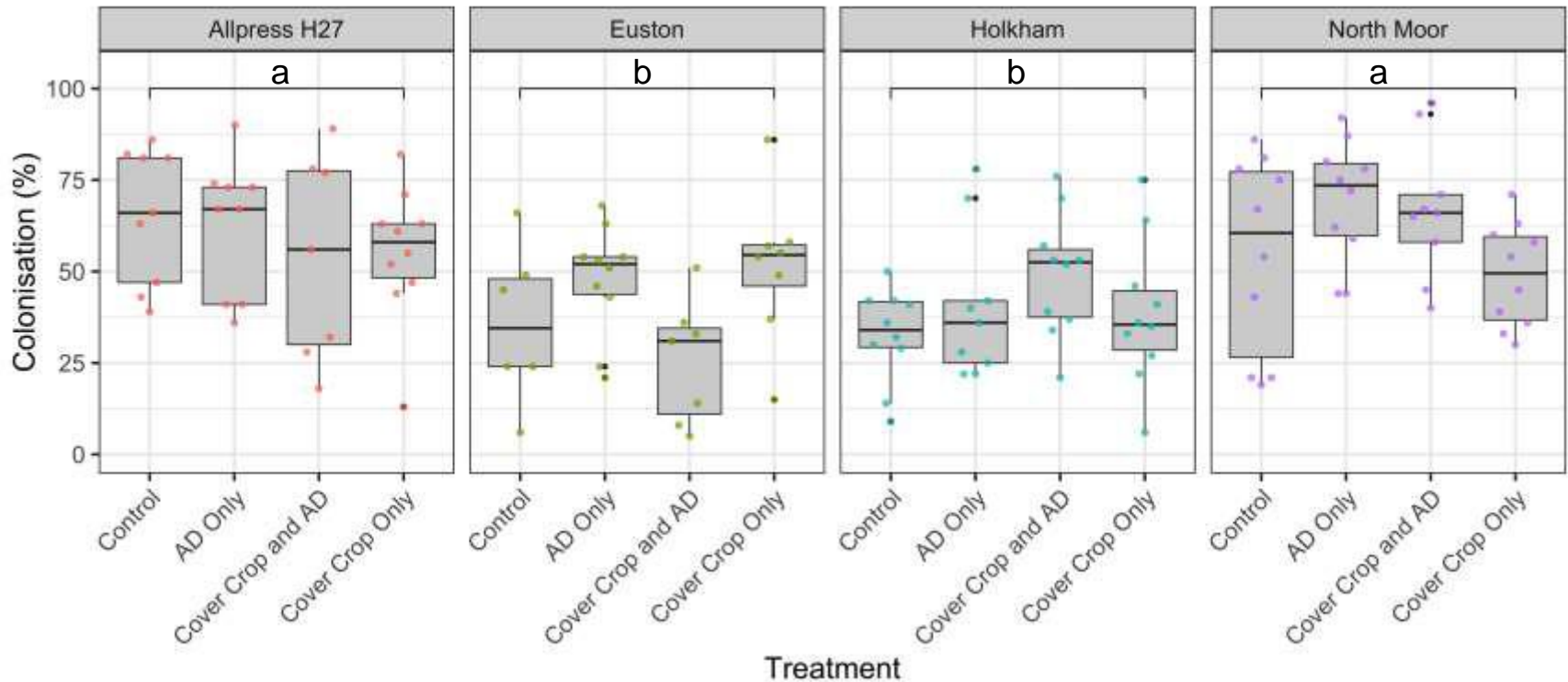
Results – Cover Crop Colonisation by AMF



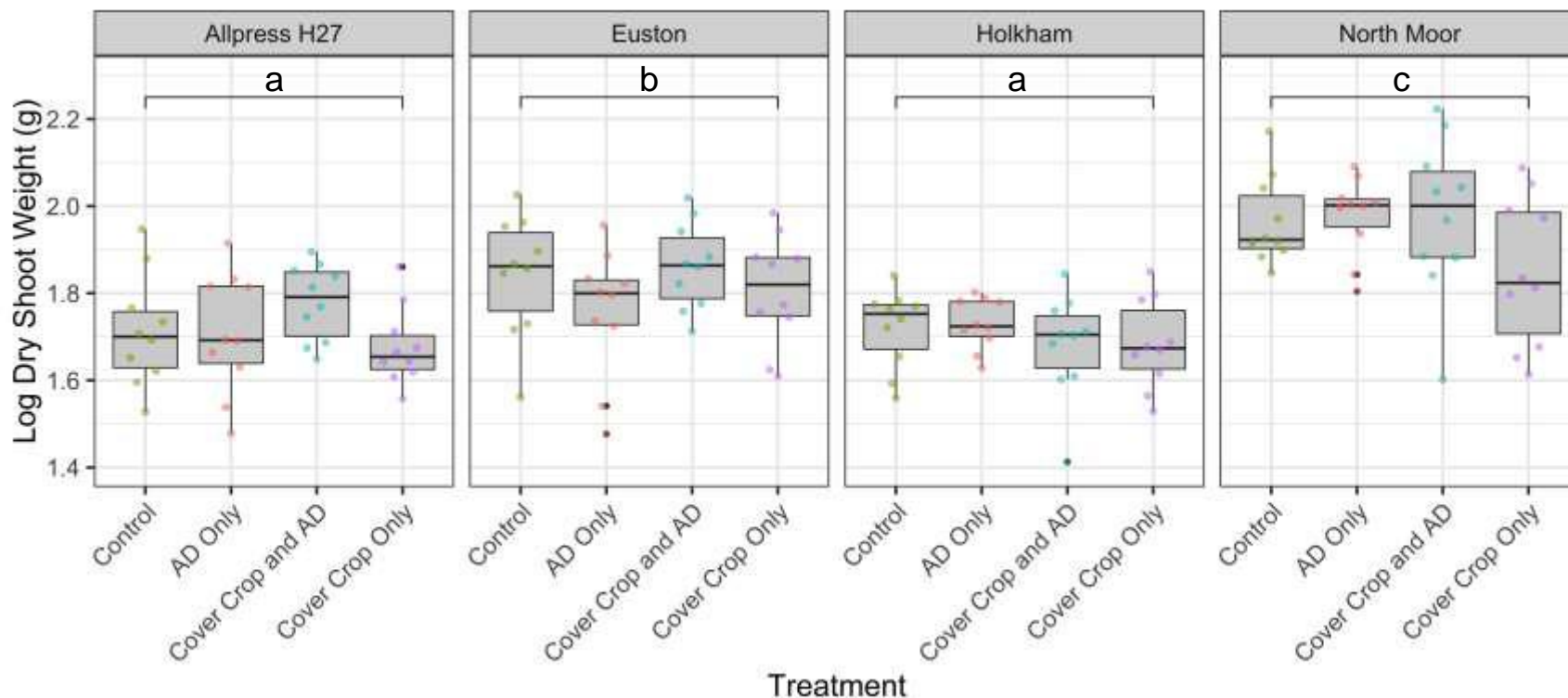
Results - Mycorrhizal interaction with non-AMF Radish Cover Crop



Results – Maize Colonisation by AMF



Results – Maize Biomass



Challenges Winter 17- Summer 18



Conclusions of IF project



- **AD decreased colonisation** of cover crops, but **inconsistent** between species and site
- **No effect** of cover crops or AD on **mycorrhizal colonisation** or **biomass** of following maize
- Cover crops **stabilised soil N** and **improved organic matter** on some soil types



AMF Diversity and yield ongoing...

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Future Plans 1 – New Farming Systems Trial

- Cover crop rotations since **Autumn 2007**
- Cover crop mixes:
 - Fodder radish and black oat
 - Legume mix - crimson clover, red clover, black medic, lucerne, and vetch
 - Fallow
- **Three levels** of nitrogen application
- 2018 crop of spring barley



Future Plans 2 – Replicated AMF Inoculant Trial

- Black oat, vetch, and radish cover crops
- **Two radish seed rates** grown with oats
- Five species **AMF inoculant** mix drilled with cover crop, consisting of:
 - *Funneliformis mosseae*
 - *Funneliformis geosporum*
 - *Claroideoglossum claroideum*
 - *Rhizophagus irregularis*
 - *Glomus microaggregatum*
- **Legacy** effect in oats, following barley



Future Plans 3 – Glasshouse Experiments



1. **Inoculation** of barley and oats with one of five AMF species, or a five way mix
 - What are the effects on **growth**?
 - Does the **most beneficial** species **dominate colonisation** in the mix?
1. Blumenol method of establishing mycorrhizal colonisation



Thanks!

- The AF Group
- AHDB and AFCP
- Agri-Tech East, Allpress Farms and Plantworks Ltd
- Dr Lydia Smith and the Innovation Farm team
- Dr Uta Paszkowski, Chai Hao Chiu, and the Cereal Symbiosis lab
- Dr Nathan Morris, Dr Liz Stockdale, David Clarke, David Jones and the trials team at NIAB Morley
- Innovative Farmers: Jim and Patrick Allpress, Andrew Blenkiron, James Beamish, Phil Rayns, Robert England, and David Wright

