Root diversity effects on agroecosystem function

Can increased cover crop diversity restore soil-associated ecosystem services under variable rainfall patterns?

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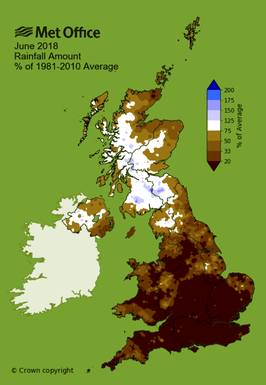
The problem

Agricultural intensification has simplified landscapes in the UK, thereby:

- Reducing biodiversity
- Depleting natural resources
- Threatening ecosystem services

This has **reduced resilience to abiotic stress**, thus:

- Threatening agricultural production
- Causing environmental degradation

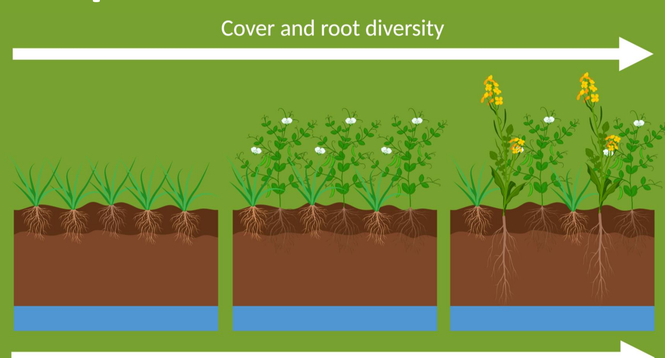


UK climate predictions:

- **Hotter and drier summers** can improve sowing and harvesting conditions but increase drought risk
- **Wetter winter and spring** can lead to waterlogging

UK climate reality: 2018 drought decreased yields

Proposed solution



Research lacking in quantifying plant diversity effects on soil water availability and soil-associated agroecosystem services regulated by **root systems:**

- Limiting soil erosion
- Building soil carbon stores
- Reducing pollution from nutrient leaching

How **cover crops bind soil** through root and rhizosheath development has attracted little attention despite their soil erosion control capacity.

Aim

Address the significant knowledge gap in potential benefits of increased cover crop diversity for improving soil nutrient stocks (carbon, nitrogen) and soil-associated ecosystem services under varying soil water availability.

Objectives

- Project Timeline (Y1-Y3.5)
- Obj.1 Survey the literature to identify species combinations suitable for studying the research hypothesis (Y1).
- Obj. 2 Determine below-ground mechanisms leading to improved nutrient retention and reduced water flow and erodibility in vegetation of increasing diversity under different precipitation scenarios (Y1-2).
- Obj. 3 Quantify soil stocks and ecosystem services under different levels of cover crop diversity at field scale (Y2-3).
- Obj. 4 Knowledge transfer to land managers and other stakeholders (Y1-3.5).

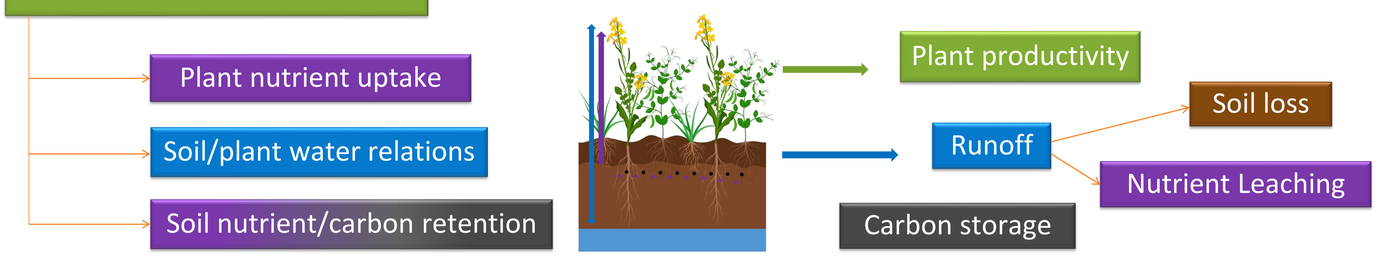
Experimental plans

Mesocosm scale (Obj. 2)
Mechanistic measurements

Varying water availability

Different levels of plant diversity

Field scale (Obj. 3)
Ecosystem service measurements



Mesocosm

Aim:
Investigate cover crop rhizosheath development (soil binding capacity) in droughted and well-watered soil.

Secale cereale, Lolium westerwoldicum, Raphanus sativus, Brassica juncea.

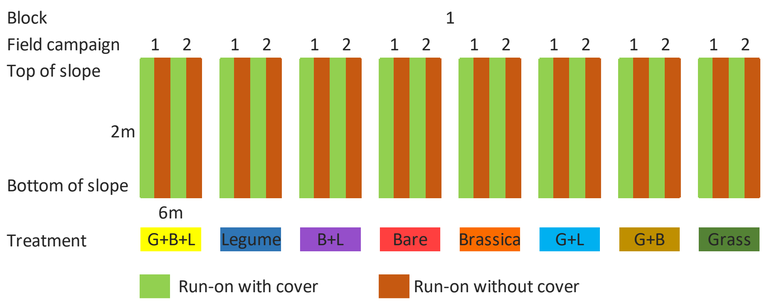
- Species development stage & structural differences in rooting systems affect rhizosheath formation.
- Next mesocosm will combine species to determine if effects are additive or interact.

Run-on field trials – Autumn-sown at JHI

Aim:
Assess cover crop diversity impact on soil erodibility and nutrient loss.

Measurements:

- Coverage (%)
- Stems/unit area
- Soil moisture (TDR probe)
- Bulk density
- Soil organic matter
- Rhizosheath cores:
  - Rhizosheath mass
  - Root biomass
- Run off collection:
  - Sediment loss
  - Sediment C & N



Conclusions

By providing scientific evidence for increased cover crop diversity effects on agroecosystem function, this work will inform land managers of cropping practices to conserve soil stocks and function and aid in delivering environmental policy targets for agriculture.

Acknowledgements
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