

Soil biological quality in temperate agroforestry systems: tree rows enhance soil arthropod abundances, diversity, and QBS-ar scores on UK arable land

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Background



Background



£10m a year needed to ensure England's soil is fit for farming, report warns

Soil erosion and water pollution caused by poor farming practices mean land could become too poor to sustain food crops by the end of the century



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The hidden cost of UK food: Soil degradation

17.03.2018 | ARTICLE | ENVIRONMENTAL ISSUES | SOIL HEALTH | MEGAN PERRY

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Is the source of 95 percent of our food in trouble?

by Hattie Ellis

Headlines warn the state of our soil is now a serious threat to the environment and crops. But they also say good-quality soil can help save the planet. "No country can withstand the loss of its soil and fertility", said Michael Gove in 2017, raising fears there are just decades of UK farming left. What are the powers and dangers of this dark material, and how worried should we be?



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'Urgent action' needed on unsustainable soil degradation, campaigners warn

Environmental activists have warned that farmers and land managers need more resources to restore soil health as the UK marks Organic September.

Rebecca Speare-Cole • Friday 01 September 2023 17:36 BST



Improving soil could keep world within 1.5C heating target, research suggests

Better farming techniques across the world could lead to storage of 31 gigatonnes of carbon dioxide a year, data shows

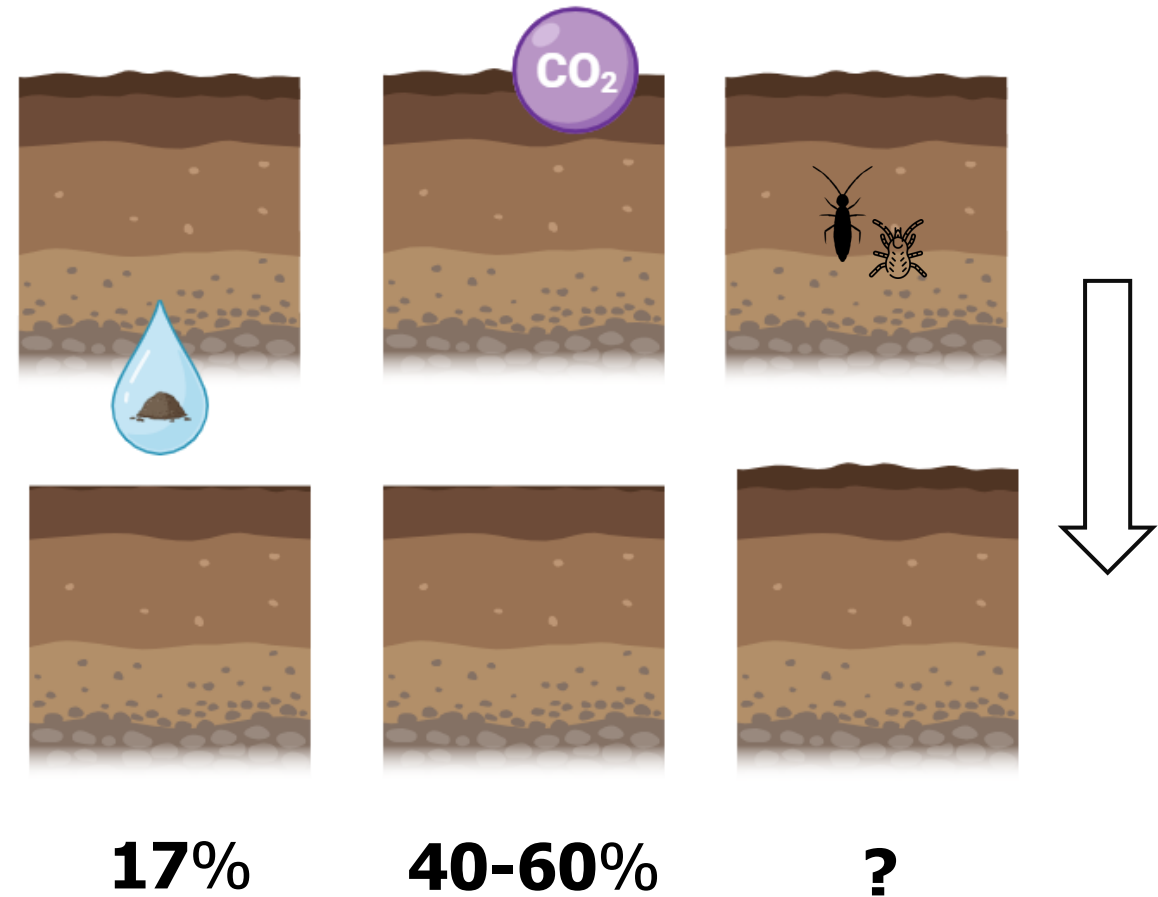
UK farmers consider quitting after extreme wet weather and low profits

Farmers 'on the brink' after record rains, phasing out of EU subsidies and price volatility

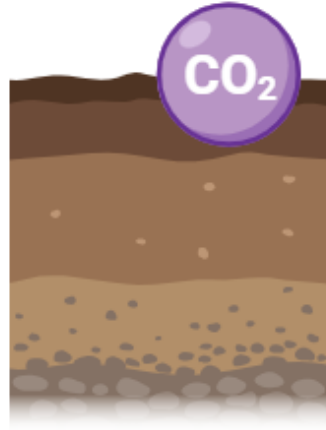
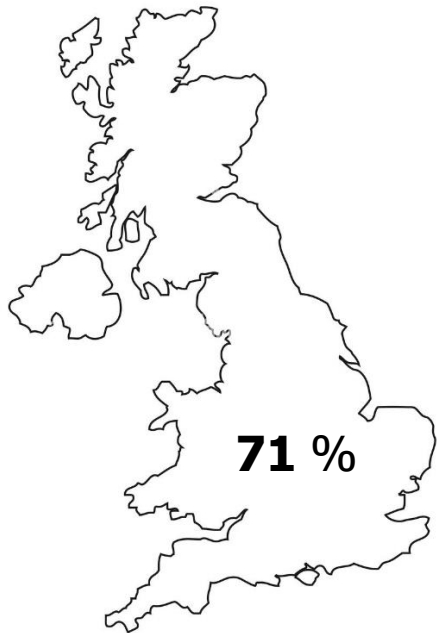
Background

What do we actually know?

- UK soils are experiencing substantial physical, chemical, and biological degradation due to intensive agricultural practices. (EA, 2023)
- Soil degradation places soil biotic communities under unsustainable pressure. (Jeffrey and Gardi, 2010; Tsiafouli et al., 2015)



Background



“UK soil contains about 10 billion tonnes of carbon, roughly equal to 80 years of annual greenhouse gas emissions... Soil carbon loss is an act of economic and environmental self-harm.” (EA, 2023)



“The biggest medium to long term risk to the UK’s domestic production comes from climate change and other environmental pressures like **soil degradation**, water quality and **biodiversity**.” (DEFRA, 2023)

Alley-cropping is the integration of parallel rows of trees into farmland *to foster beneficial ecological interactions between components.*

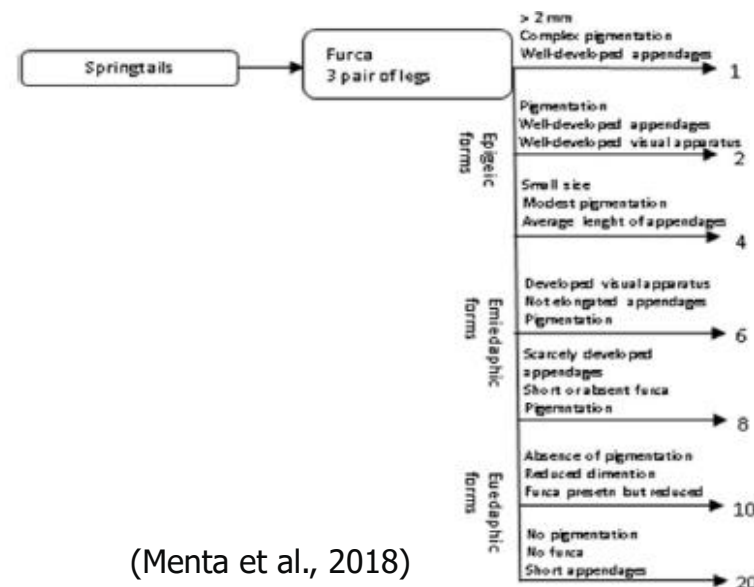


Research questions

1. Does tree row presence and proximity on arable fields increase soil meso- and macrofauna (fauna) abundance or richness?
2. Is the taxonomic composition of soil fauna different between fields with and without tree rows, and at an increasing distance from tree rows?
3. Does tree row presence and proximity on arable fields increase soil meso- and macrofauna (fauna) soil biological quality?

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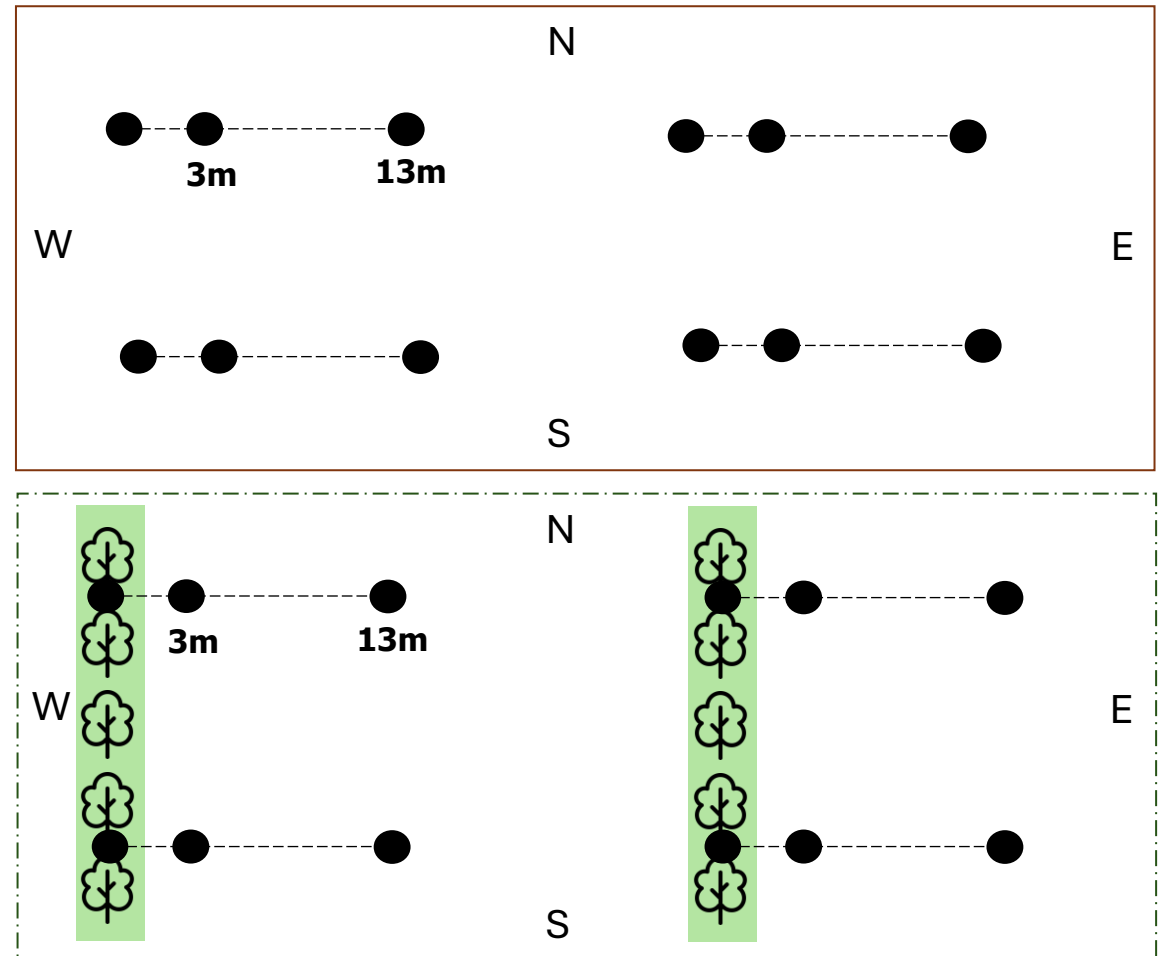
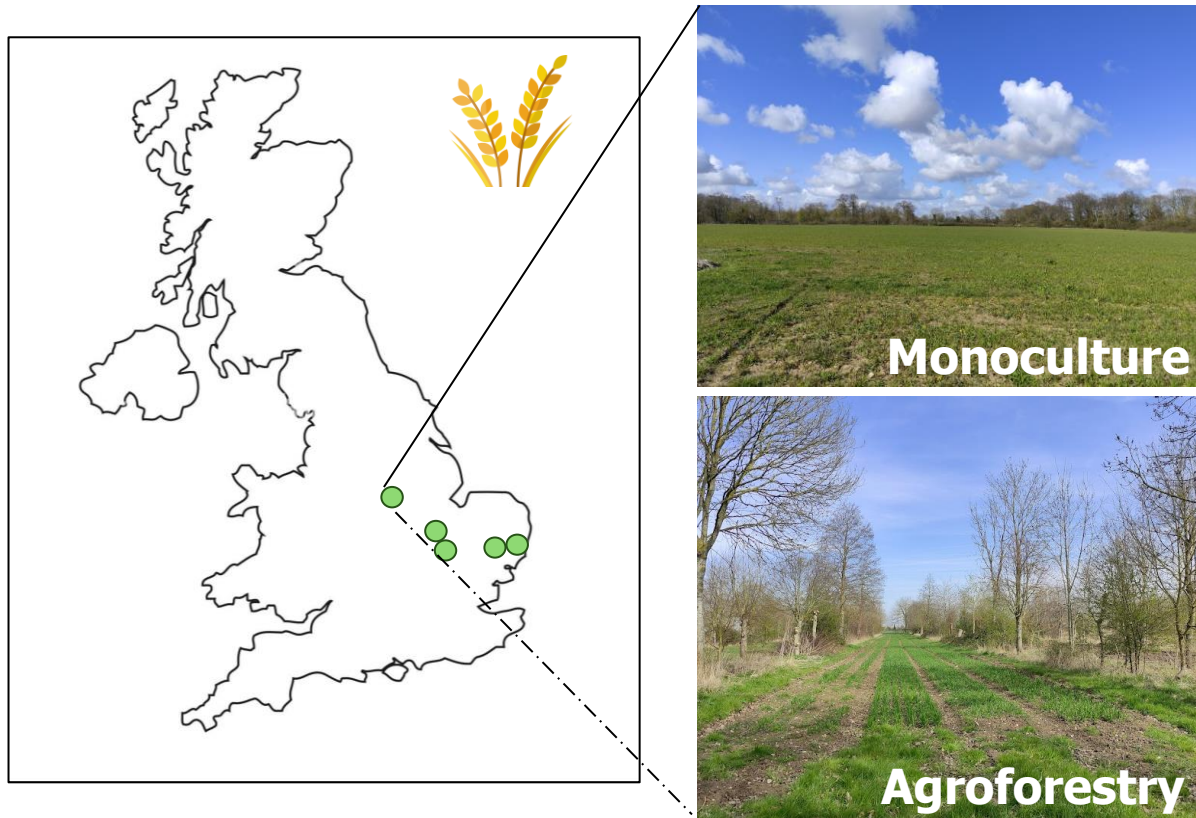


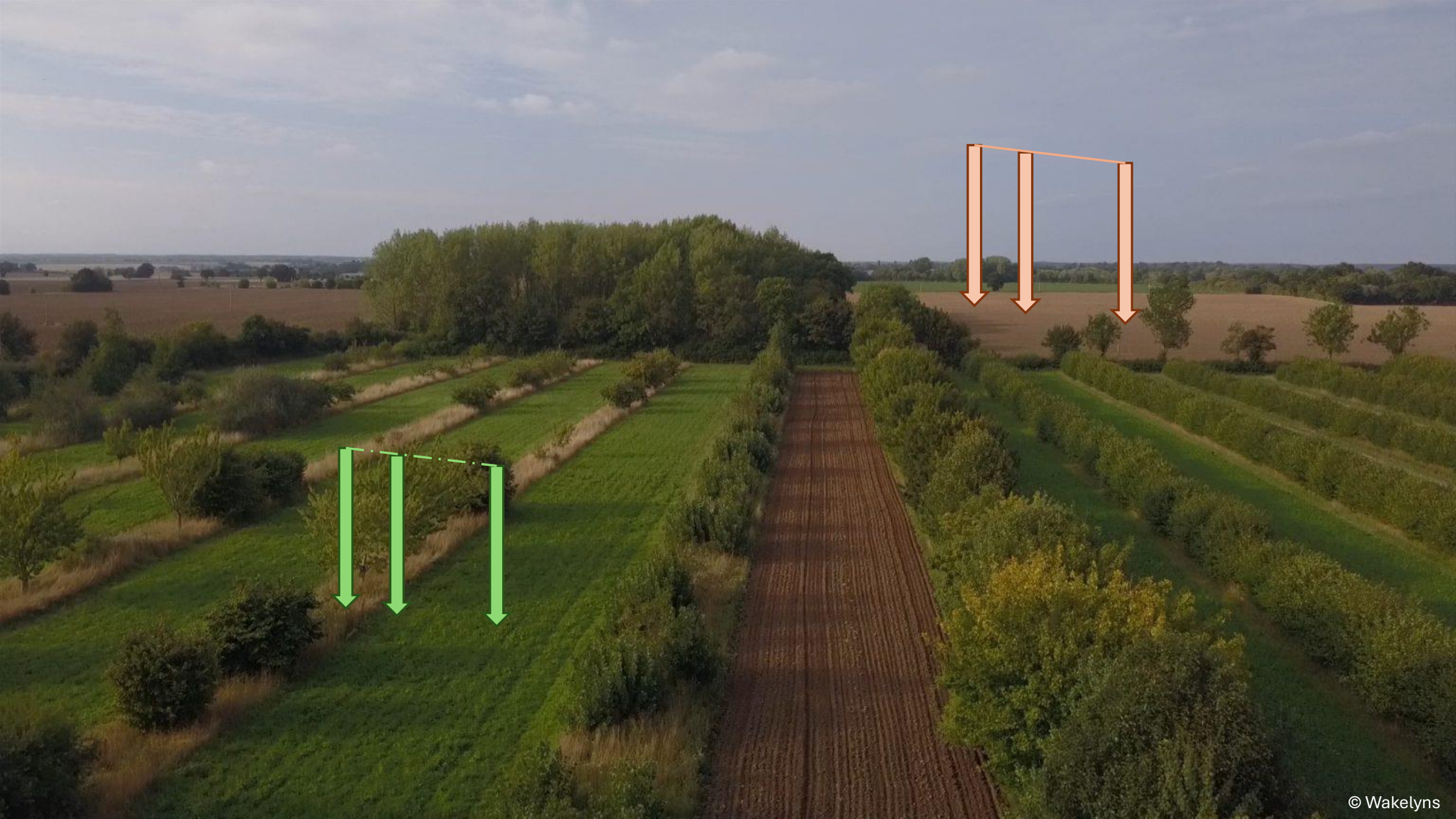
(Menta et al., 2018)



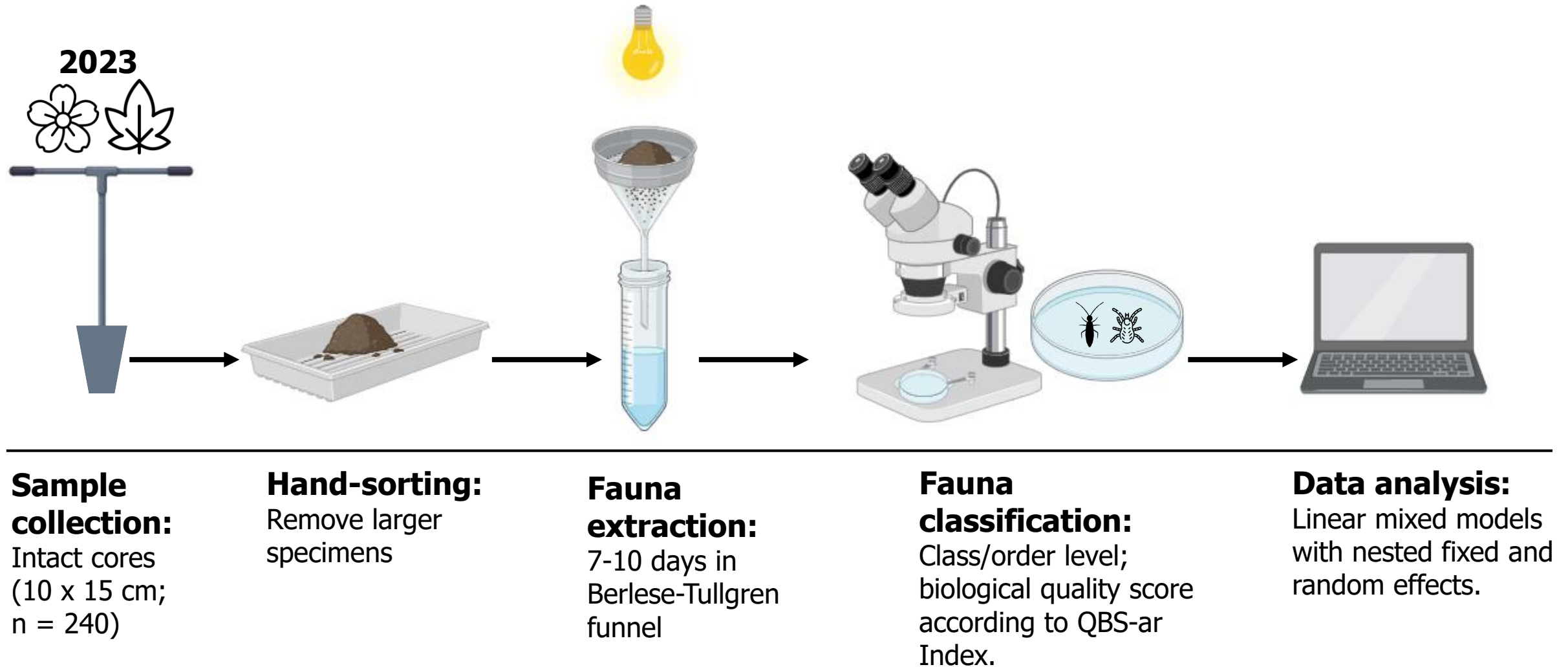
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Methods



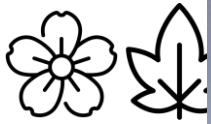


Methods



Metho

2023



Sample collection

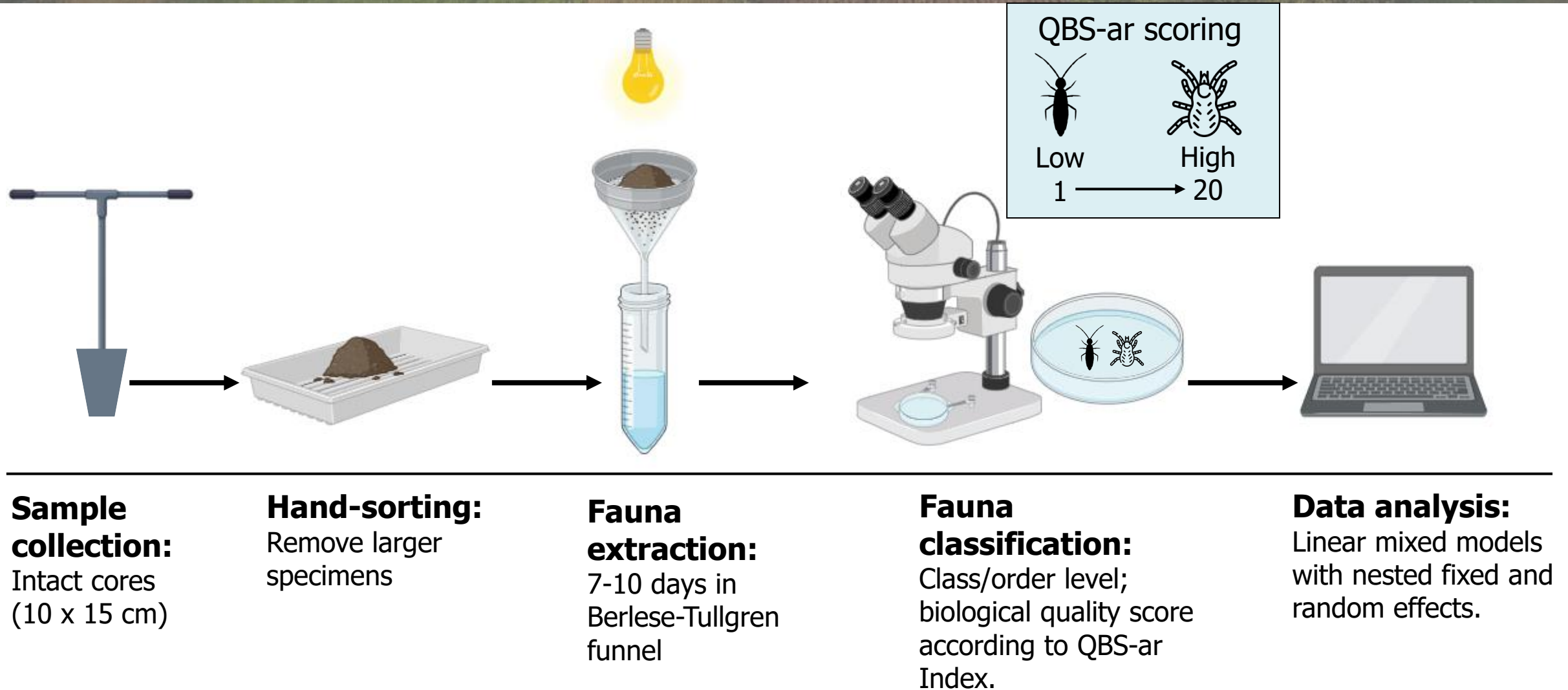
Intact cores
(10 x 15 cm
n = 240)



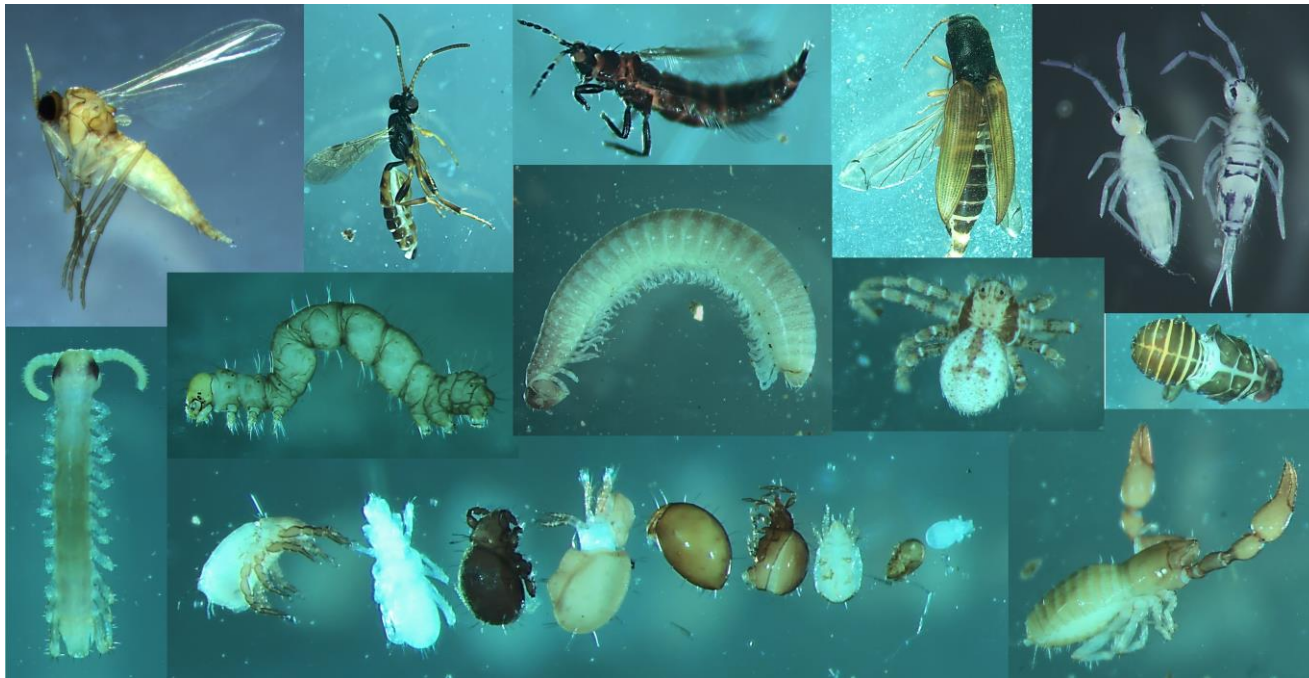
Analysis:

mixed models
tested fixed and
effects.

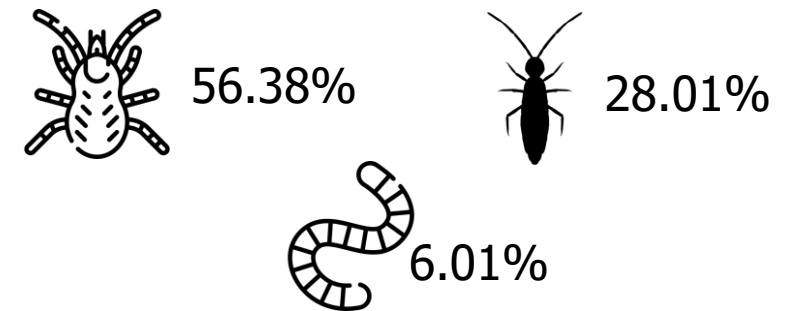
Methods



Results



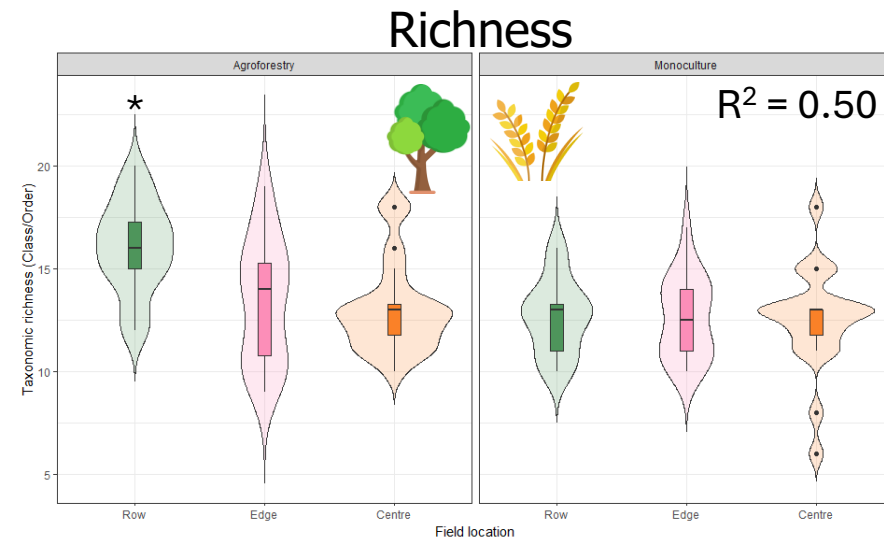
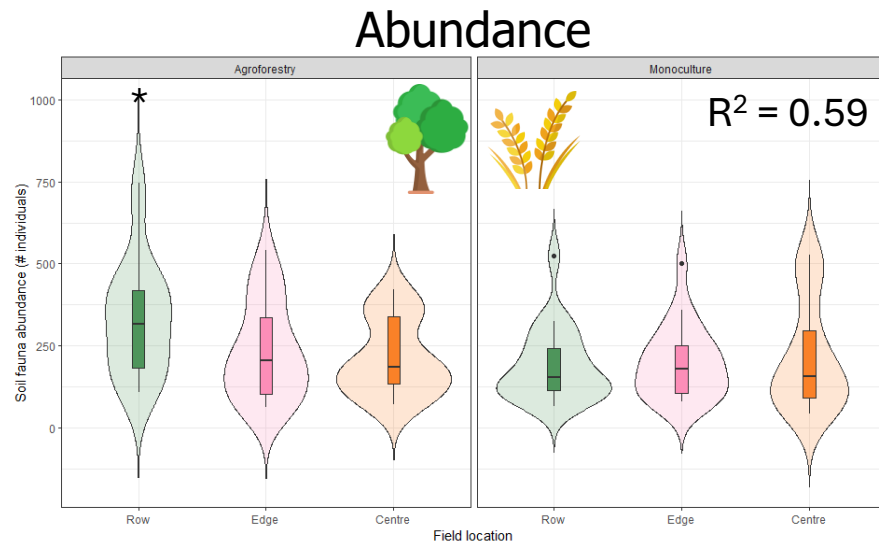
- **27,580** specimens across 29 orders*
- 90% made up of three broad groups:



- **Four** orders unique to agroforestry; none for monoculture

Results

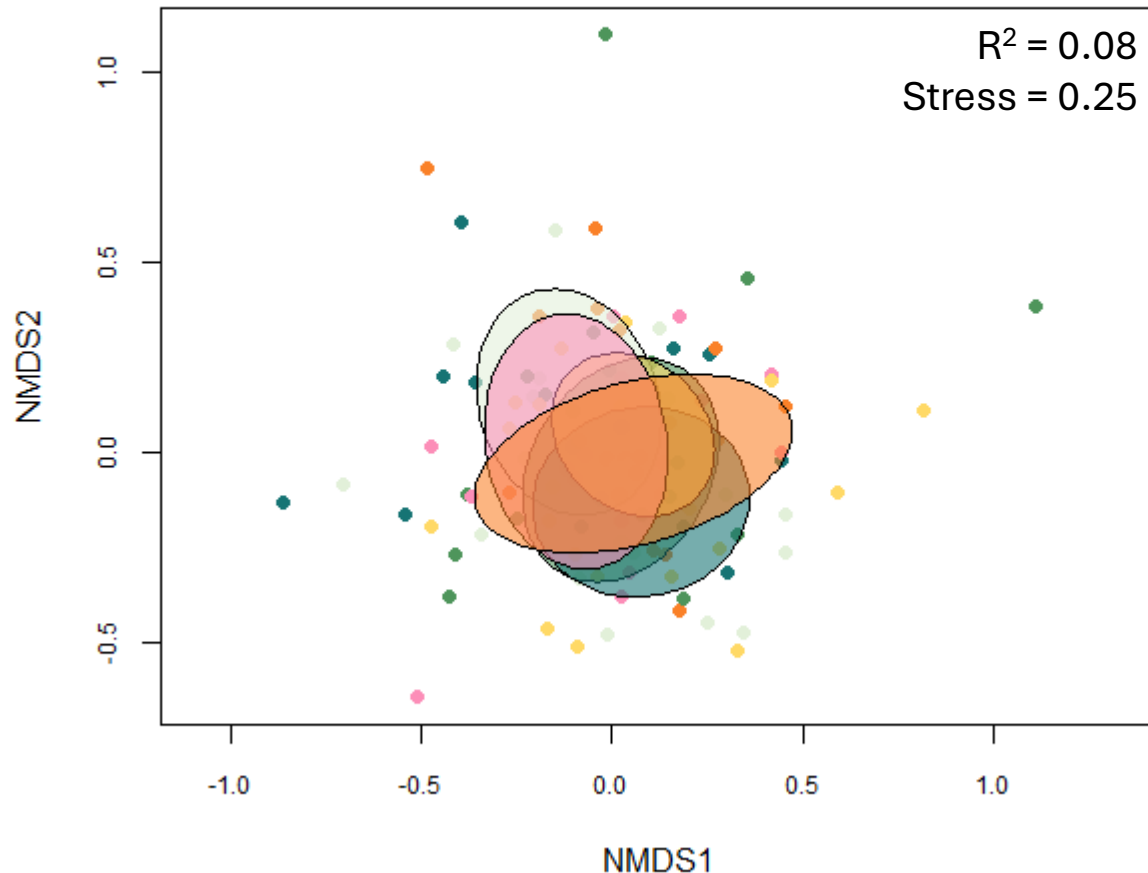
Research questions 1: Do fields with tree rows support a higher abundance and/or richness of soil meso- and macrofauna than those without, and do these changes extend into the crop alley?



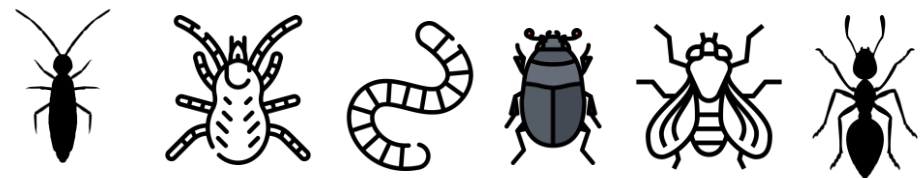
- Significant increase in soil fauna abundance and richness (class/order) under alley-cropping, but **only in the tree row**.

Results

Research question 2: Is the composition of soil fauna different between fields with and without tree rows, and at an increasing distance from tree rows?

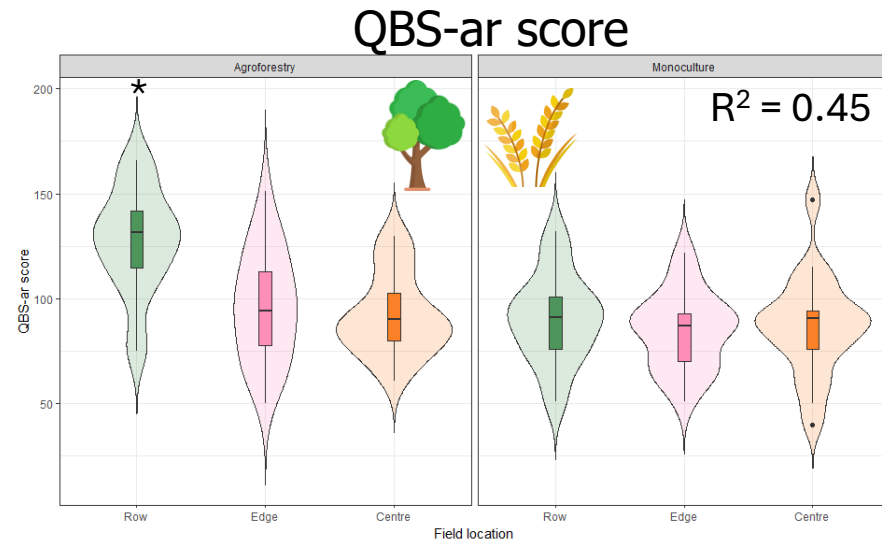


- Presence/absence composition of soil fauna (class/order) is significantly different between treatments ($p < 0.01$).
- Only small proportion of variation explained by our treatments.



Results

Research question 3: Is soil biological quality higher on fields with tree rows than those without, and do those changes extend into the crop alley?



- Significant increase in soil biological quality, but **only in the tree row.**

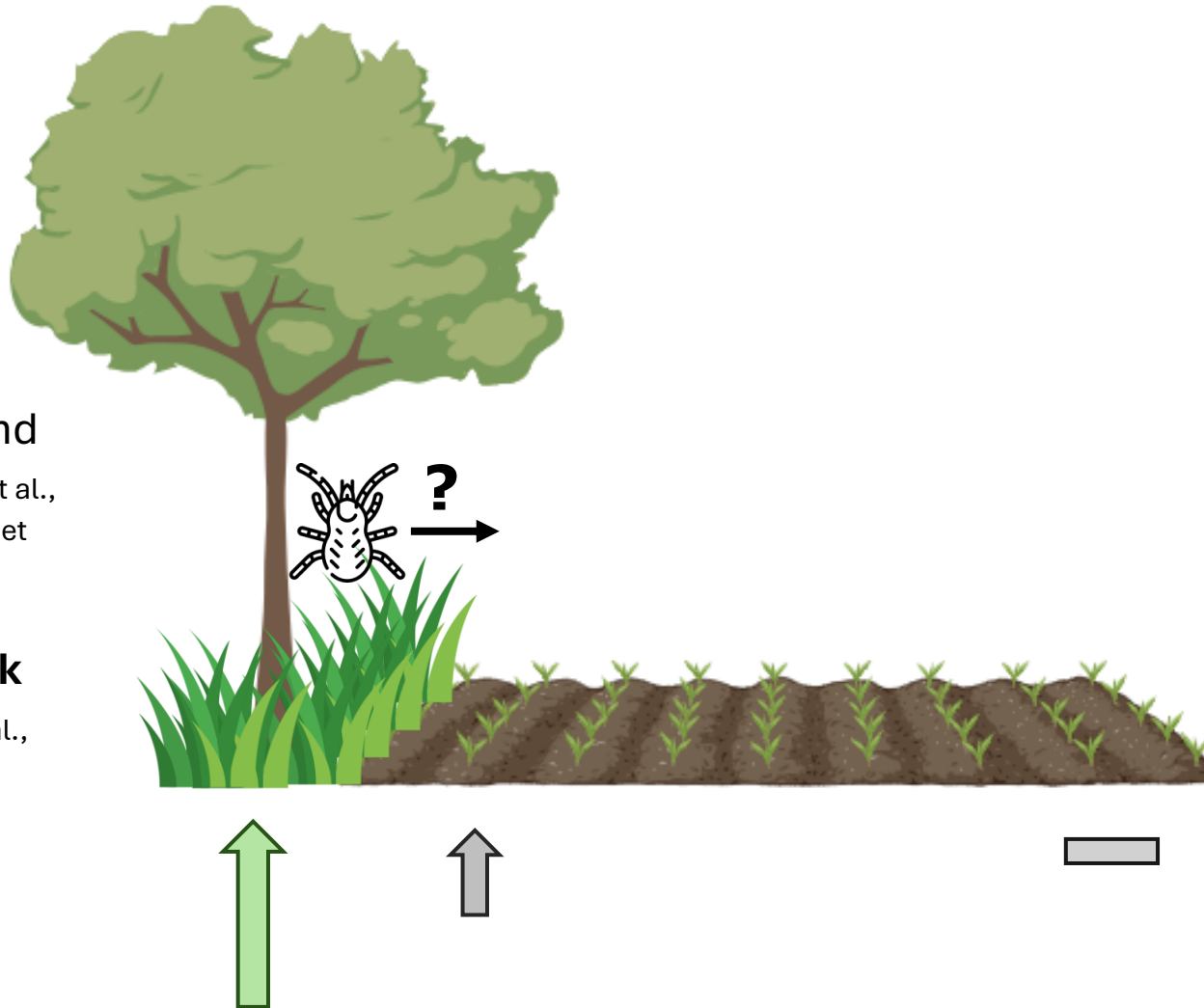


Only soil pH had a near-significant ($p < 0.1$) positive effect on soil biological quality score.

Discussion

Tree rows increase soil meso- and macrofauna abundance, richness, and biological quality. (Boinot et al., 2019; Cardinael et al., 2019; Pardon et al., 2019).

Most likely due to a lack of disturbance. (Guillot et al., 2021)



No significant changes were observed in the crop alley.

Small increase in richness & biological quality at edge of tree row.



Thank you to...



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- Ken Norris
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- Aidan Byrne
- Cris Raw

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- Farm Eco
- Maple Farm
- Red House Farm
- Wakleyns
- Whitehall Farm

Literature cited

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