

Comparing plant and invertebrate communities in agroforestry versus arable fields: traits or taxonomy?

Background

- Agroforestry, or ‘farming with trees’, has been proposed as a win-win solution for productivity and sustainability;
- Agroforestry systems are thought to increase populations of animals that control crop pests, reducing the need for chemicals;
- However, some studies have found that agroforestry can worsen weed and pest problems, e.g. slugs;
- Therefore, we need to better understand the pros and cons of agroforestry in terms of beneficial and undesirable species.

Study aims

- In this study we used a trait-based approach that groups different species by characteristics such as dietary specialism and mobility, in order to understand how and why different species react differently to agroforestry.
- We aimed to compare the diversity and community composition of plants, invertebrate herbivores and invertebrate natural enemies (predators and parasitoids) in agroforestry versus arable fields. We also compared pest and weed abundance in agroforestry versus arable fields.

Field sites and sampling

- We sampled plants and invertebrates at three farms in Nottinghamshire and Cambridgeshire;
- Each farm contained an agroforestry field with a paired arable field under the same management;
- The agroforestry systems comprised mostly apple trees intercropped with cereals or other combinable crops in 24 m wide alleys;
- Sampling techniques included pitfall traps, pan traps (Fig. 1), and quadrats;
- We conducted the study over two years (2018 and 2019).

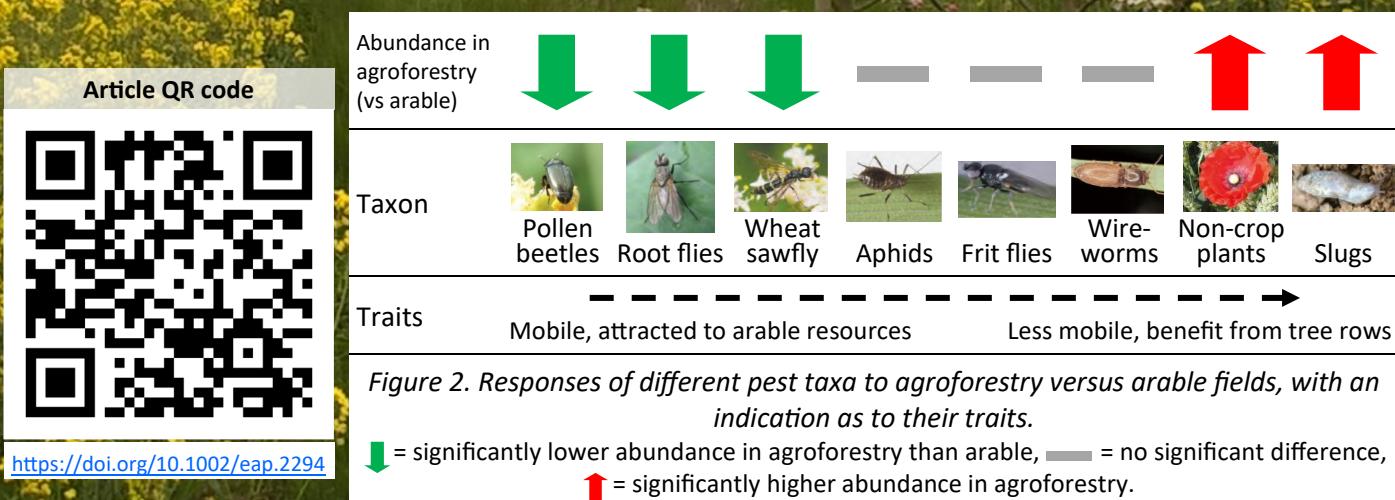


Figure 1. Pan traps, painted with UV colours and filled with water to sample aerial insects

Comparing plant and invertebrate communities in agroforestry versus arable fields: traits or taxonomy?

Key findings

- Taxonomic diversity of plants and invertebrates was significantly higher in agroforestry than arable fields.
- Traits associated with agroforestry rather than arable included lack of wings and diet specialisation in invertebrates, and perenniability and flowering time in plants.
- This can be explained by the lower disturbance and availability of year-round habitat resources in agroforestry.
- The diversity of traits associated with pest control in natural enemies was significantly higher in agroforestry than arable, indicating an improved level of natural pest control.
- Pest abundance in agroforestry versus arable varied strongly by taxon, but the effects can potentially be explained by resource attraction and mobility traits (Fig. 2).



Implications for agroforestry

- Our results suggest that agroforestry fields have different pest and weed management issues to arable fields;
- High-mobility pests attracted to arable resources (e.g. root flies) were suppressed in agroforestry;
- Generalist, low-mobility pests (e.g. slugs) were more abundant in agroforestry;
- Perennial, creeping weeds (e.g. creeping thistle) were more prevalent in agroforestry than arable, unlike annual weeds (e.g. black-grass).

Implications for research

- We recommend further application of trait-based approaches to understand how farm management affects pests and their natural enemies;
- Taxonomic approaches often lead to unpredictable results, e.g. the effects of habitat diversification on carabid beetles strongly varies by species;
- Trait-based approaches can improve the generality and predictability of results, in addition to statistical significance.