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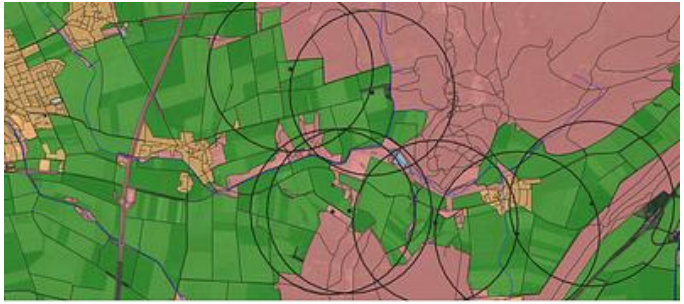
Leading | Protecting | Enhancing

Can the structure of agricultural landscapes influence the insect-microbe relationship?

Dr Daniel Leybourne

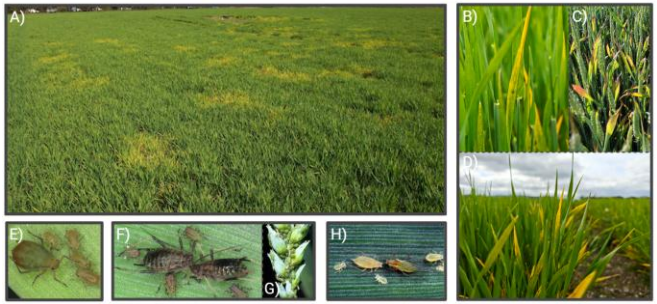
September 2026

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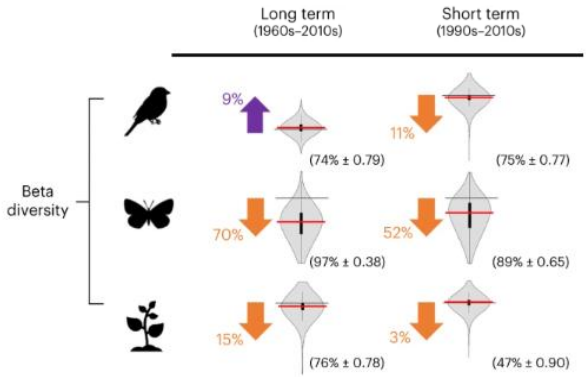


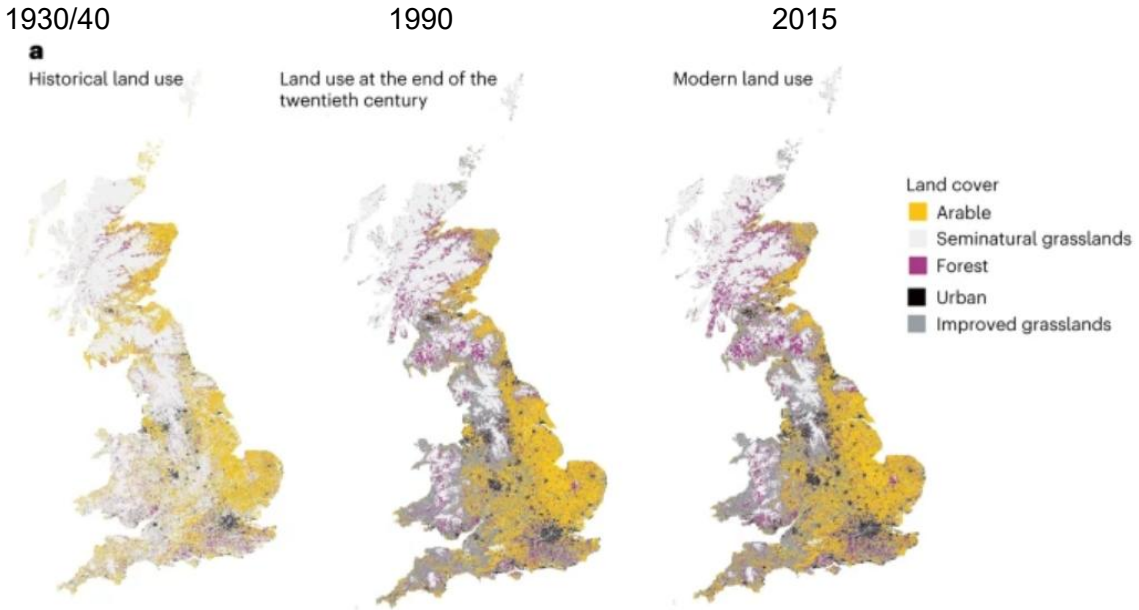




Insects, agricultural ecosystems, and anthropogenic change

Anthropogenic change –
Environmental changes driven (directly or indirectly) by human activity. Including ***land-use change***, deforestation, urbanisation, and overexploitation of natural resources.

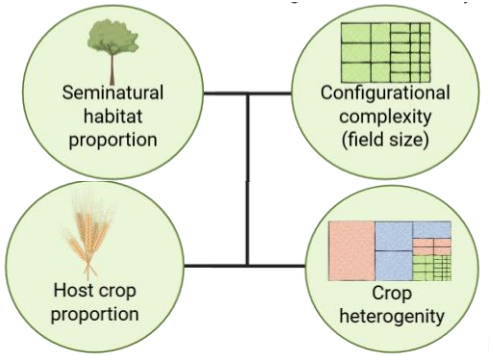




Montràs-Janer et al., 2024. *Nature Ecology & Evolution*

The agricultural landscape: Why is it important?

Agricultural landscapes –
Areas of land specifically shaped by agricultural practices, reflecting the arrangement and appearance of land as influenced by human activity via farming.



Ecology Letters

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ECOLOGY LETTERS

SYNTHESIS OPEN ACCESS

Semi-Natural Habitats Buffer the Effects of Crop Diversification on Arthropod Pest Control Services in Agricultural Landscapes

Thomas Perrot[1,2] | Léa Beaumelle[1,3] | Eva Thomine[1,4] | Yann Tricault[5] | Nicolas Desneux[4] | Matthias Albrecht[6] | Péter Batáry[7] | Felix Bianchi[8] | Klaus Birkhofer[9] | Aliette Bosem Baillod[10] | Rebecca Chaplin-Kramer[11] | Anne-Marie Cortesero[12] | Alejandro C. Costamagna[13] | Tim Diekötter[14] | Johan Ekroos[15,16,17] | Martin H. Entling[18] | Vesna Gagic[19] | Russell Groves[20] | Anders Huseth[21] | Coline Jaworski[1,4] | Marina Kaiser[22] | Daniel S. Karp[23] | Jochen Krauss[24] | Blas Lavandero[25] | Anne Le Ralec[12] | Yanhui Lu[26] | Emily A. Martin[27] | Matthew Mitchell[28] | Gonzalo A. R. Molina[29] | Erkki David J. Perovic[31] | David Ragsdale[32] | Sarah Redlich[24] | Ishan Samaranayake[33] | Julia Saulais[12] | Nancy A. Schellhorn[34] | Ingolf Steffan-Dewenter[24] | Louis Sutter[35] | Teja Tscharntke[36] | Matthias Tschur Adrien Rusch[1]

RESEARCH ARTICLE | ECOLOGY

Plant diversity modifies multi-trophic interactions in croplands, grasslands and forests

NIAN-FENG WAN, MUYAO LI, SIYUAN SHEN, JUN-XIANG ZHOU, YU-TONG ZHU, BEN A. WOODCOCK, YUE-QING HU, SHINICHI NAKAGAWA, DAVID TILMAN, [...], AND CHRISTOPH SCHERBER +168 authors Authors Info & Affiliations

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Received: 20 July 2025 | Accepted: 6 October 2025

DOI: 10.1111/1365-2664.70210

RESEARCH ARTICLE

Journal of Applied Ecology

Landscape composition shapes biological control by promoting off-season predator diversity

Yulin Zhu[1,2,3] | Hainan Chong[1,2] | Yi Zou[4] | Qian Lai[2] | Quanfeng Yang[1] | Kris A. G. Wyckhuys[5,6] | Wopke van der Werf[7] | Haijun Xiao[1]

Ecology Letters

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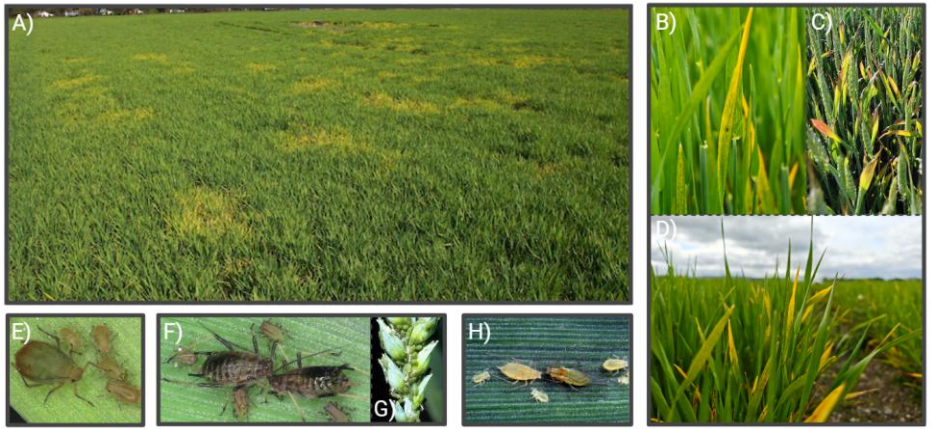
The Importance of Landscape Composition for Pest Control and Crop Yield: A Global Quantitative Synthesis

Katja Poveda[1] | Daniel S. Karp[2] | Rebecca Chaplin-Kramer[3] | Mary Centrella[4] | Tim Luttermoser[5] | Ricardo Perez-Alvarez[6] | Megan E. O'Rourke[7] | Emily A. Martin[6] | Heather Grab[8]

Two economically impactful insects

Cereal aphids – economically damaging in cereal and grassland systems

- Grain aphid
- Rose-grain aphid
- Bird cherry-oat aphid

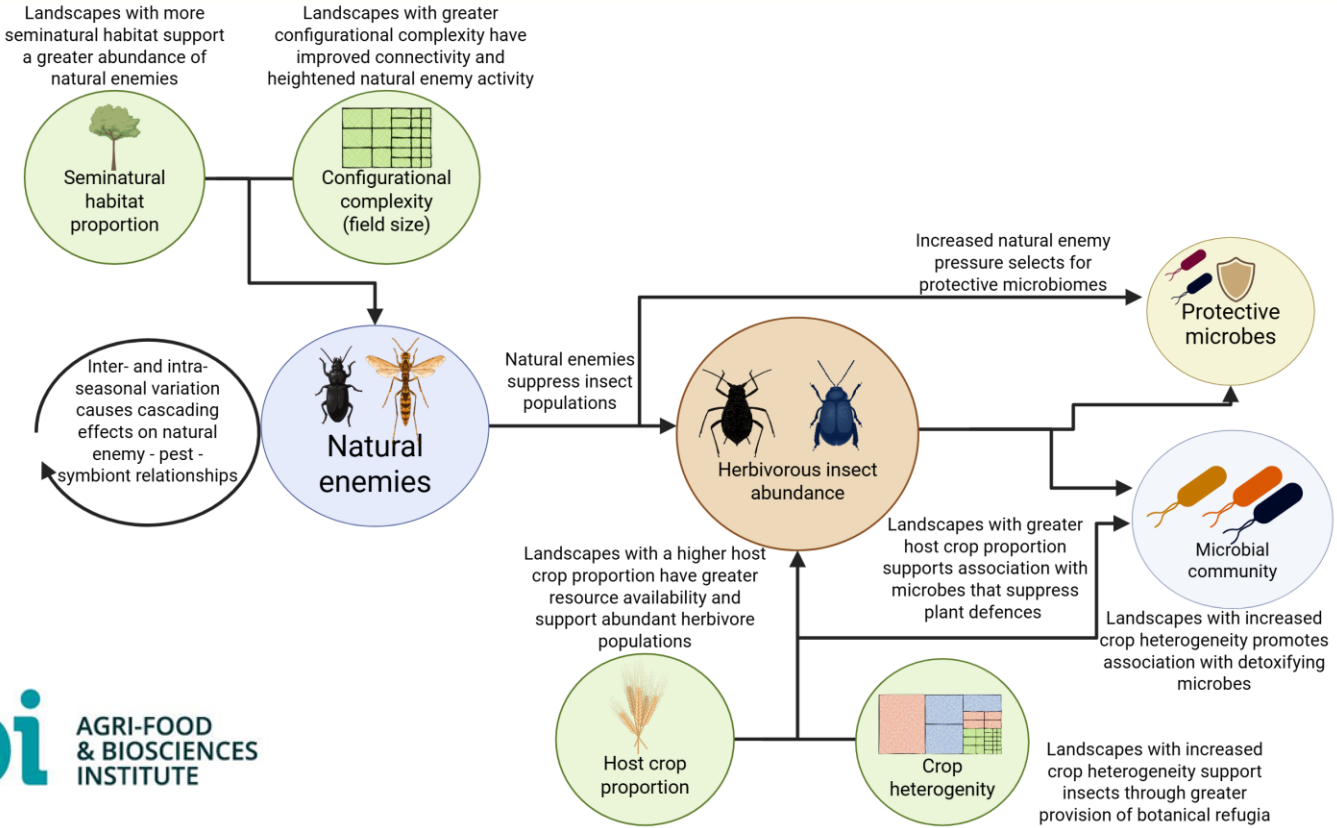


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Cabbage stem flea beetle – most damaging insect of oilseed rape in Europe

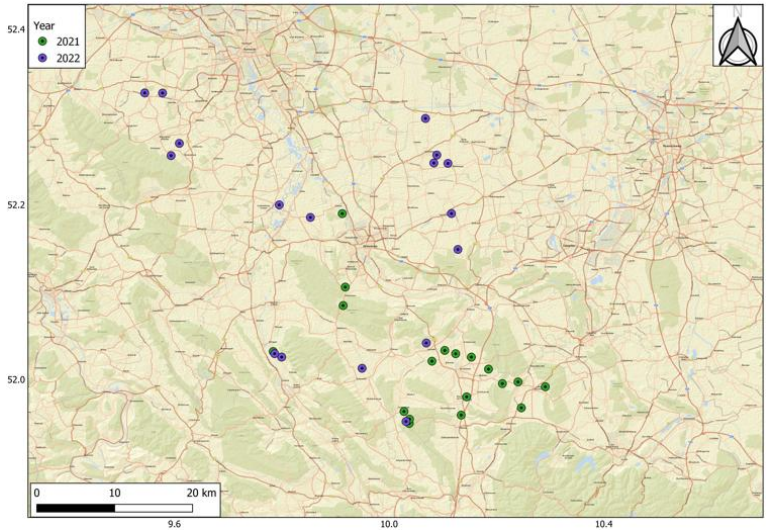


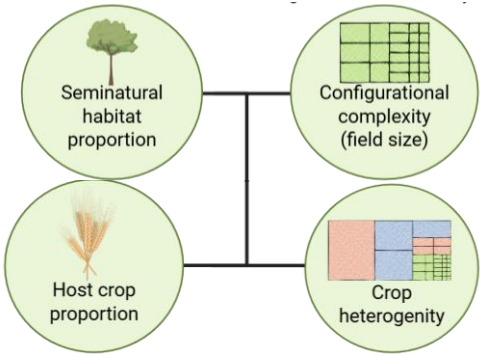
How might landscape structure affect insect-symbiont interactions?

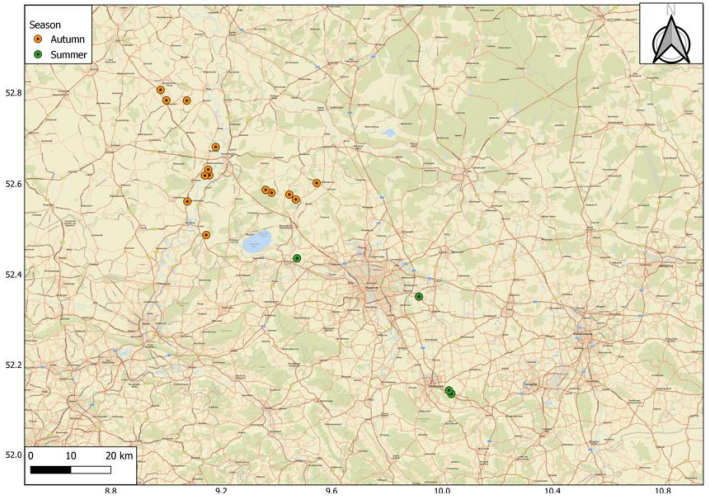


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How might landscape structure affect insect-symbiont interactions?

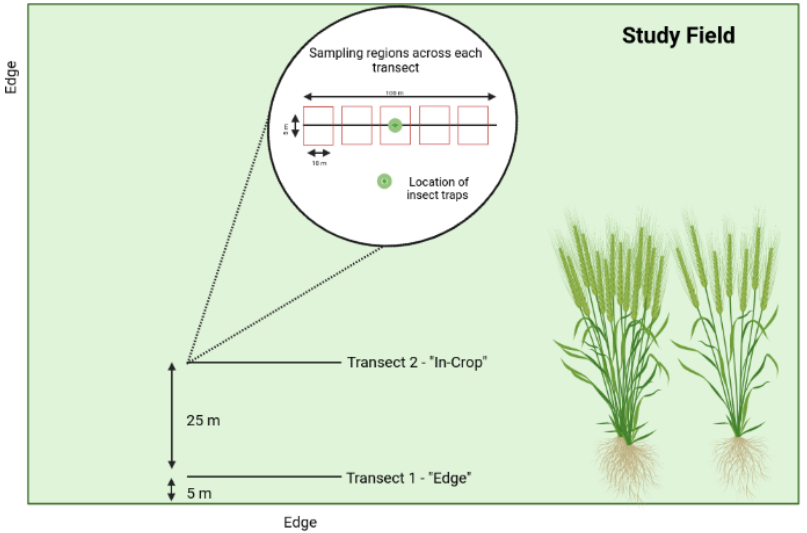


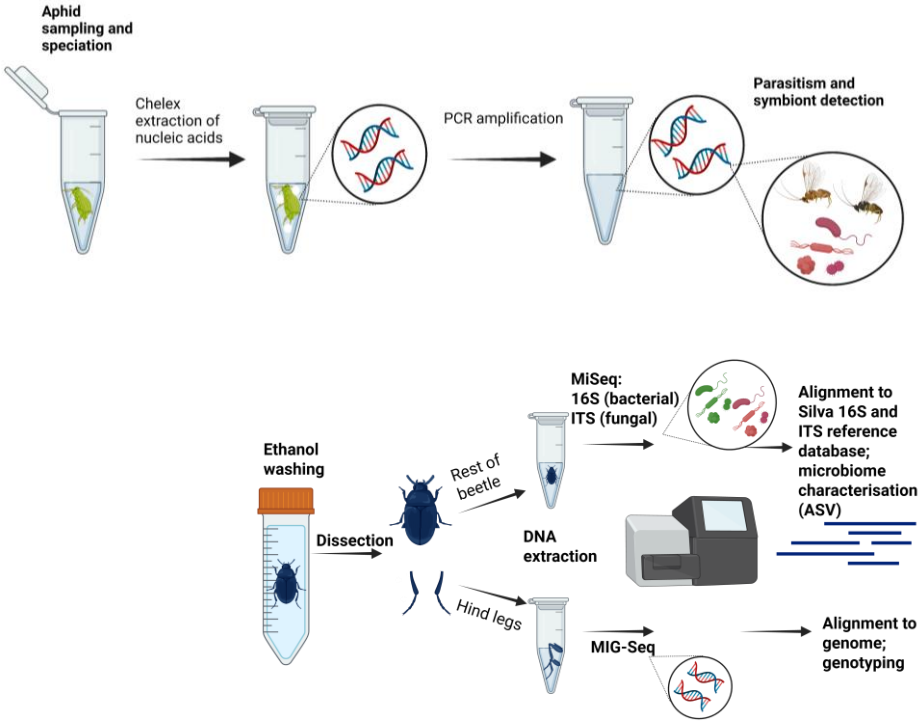




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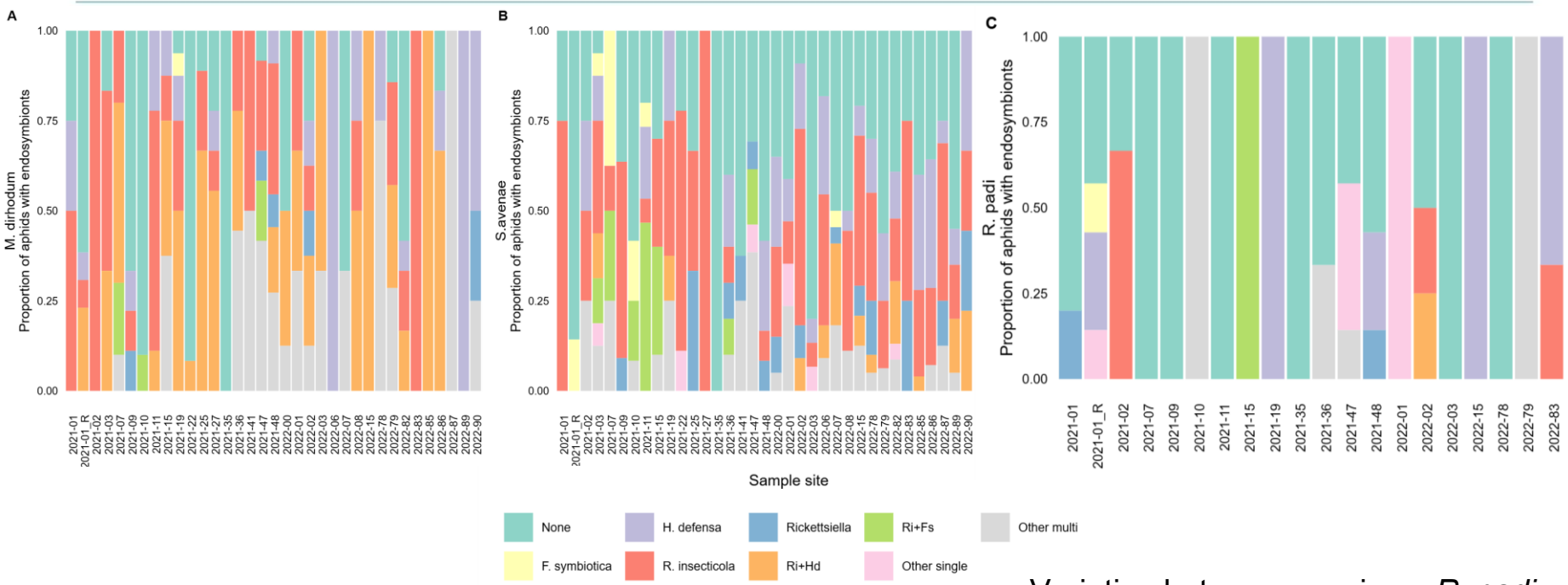
How might landscape structure affect insect-symbiont interactions?





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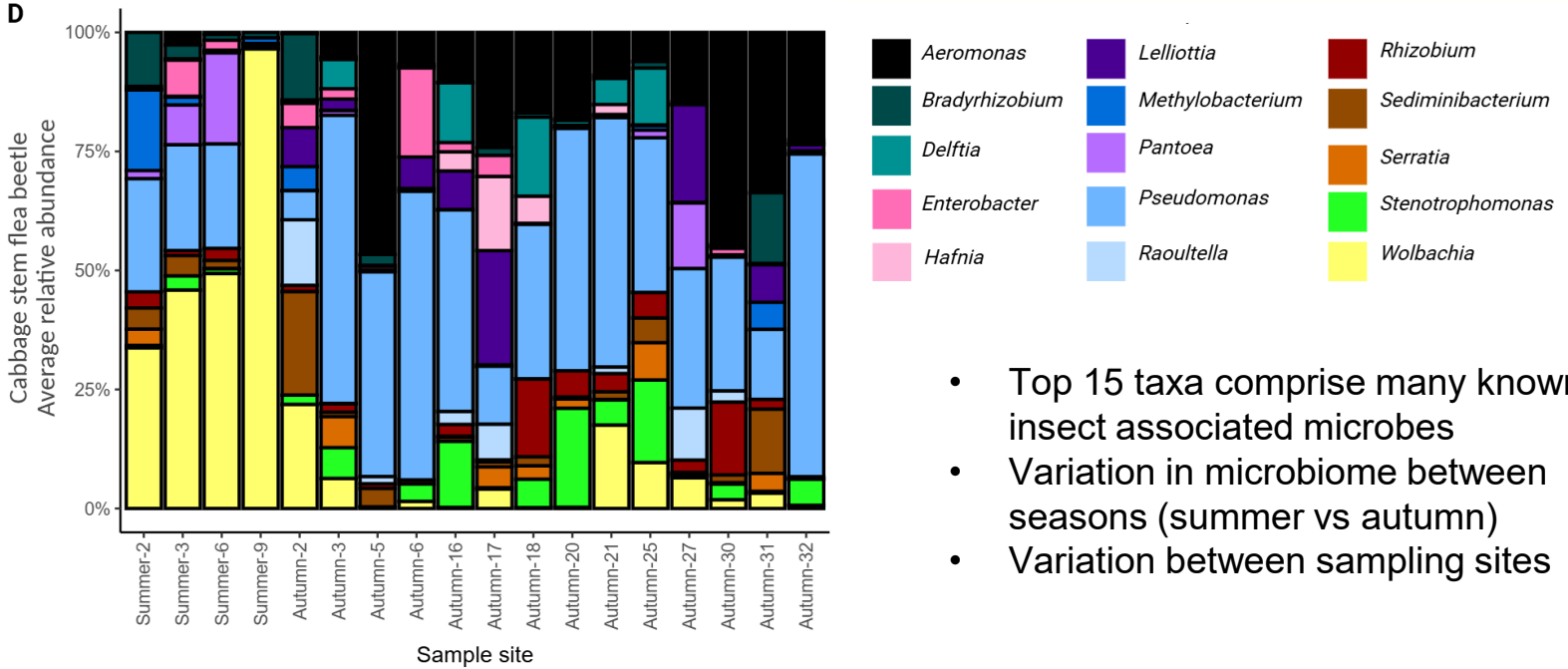
Variation in the insect microbiome across sites



- Variation between species – *R. padi* least likely to associate with symbionts
- Variation in prevalence and diversity between sampling sites

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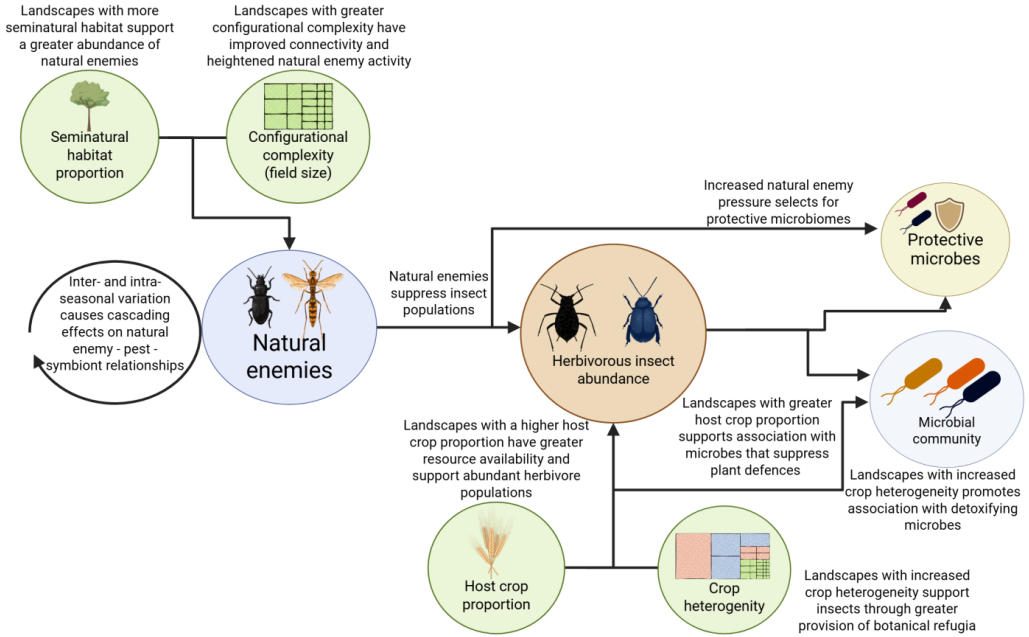
Variation in the insect microbiome across sites



- Top 15 taxa comprise many known insect associated microbes
- Variation in microbiome between seasons (summer vs autumn)
- Variation between sampling sites

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How might landscape structure affect insect-symbiont interactions?



Information for four insect species across two agricultural ecosystems:

- Grain aphid (cereals)
- Rose-grain aphid (cereals)
- Bird cherry-oat aphid (cereals)
- Cabbage stem flea beetle (rapeseed)

Insect abundance data:

- All aphid species

Characterisation of natural enemies

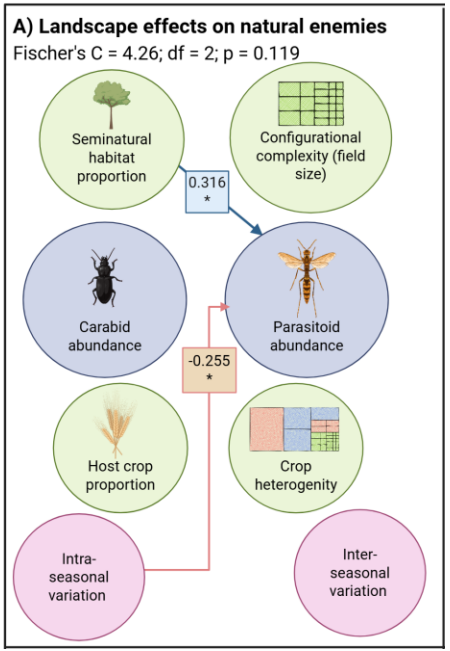
- Both ecosystems

Landscape characterisation:

- Both ecosystems

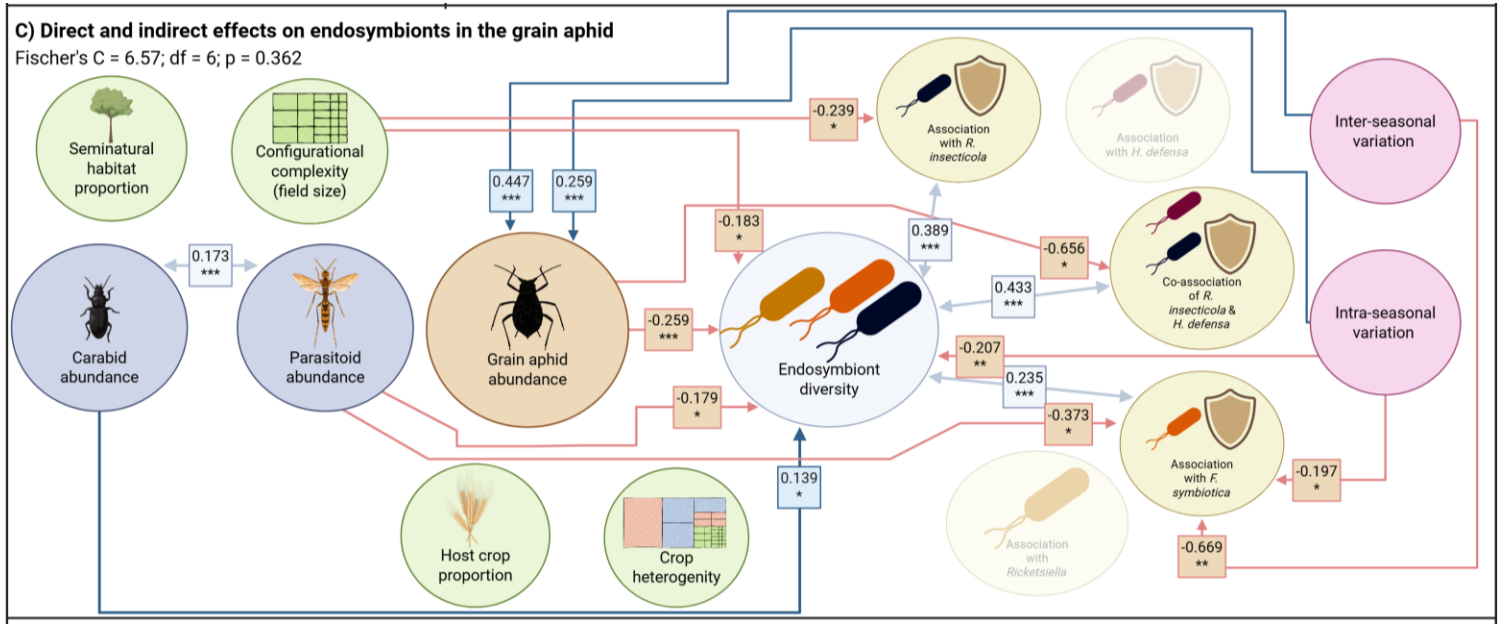
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Landscape effects on aphid-natural enemy interactions



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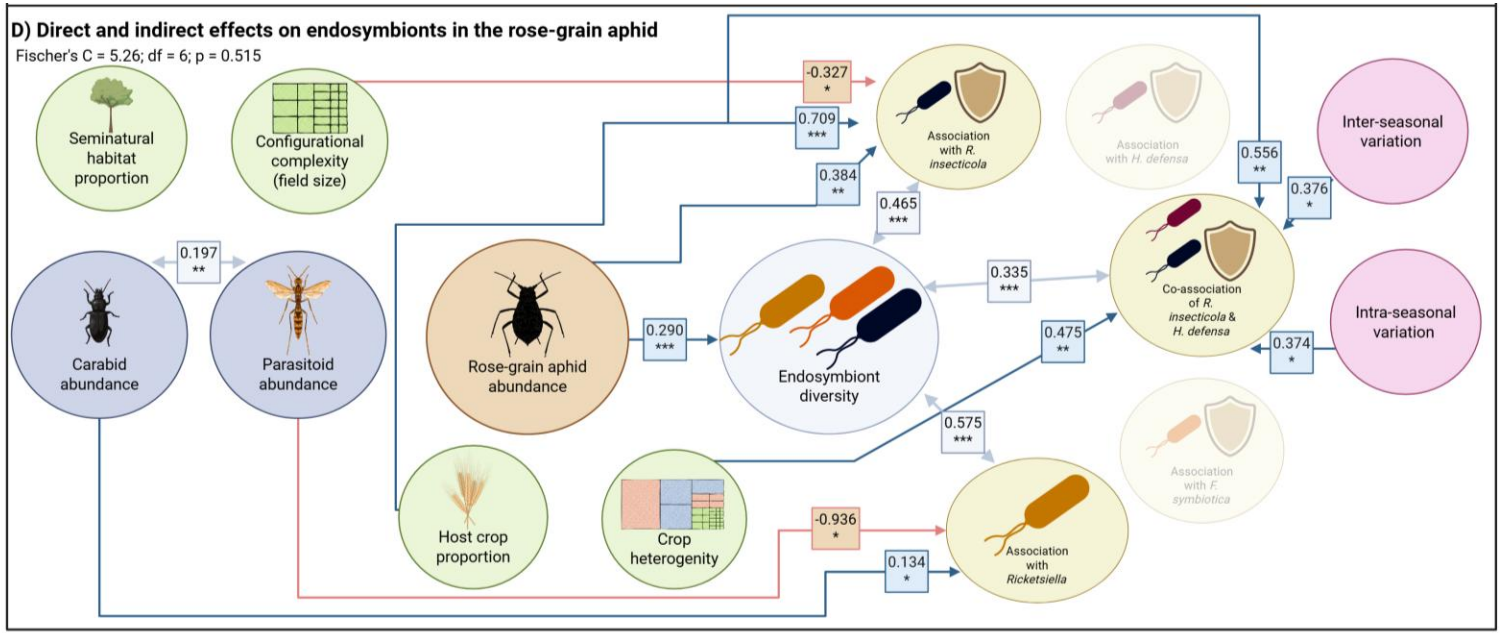
Landscape effects on grain aphid symbionts



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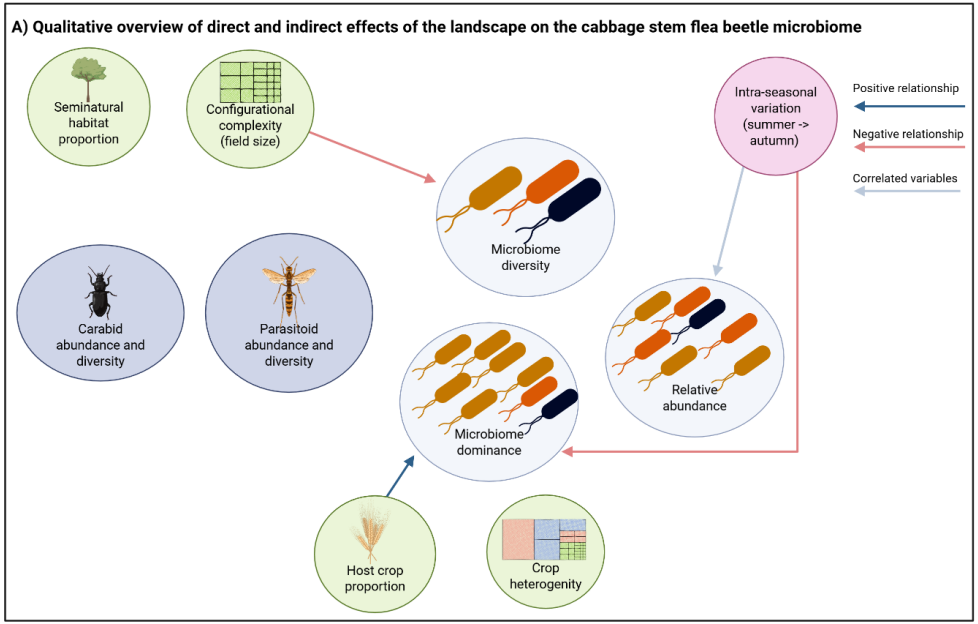
Landscape effects on rose-grain aphid symbionts

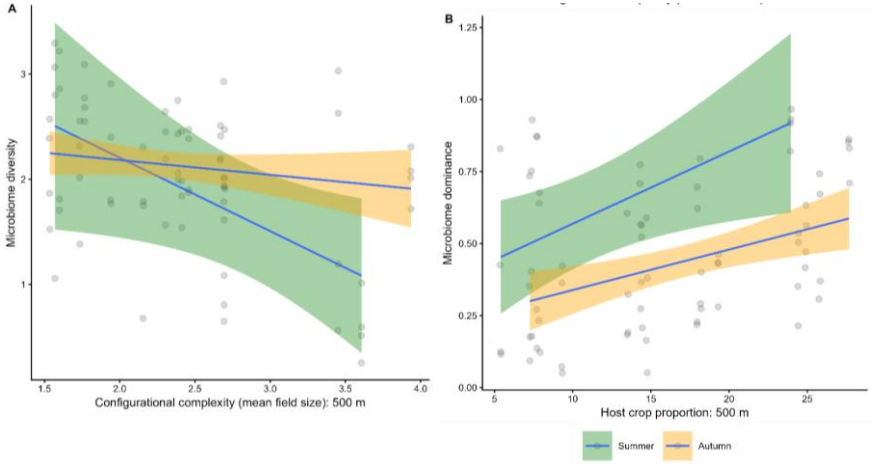


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Landscape effects on leaf beetle microbiome





Conclusion

- Agricultural configuration (size of arable fields) is a key driver in all species – larger average field size reduces microbial diversity in both sap-feeding and chewing insects
- Host plant composition in the landscape a key driver for leaf-chewing flea beetle – More host plant abundance increases the dominance of core microbial species
- Higher natural enemy abundance can decrease association with key endosymbiont species in sap-feeding aphids







Alexander von
HUMBOLDT
STIFTUNG

afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

- Prof Emily Martin (Giessen)
- Dr Sharon Zytynska (Manchester)
- Petra Melloh (Hannover)
- Eric Muehlnikel (MSc, Hannover)
- Zoological Biodiversity Group (Hannover/Giessen)