AGRI-FOOD
& BIOSCIENCES
INSTITUTE

Leading | Protecting | Enhancing

Working towards more sustainable management of BYDV













Dr Daniel Leybourne

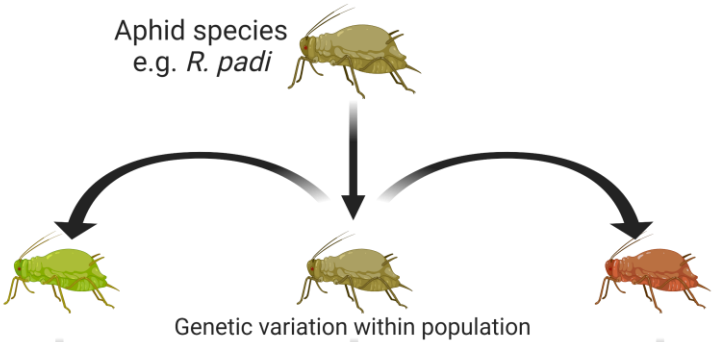
March 2026

afbini.gov.uk

Are all aphid populations equal?

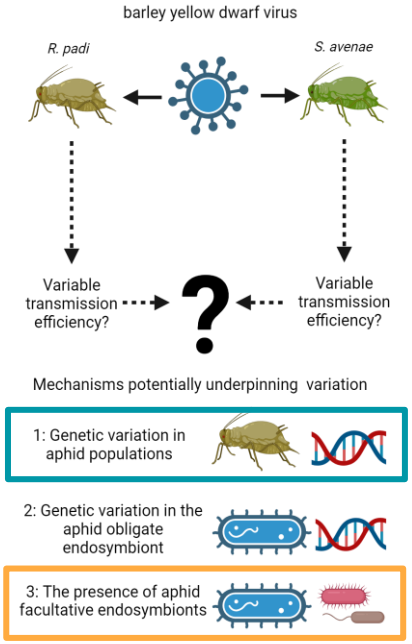
Main facultative endosymbionts:

- *Hamiltonella defensa*
- *Regiella insecticola*
- *Serratia symbiotica*
- *Fukatsia symbiotica*
- *Aresnophonus spp.*
- *Rickettsia spp.*
- *Ricketsiella spp.*
- *Spiroplasma spp.*



afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

Are all aphid populations equal?



afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

ELISA: Disease detection



Genetic diversity in vector populations influences the transmission efficiency of an important plant virus

Daniel J. Leybourne[1], Mark A. Whitehead[2] and Torsten Will[3]

[1]Department of Evolution, Ecology and Behaviour. Institute of Infection Veterinary and Ecological Science, and [2]Centre for Genomics Research. Institute of Infection Veterinary and Ecological Science, University of Liverpool, Liverpool L69 7ZB, UK
[3]Institute for Resistance Research and Stress Tolerance, Julius Kühn-Institute – Federal Research Centre for Cultivated Plants, Quedlinburg 06484, Germany





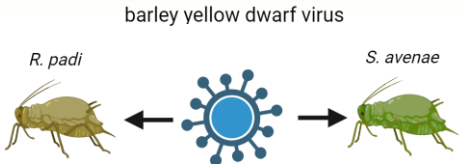
Are all aphid populations equal?





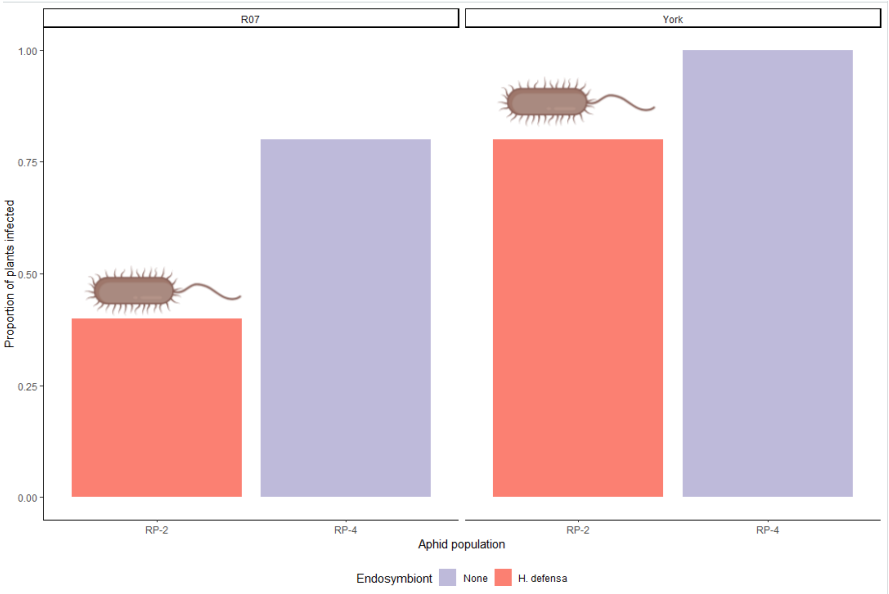
Two vector populations
- Same genotype
- Different endosymbiont

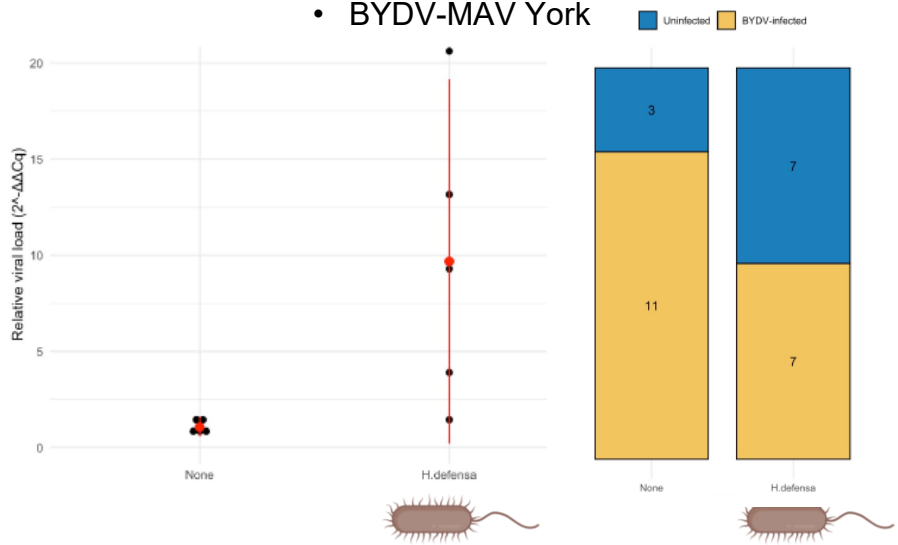
Two virus variants:
- BYDV-PAV R07
- BYDV-PAV York



- Two vector populations
  - Same aphid line
  - Endosymbiont introduced through microinjection

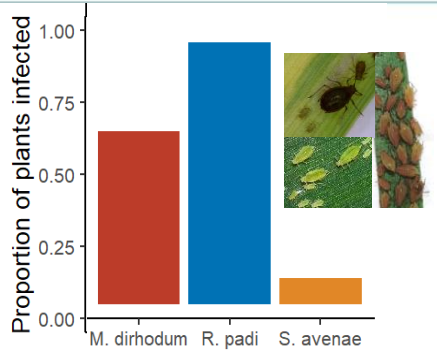
- One virus variant:
  - BYDV-MAV York

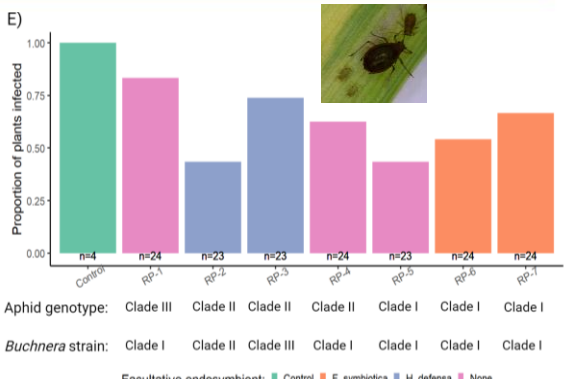


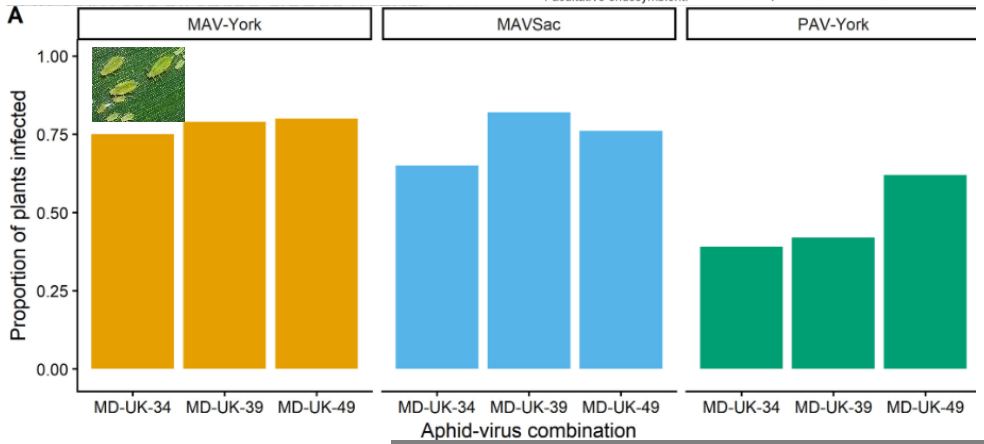


Modelling for better management

- Aphid species vector different virus species with variable efficacy
- Aphid life-history differs between species and genotypes
- These will all ultimately interact to influence vector-virus-host dynamics
- Model these interactions?

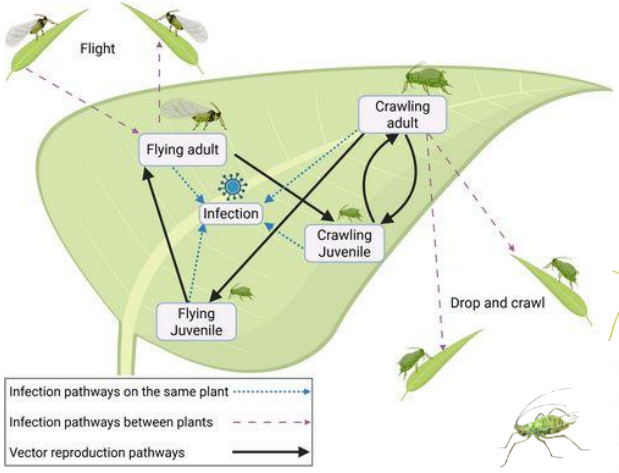




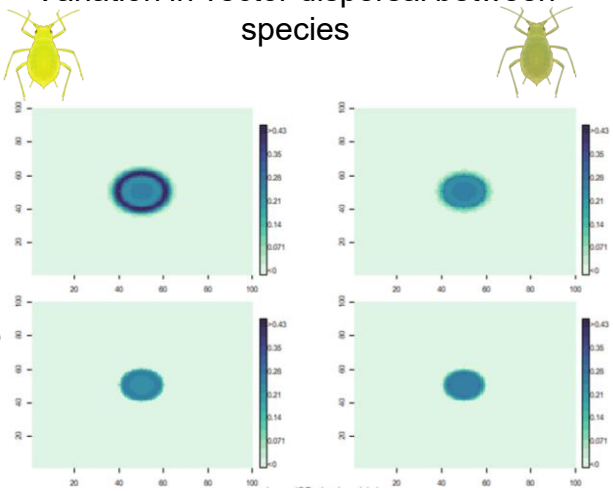


Leybourne et al., 2026 *Plant Pathology;* 2024 *Biology Letters.*

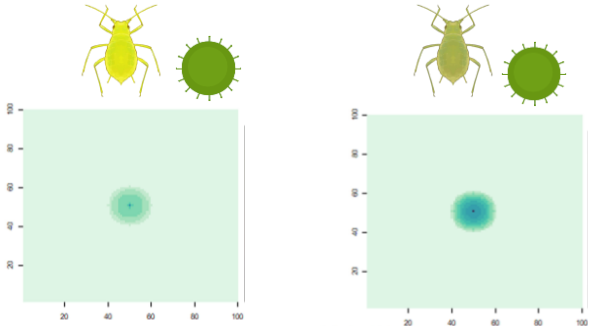
Modelling for better management



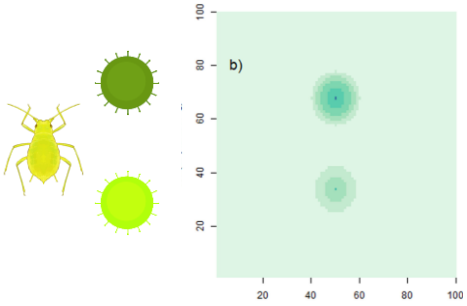
Variation in vector dispersal between species



Variation in disease spread between vector species



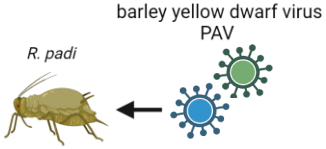
Variation in disease spread between vector-virus combination



afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

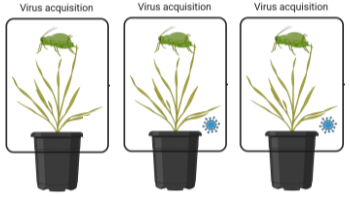
Preedy … Leybourne (2026). *Journal of Sustainable Agriculture and Environment.*

Indirect consequences of symbionts and viruses

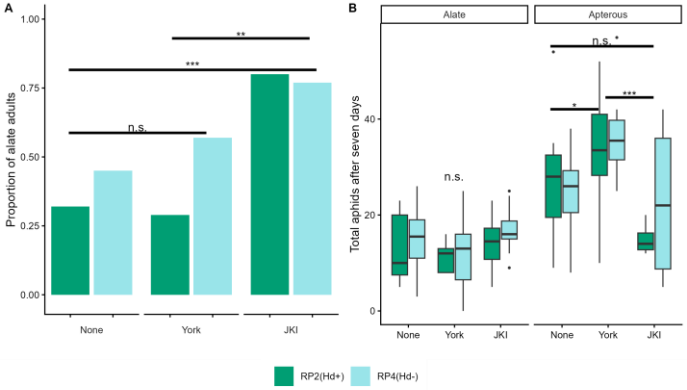


- Two vector populations
  - Same genotype
  - Different endosymbiont

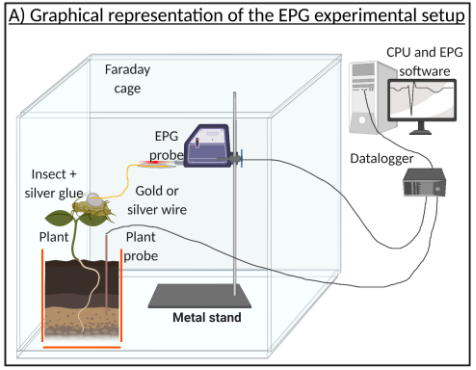
- Two virus variants:
  - BYDV-PAV JKI (R07)
  - BYDV-PAV York

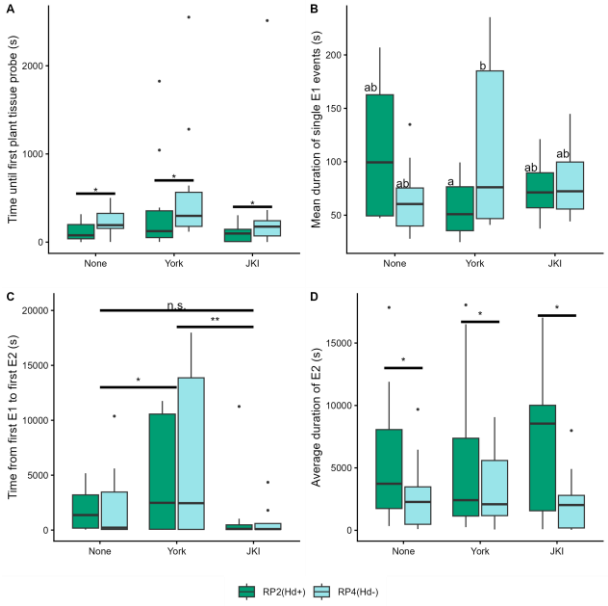


afbi AGRI-FOOD & BIOSCIENCES INSTITUTE



Aphid population (endosymbiont presence) and virus status

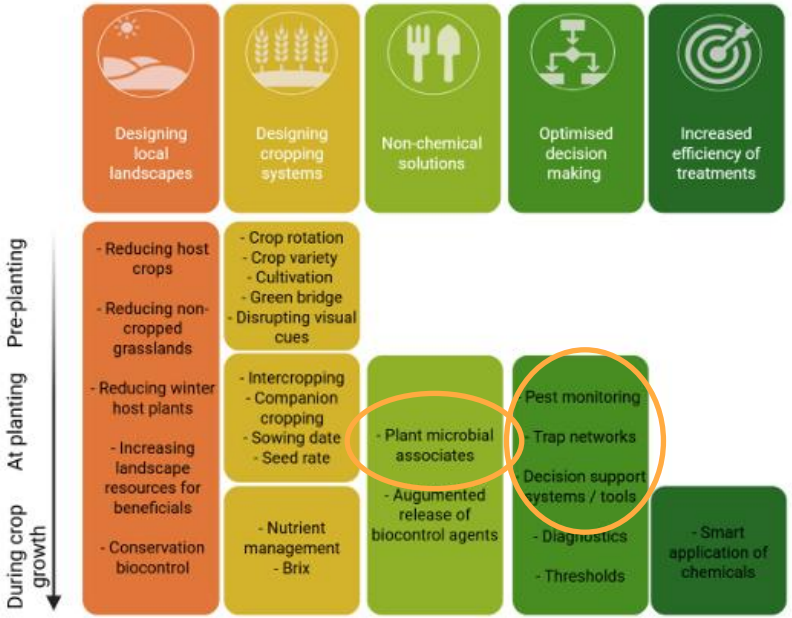




Leybourne et al., 2026 *Ecological Entomology*.

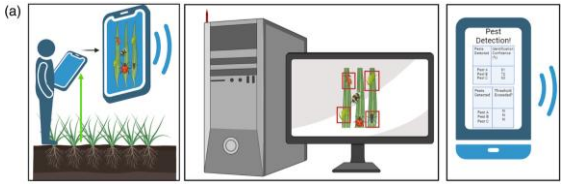
Sustainable management of aphids and BYDV

- Five pillars for holistic integrated pest management (IPM)
- Developed by ADAS through the IPMWorks and IPMDecisions projects
- Supports transition away from chemical insecticide
- Considered across growing period
- Case-study for cereal aphid and barley yellow dwarf virus management

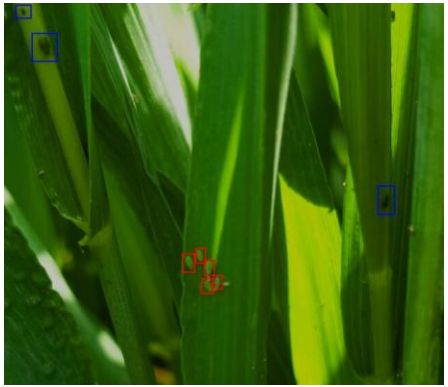


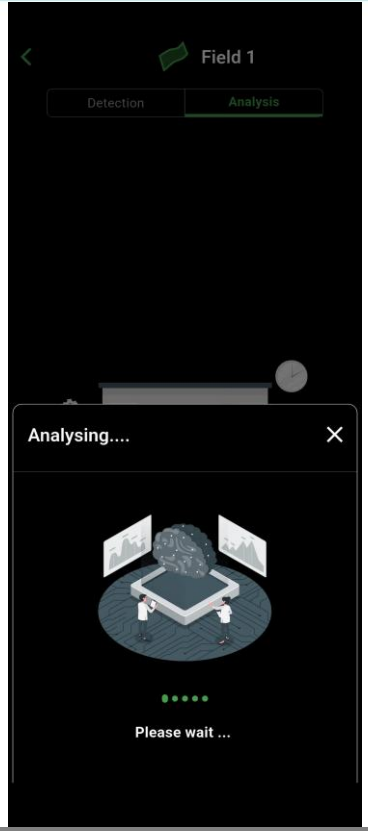
afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

Smart tools for on-farm monitoring







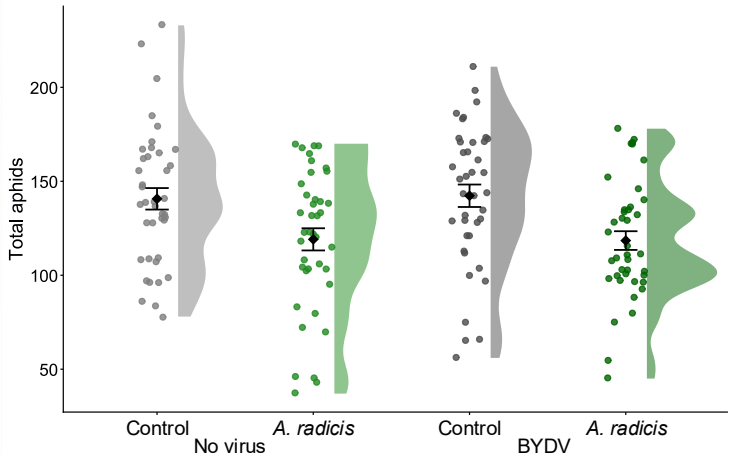


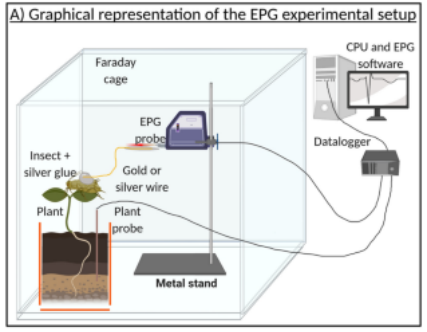
afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

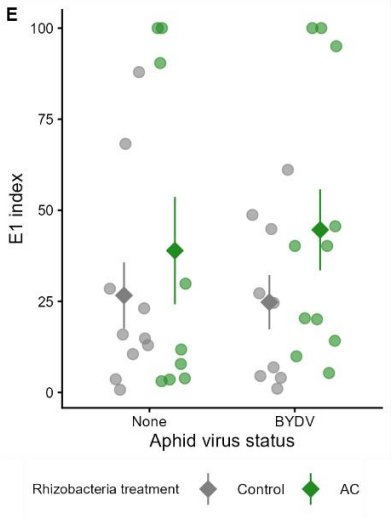
Sustainable strategies for vector control



S Zytynska, University of Manchester.







Parker, Zytynska, Arkwright, Warnecke, Leybourne. *In-Prep.*

Conclusion



- Not all aphid populations are equal – aphid endosymbionts alter aphid-plant and aphid-virus interactions
- Biological modelling can estimate vector dispersal and disease spread, forming the basis for sustainable management systems
- Crop microbiome can suppress vector populations by ~16% but increases salivation into phloem
- Computer vision and large language models can support in-field on-the-go pest assessment

afbi AGRI-FOOD & BIOSCIENCES INSTITUTE

- Dr Megan Parker
- Elinor Baird
- Andrea Ceribelli
- Rebekah Duke
- Ananya Yadav