UNIVERSITY OF LIVERPOOL

Department of Evolution, Ecology and Behaviour

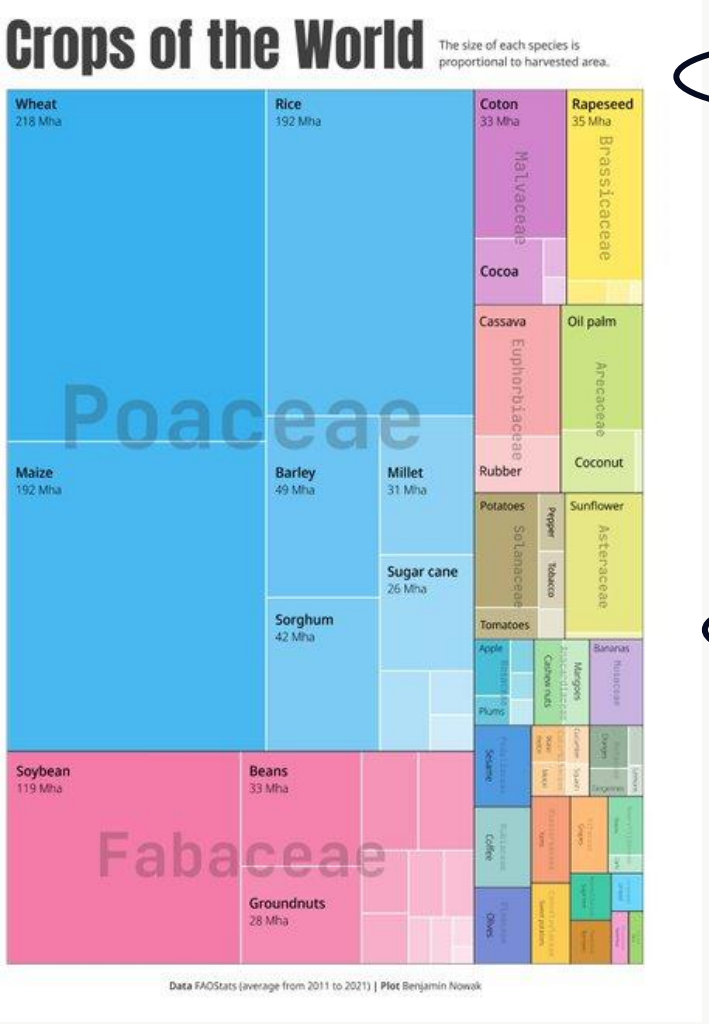
HOW DOES VECTOR-VIRUS DIVERSITY INFLUENCE VIRUS TRANSMISSION EFFICIENCY

Dr Daniel Leybourne
1851 Research Fellow

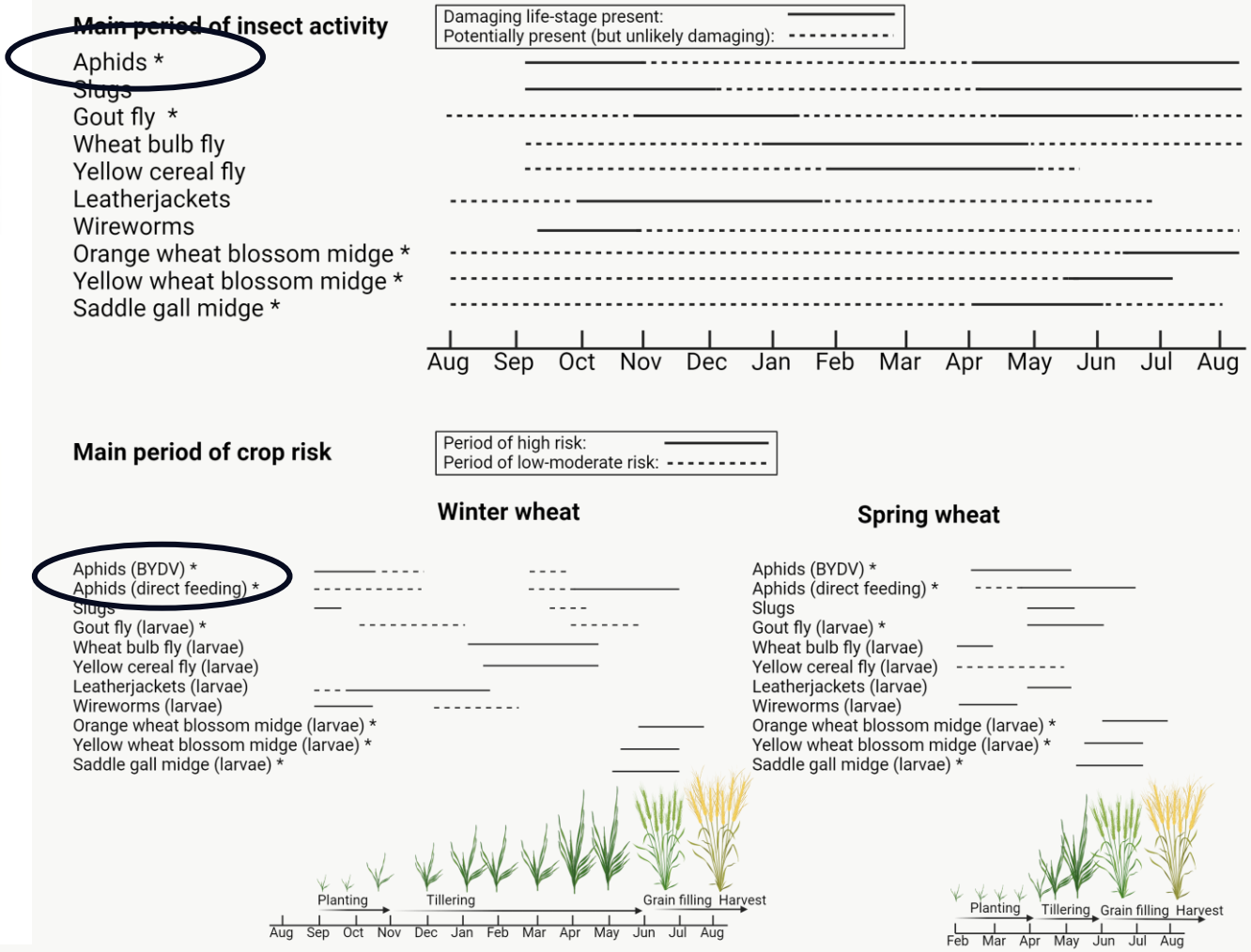
December 2024



INSECTS, DISEASE & AGRICULTURE



Benjamin Nowak





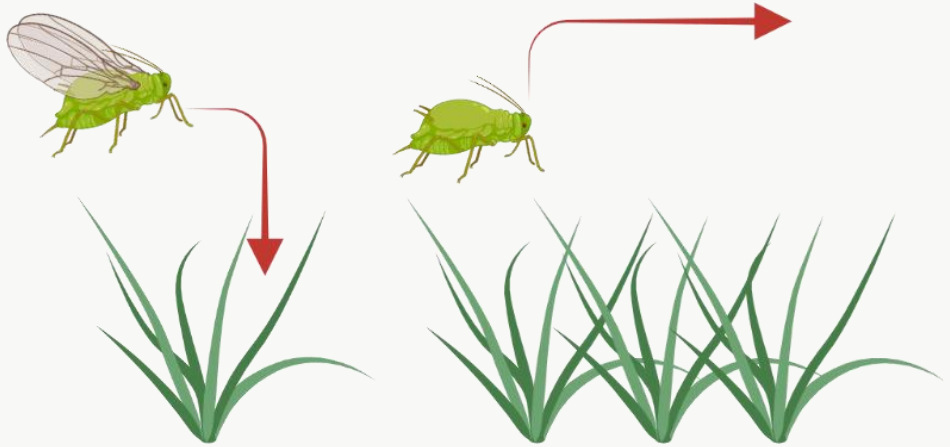
Leybourne et al., 2024. *Agronomy for Sustainable Development.*

APHIDS: PERFECT DISEASE VECTORS IN AGRICULTURAL SYSTEMS

Virus species	Virus strain (updated name, if applicable)	Main vectors (average transmission efficiency >10%)
Barley yellow dwarf virus (*Tombusviridae*, *Luteovirus*)	BYDV-PAV (*Luteovirus pavhordei*)	*Rhopalosiphum padi*, *Sitobion avenae*, *Sitobion miscanthi*, *Sitobion fragariae*,[a] *Metapolophium dirhodum*, *Schizaphis graminum*
	BYDV-MAV (*Luteovirus mavhordei*)	*S. avenae*, *S. fragariae*,[a] *M. dirhodum*, *S. graminum*[b]
	BYDV-PAS (*Luteovirus pashordei*)	*Rhopalosiphum maidis*,[a] *R. padi*,[a] *S. avenae*,[a] *M. dirhodum*[a]
	BYDV-GAV	*S. graminum*, *S. avenae*
	BYDV-OYV	Vector not reported
	ker-II (*Luteovirus kerbihordei*)	*R. padi*[a]
	ker-III (*Luteovirus kertrihordei*)	*R. padi*[a]
Cereal yellow dwarf virus (*Solemoviridae*, *Polerovirus*)	CYDV-RPV	*R. padi*, *S. graminum*, *S. avenae*[c]
	CYDV-RPS	*R. padi*[a]
Maize yellow dwarf virus (*Solemoviridae*, *Polerovirus*)	MYDV-RMV	*R. maidis*, *R. padi*, *S. graminum*
Wheat yellow dwarf virus (*Solemoviridae*, genus unassigned)	WYDV-GPV	*R. padi*, *S. avenae*, *S. graminum*
Unassigned (*Solemoviridae*)	SGV	*S. graminum*, *R. padi*, *S. avenae*, *R. maidis*[c]
Barley virus G (*Solemoviridae*, *Polerovirus*)	BVG	*R. maidis*
Wheat leaf yellowing-associated virus (*Solemoviridae*, *Polerovirus*)	WLYaV	Vector not reported

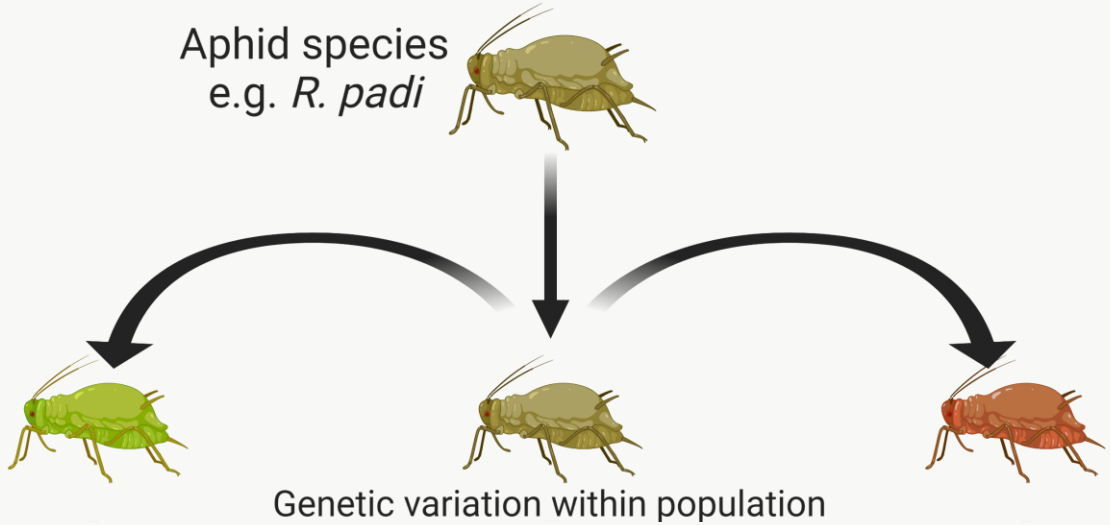
- Yellow dwarf viruses of significant importance in cereal systems
- Brought in by winged aphids
- Spread through crop by walking aphids
- Disease can reduce yield by 20-80%







ARE ALL VECTOR POPULATIONS EQUAL?

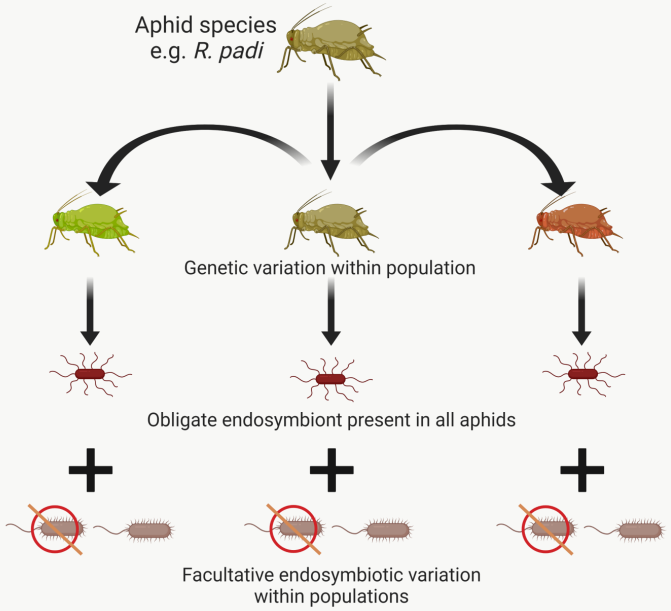


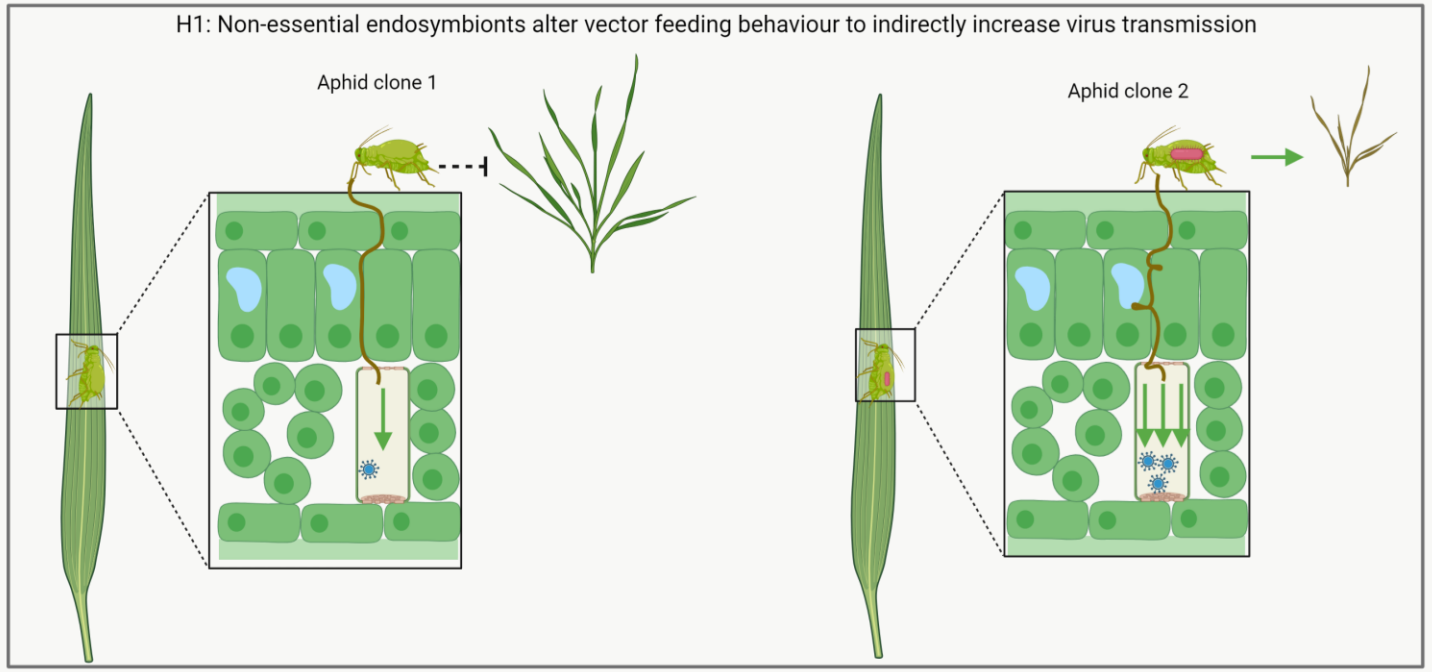
Main facultative endosymbionts:

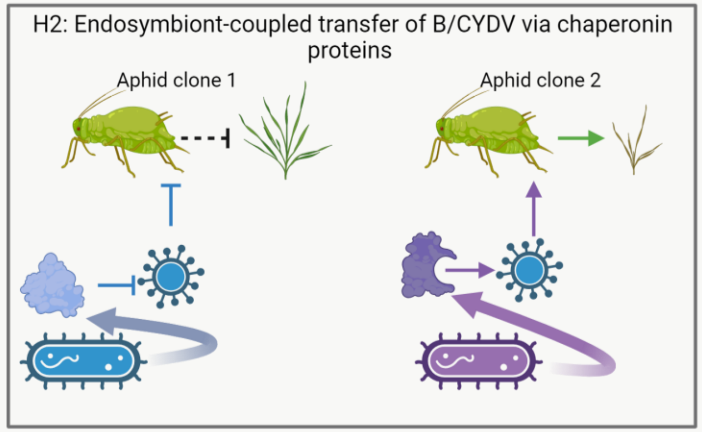
- *Hamiltonella defensa*
- *Regiella insecticola*
- *Serratia symbiotica*
- *Fukatsia symbiotica*
- *Aresnophonus spp.*
- *Rickettsia spp.*
- *Ricketsiella spp.*
- *Spiroplasma spp.*

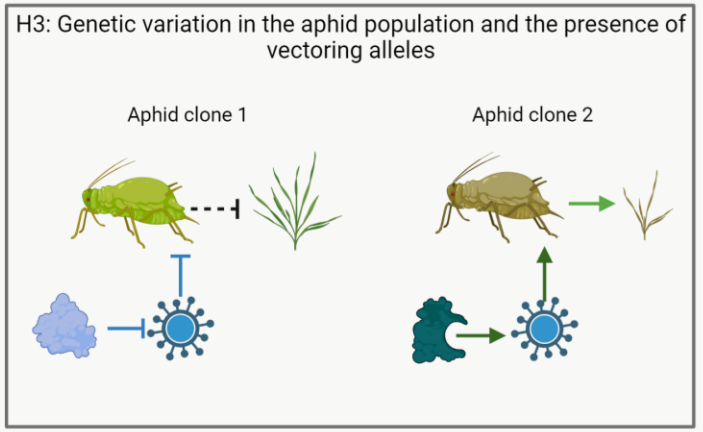


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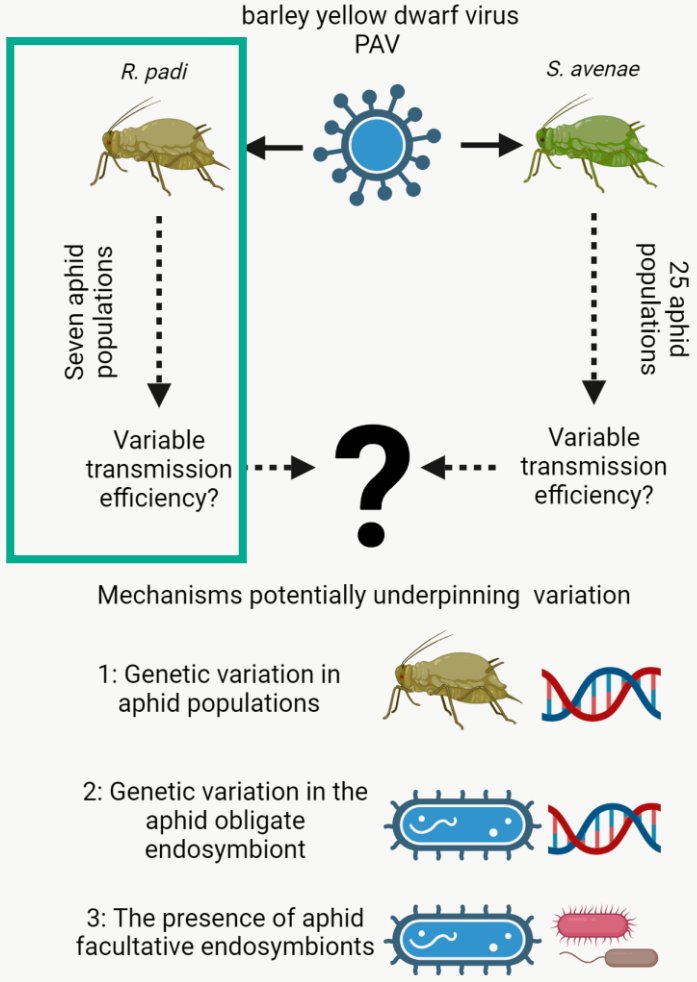




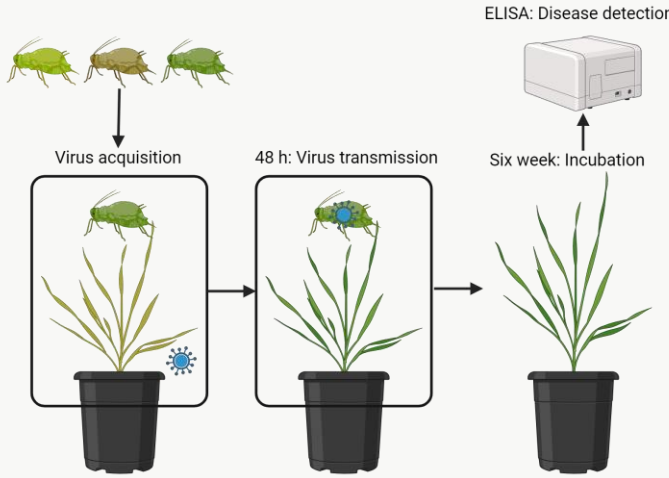


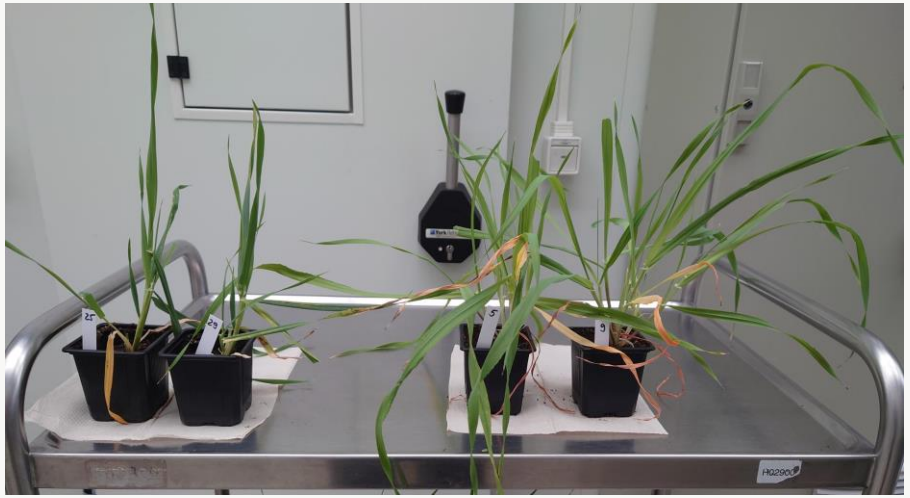
Leybourne, 2024. Plant Pathology

ARE ALL VECTOR POPULATIONS EQUAL?

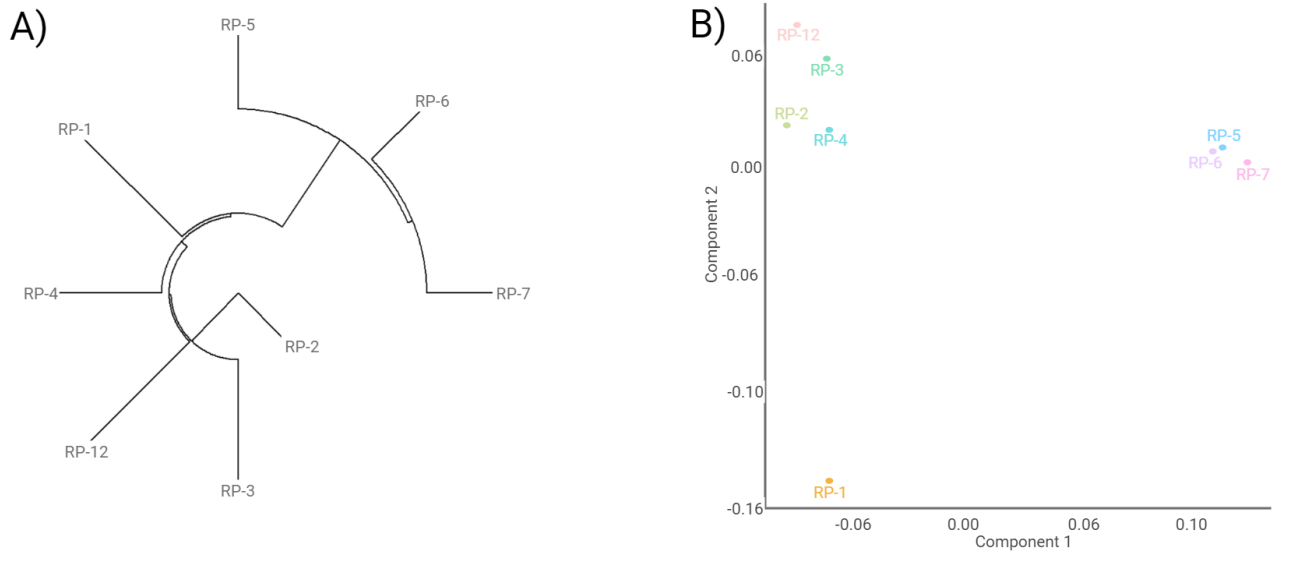








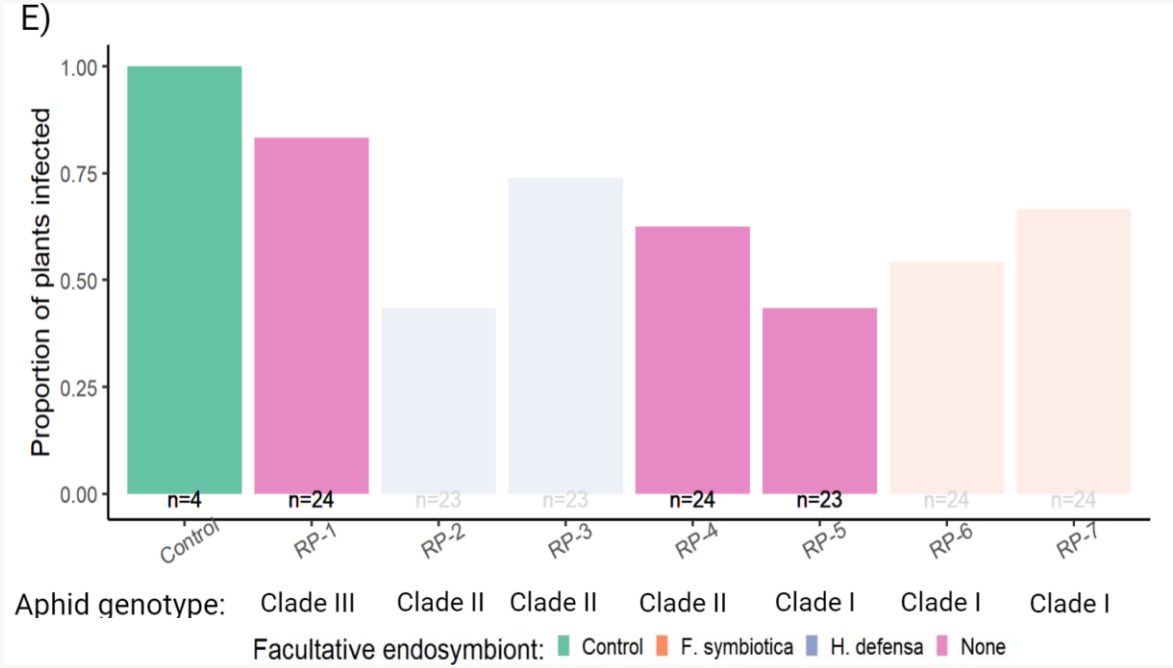
APHID DIVERSITY AND BYDV: VECTOR DIVERSITY INFLUENCES TRANSMISSION





Vector diversity influences BYDV-PAV transmission in *R. padi*

>500 **potential** SNPs

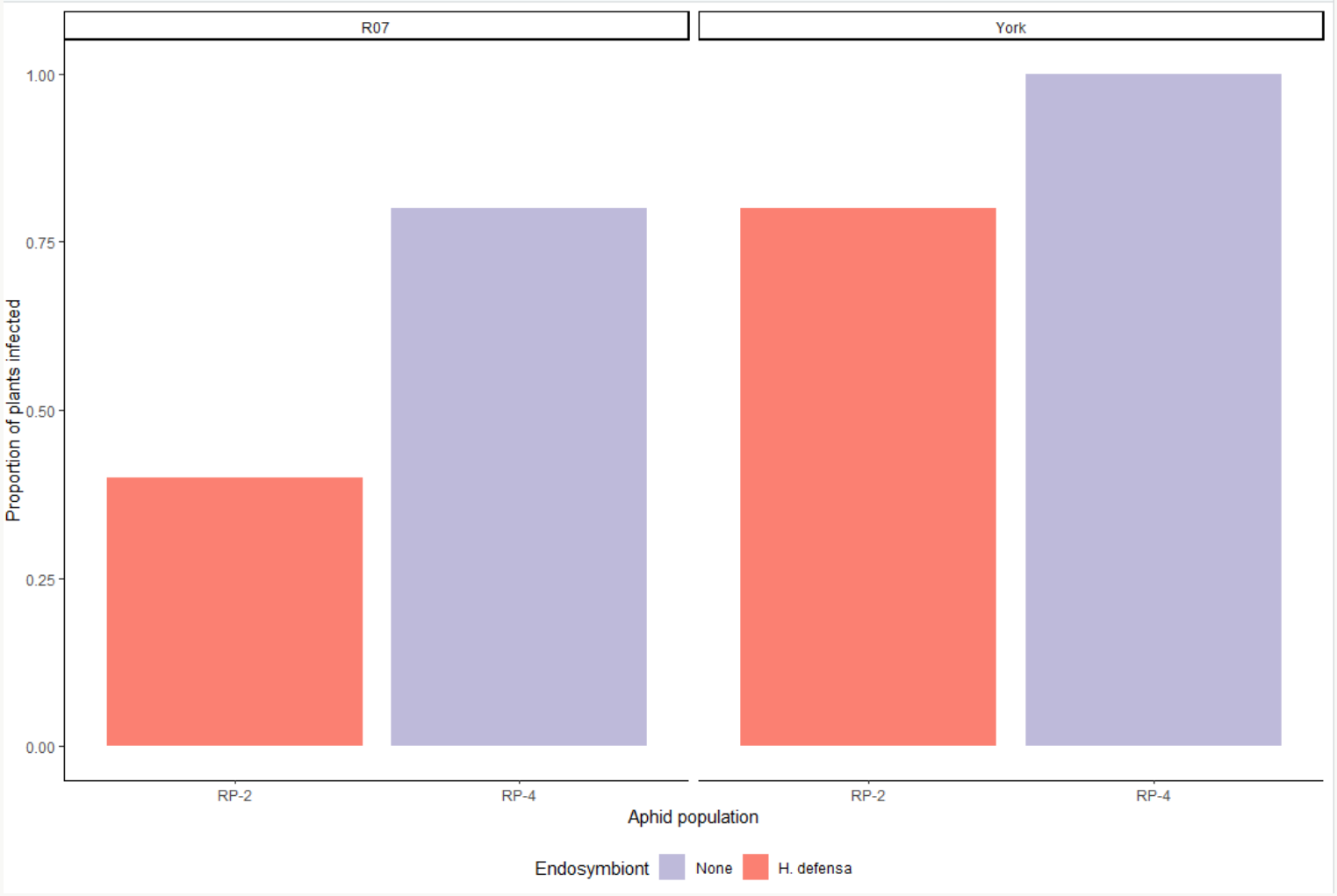


Leybourne, Whitehead, Will. 2024. *Biology Letters*

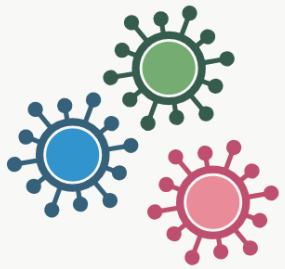
APHID DIVERSITY AND BYDV DIVERSITY



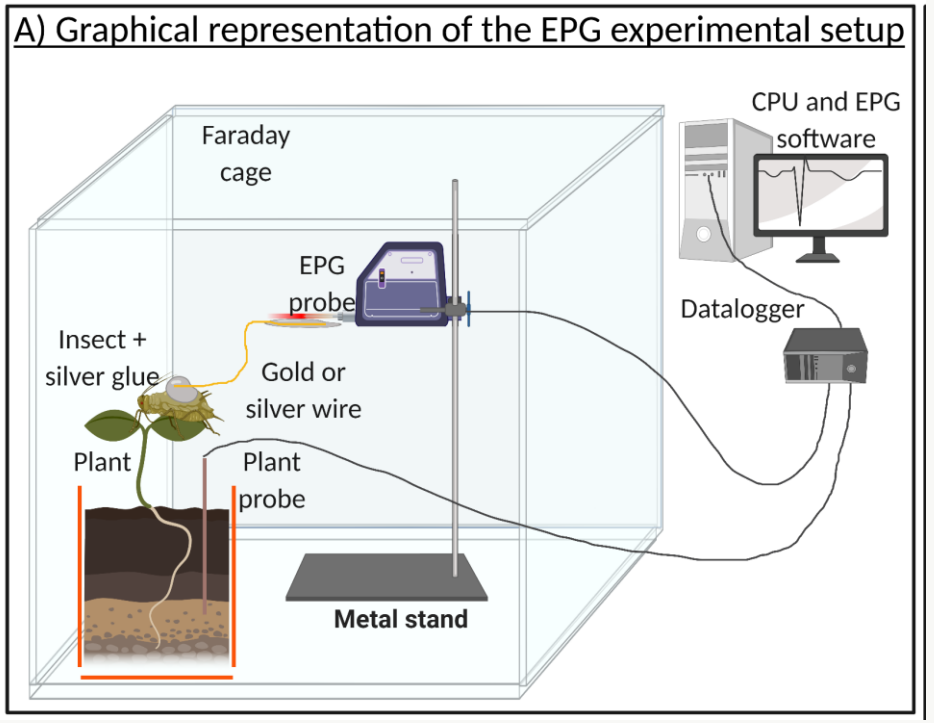
- Two vector populations
  - Same genotype
  - Different endosymbiont
- Two virus variants:
  - BYDV-PAV R07
  - BYDV-PAV York



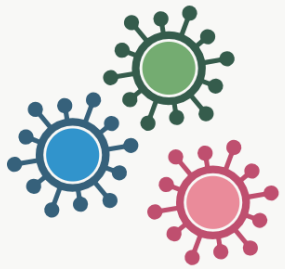
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- Differences in feeding behaviour?



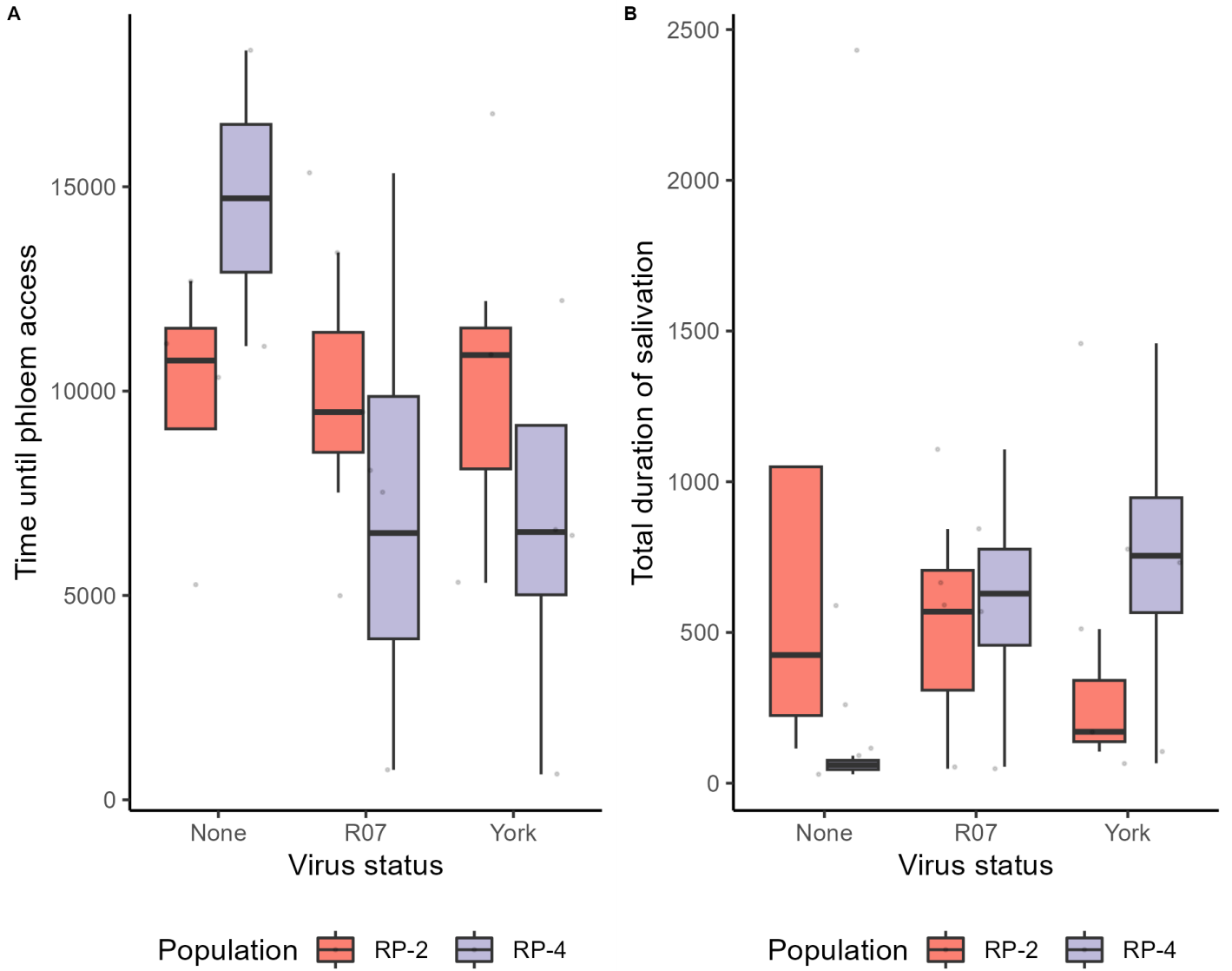
APHID DIVERSITY AND BYDV DIVERSITY



- Two vector populations
  - Same genotype
  - Different endosymbiont
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  - BYDV-PAV R07
  - BYDV-PAV York
- Differences in feeding behaviour?

Next step:

- RNA-Sequencing



CONCLUSION & FUTURE

- Variation in BYDV-PAV (R07 variant) transmission efficiency – genetically linked.
- Virus variation an important aspect to consider
- Virus promotes phloem access and salivation **but** mediated by endosymbiont
- RNA-Seq will help identify molecular drivers / dialogue between symbiont-vector-virus-host





ACKNOWLEDGEMENTS

- Elinor Baird
- Dr Mark Whitehead
- Dr Torsten Will (JKI)

