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Department of Evolution, Ecology and Behaviour

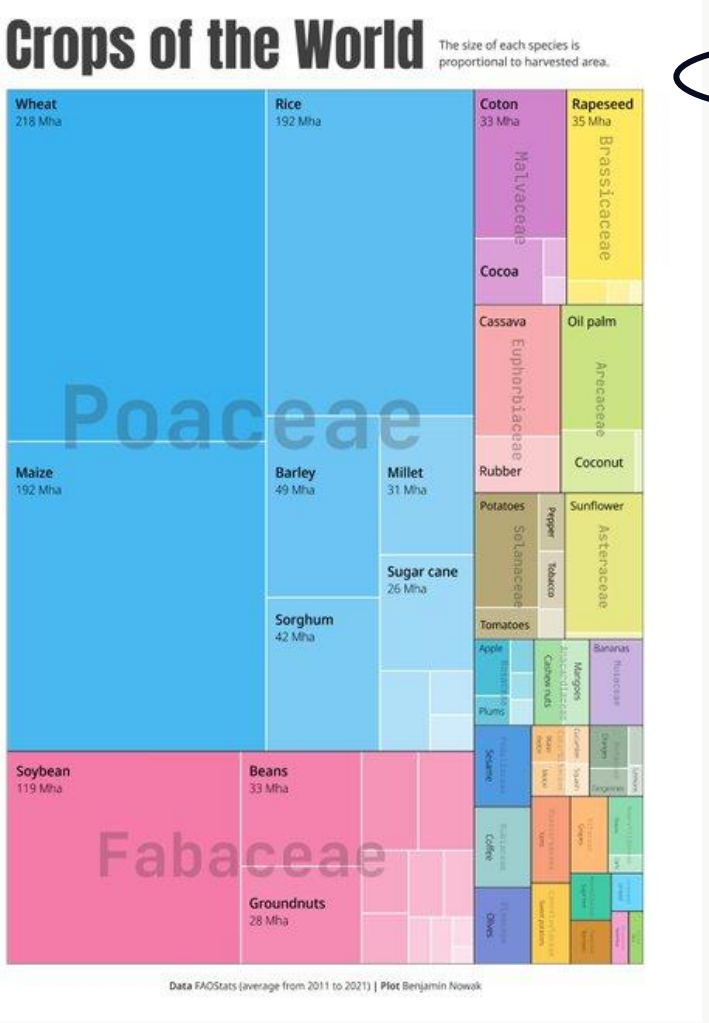
GENETIC DIVERSITY IN APHID POPULATIONS DRIVES SUCCESSFUL TRANSMISSION OF BARLEY YELLOW DWARF VIRUS.

Dr Daniel Leybourne
1851 Research Fellow

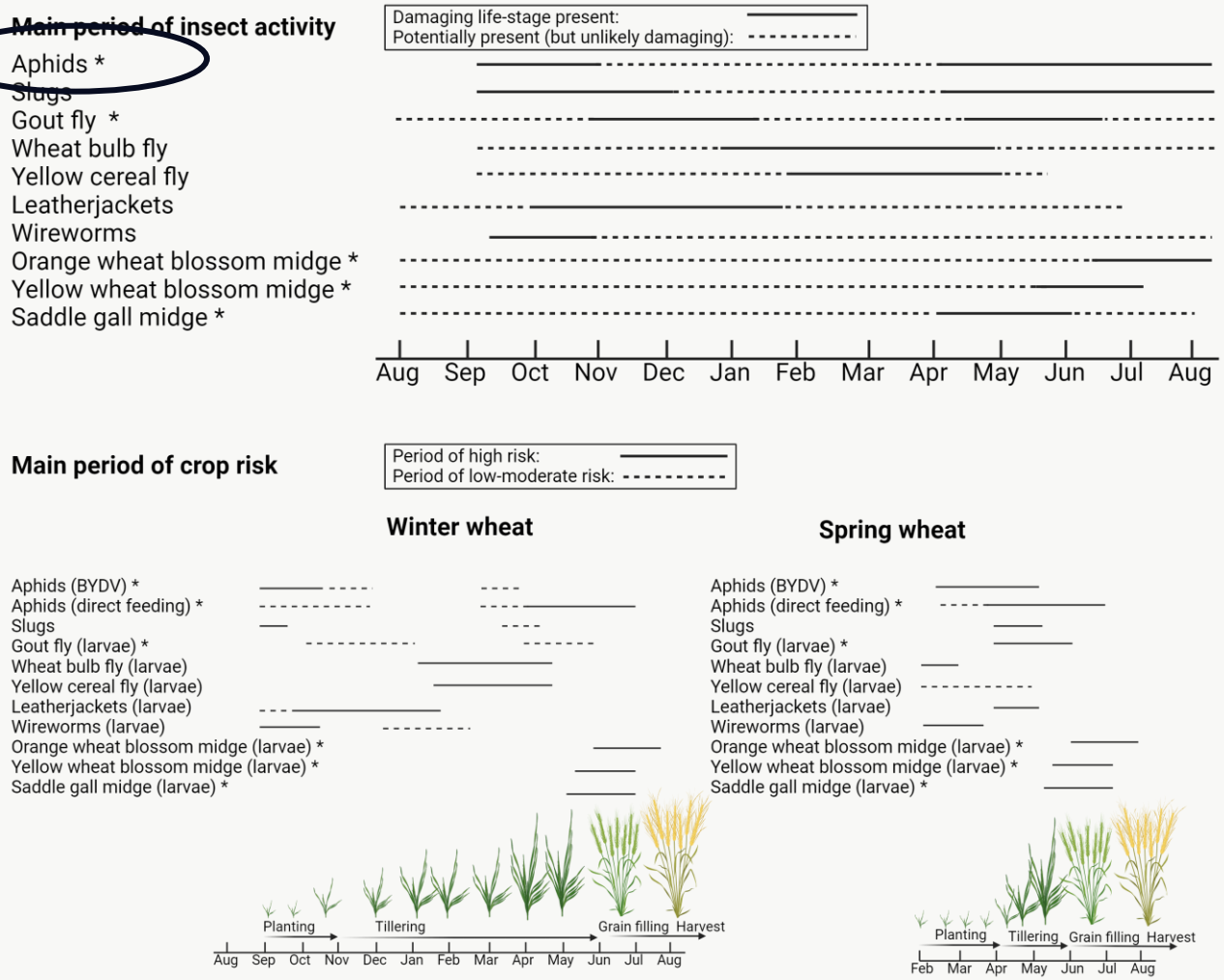
September 2024



INSECTS, DISEASE & AGRICULTURE



Benjamin Nowak





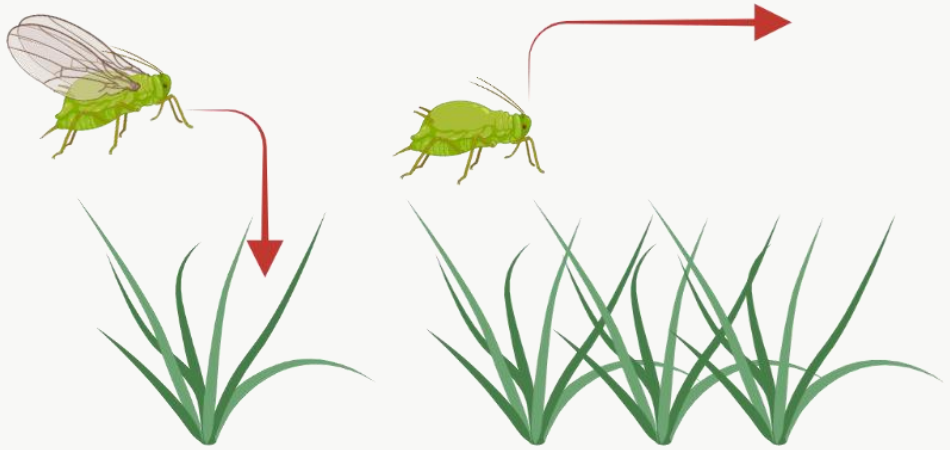
Leybourne et al., 2024. *Agronomy for Sustainable Development.*

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%
  - Rainfall might increase virus spread







MAIN YELLOW DWARF VIRUS VECTORS

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]



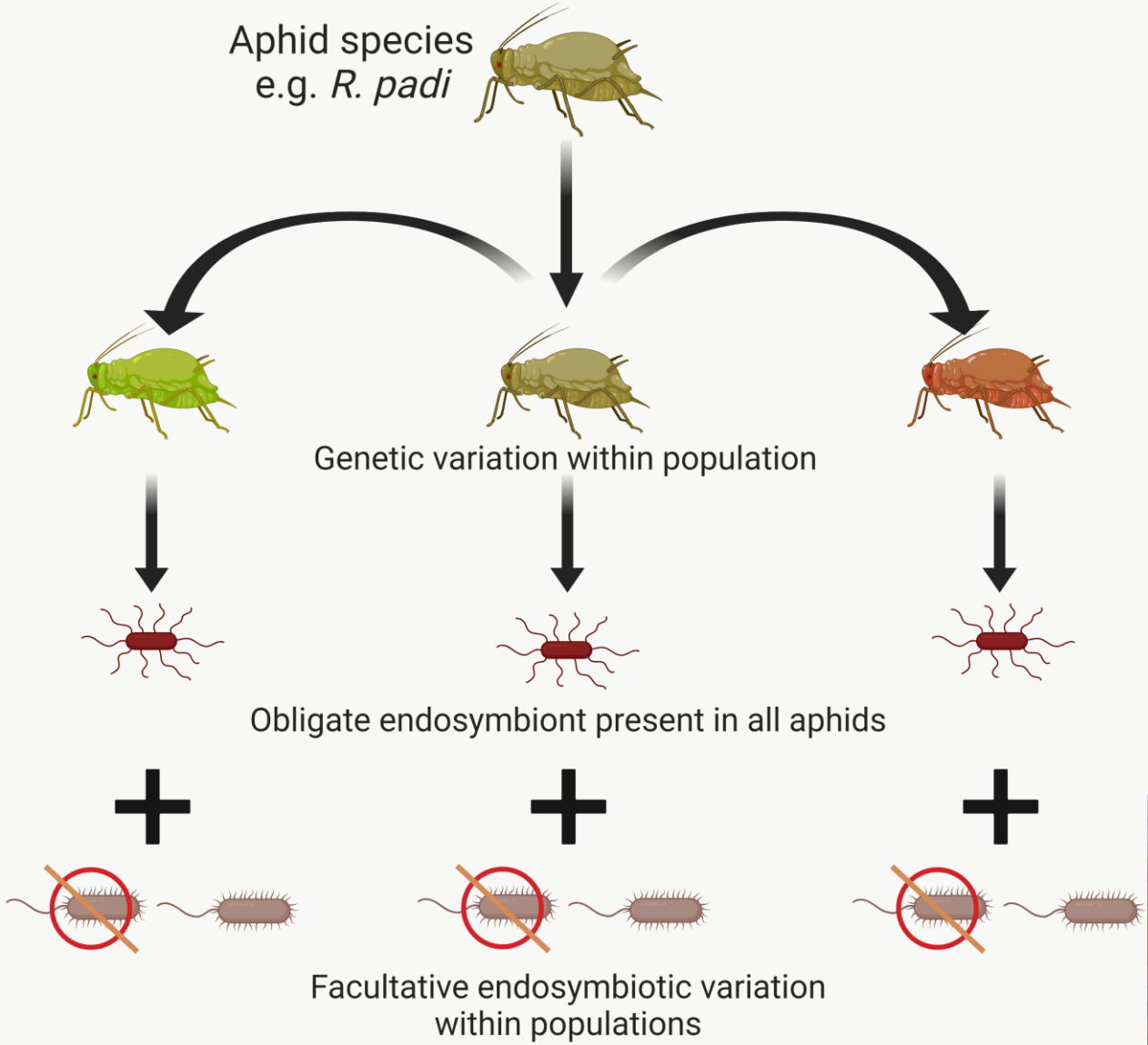
- Variable transmission between vector species:
- R. padi: BYDV-PAV
- M. dirhodum: BYDV-PAV, BYDV-MAV
- S. avenae: BYDV-MAV, BYDV-PAV (inefficiently)



ARE ALL VECTOR POPULATIONS EQUAL?

Main facultative endosymbionts:

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

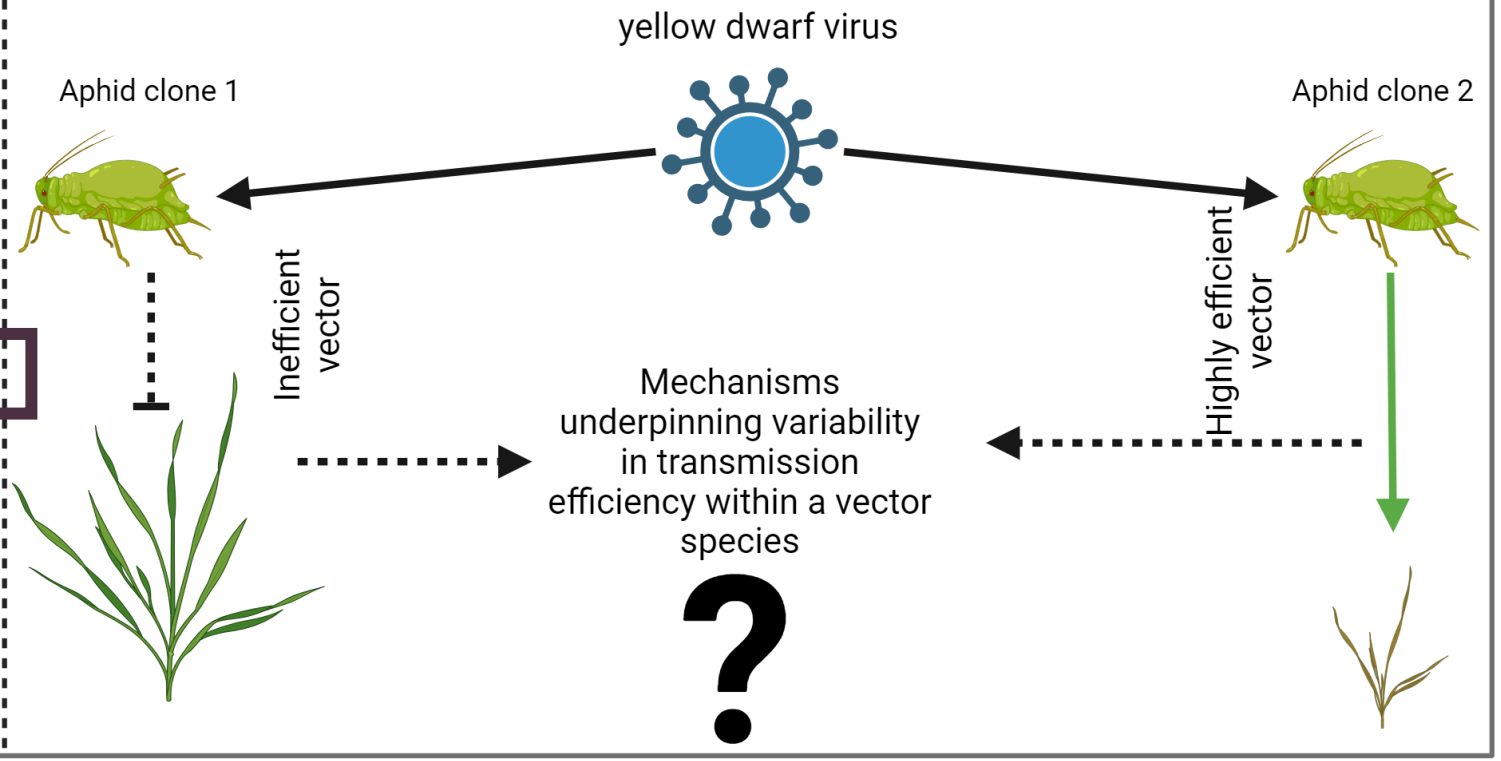




ARE ALL VECTOR POPULATIONS EQUAL?

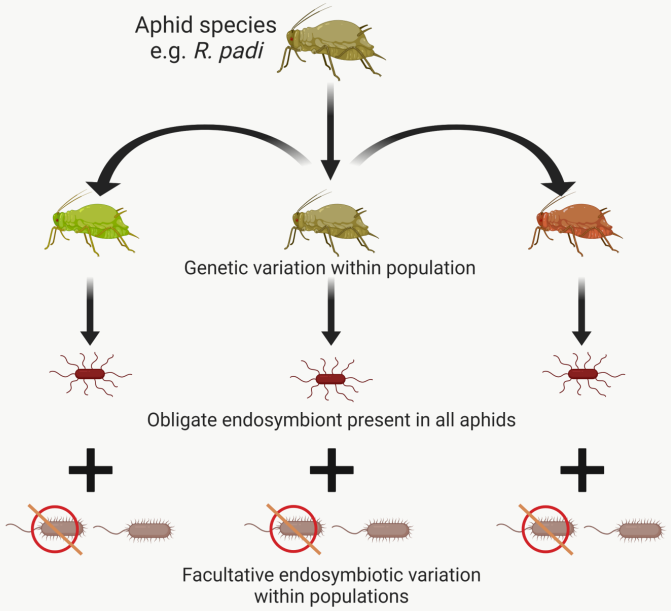
Variable transmission efficiency within an aphid species (*R. padi*) across cereal crops

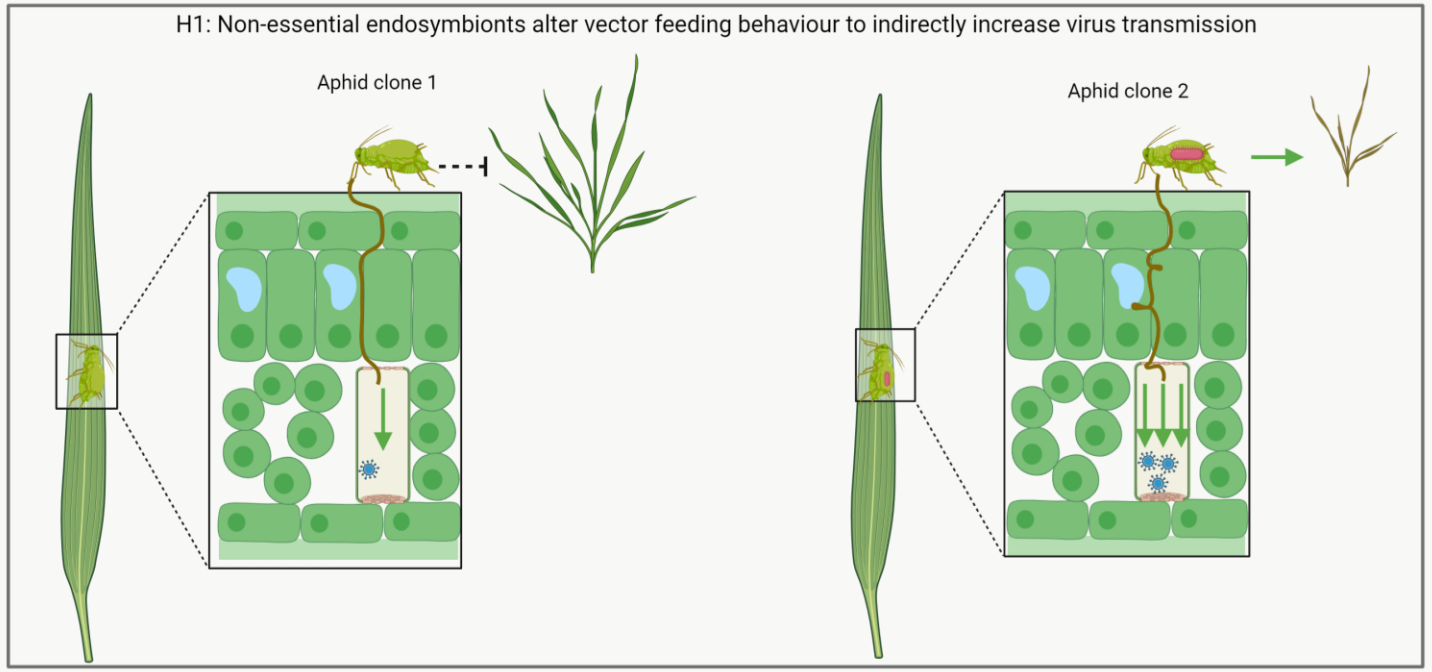
	Wheat	Barley	Oats
CYDV-RPV:	No data	32-100%	48-100%
CYDV-RPS:	No data	No data	No data
BYDV-PAV:	39-80%	0-100%	20-100%
BYDV-MAV:	No data	0-58%	0-10%
BYDV-PAS:	No data	No data	No data
BYDV-GAV:	No data	No data	0-53%
BYDV-SGV:	No data	No data	0%
MYDV-RMV:	No data	No data	0-73%
WYDV-GPV:	No data	No data	0-91%

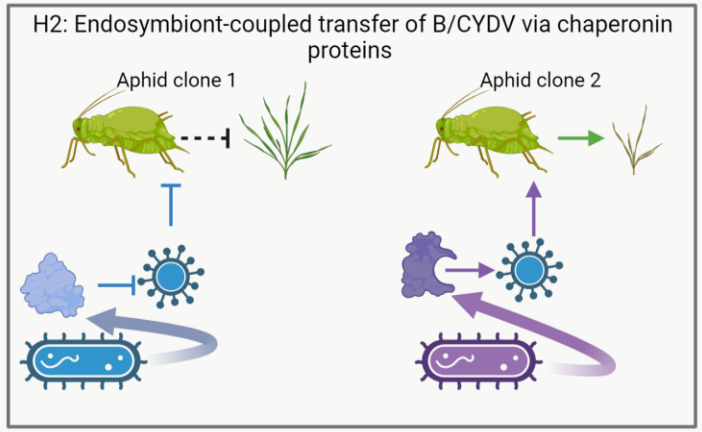


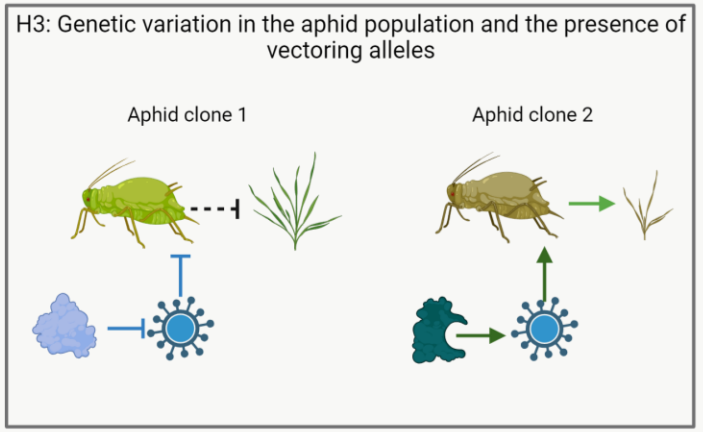
Leybourne, 2024. Plant Pathology

ARE ALL VECTOR POPULATIONS EQUAL?



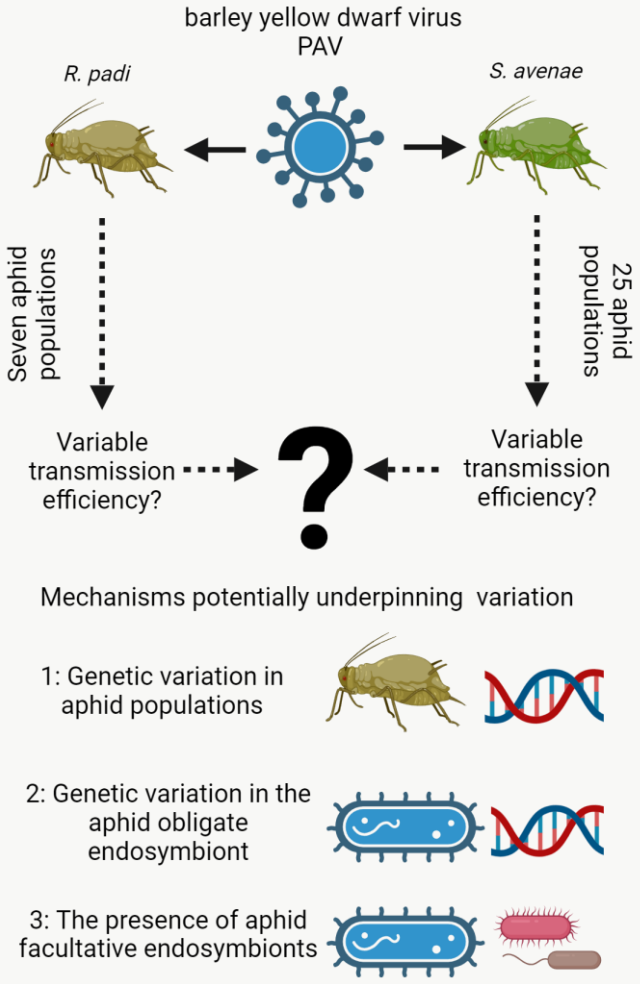




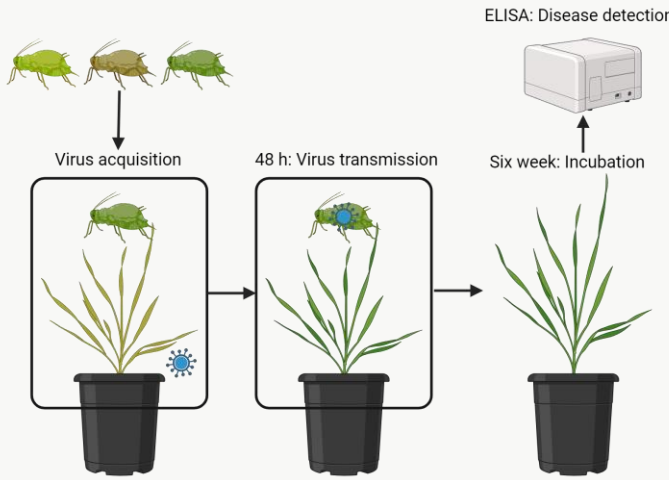


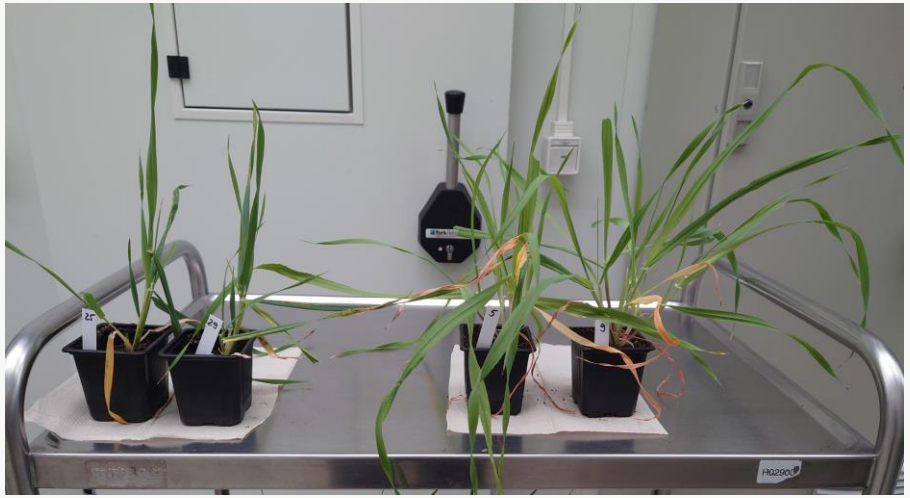
Leybourne, 2024. Plant Pathology

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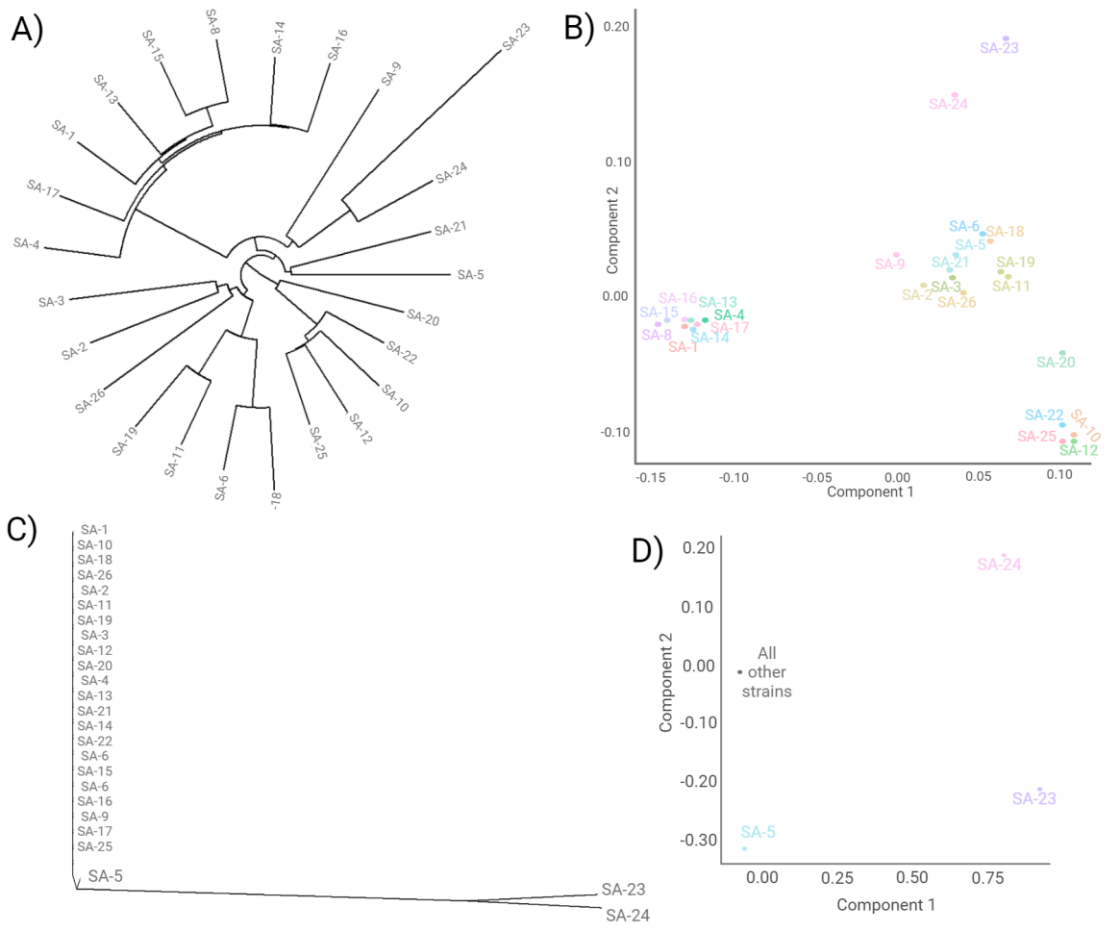


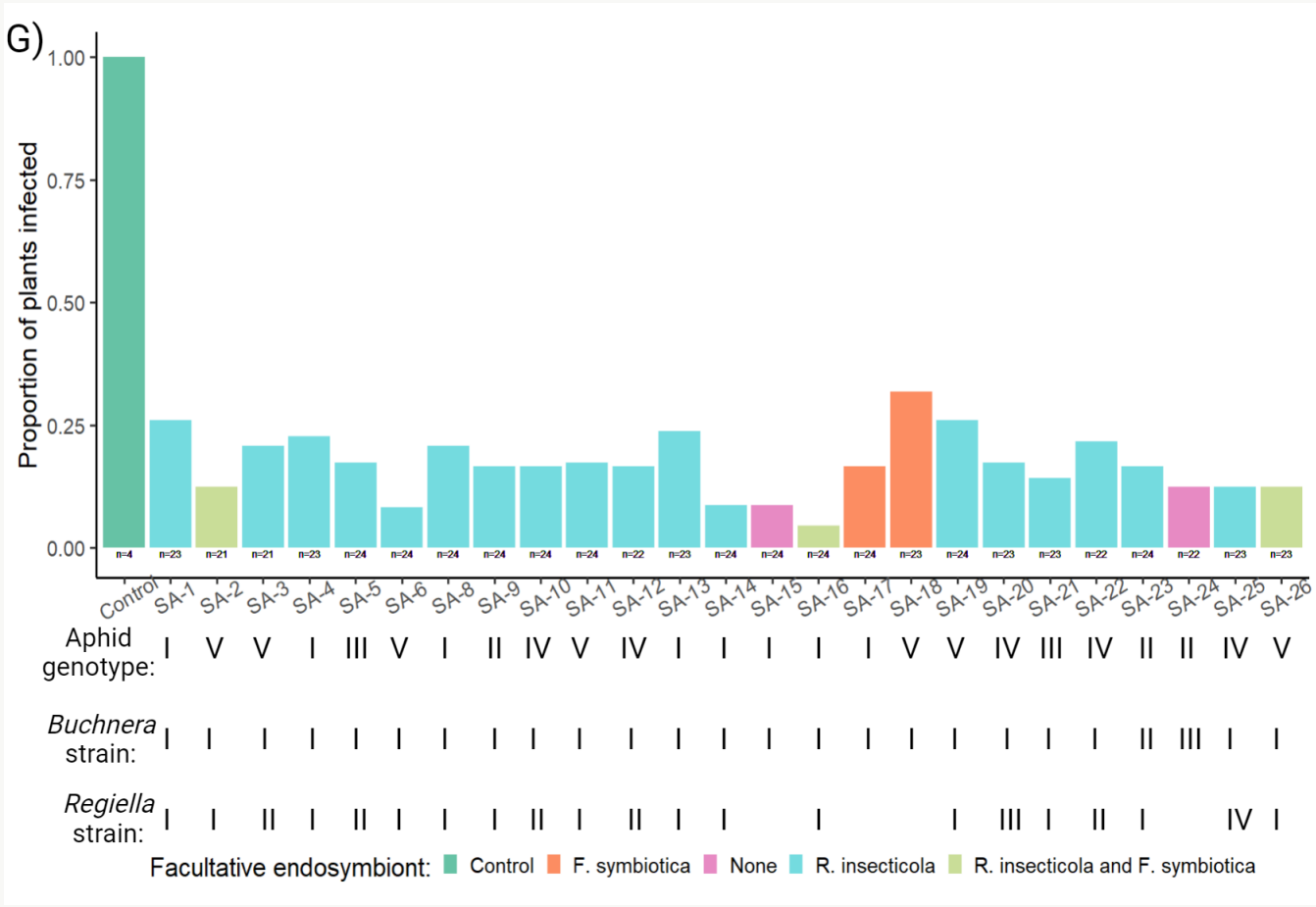




APHID DIVERSITY AND BYDV: S AVENAE

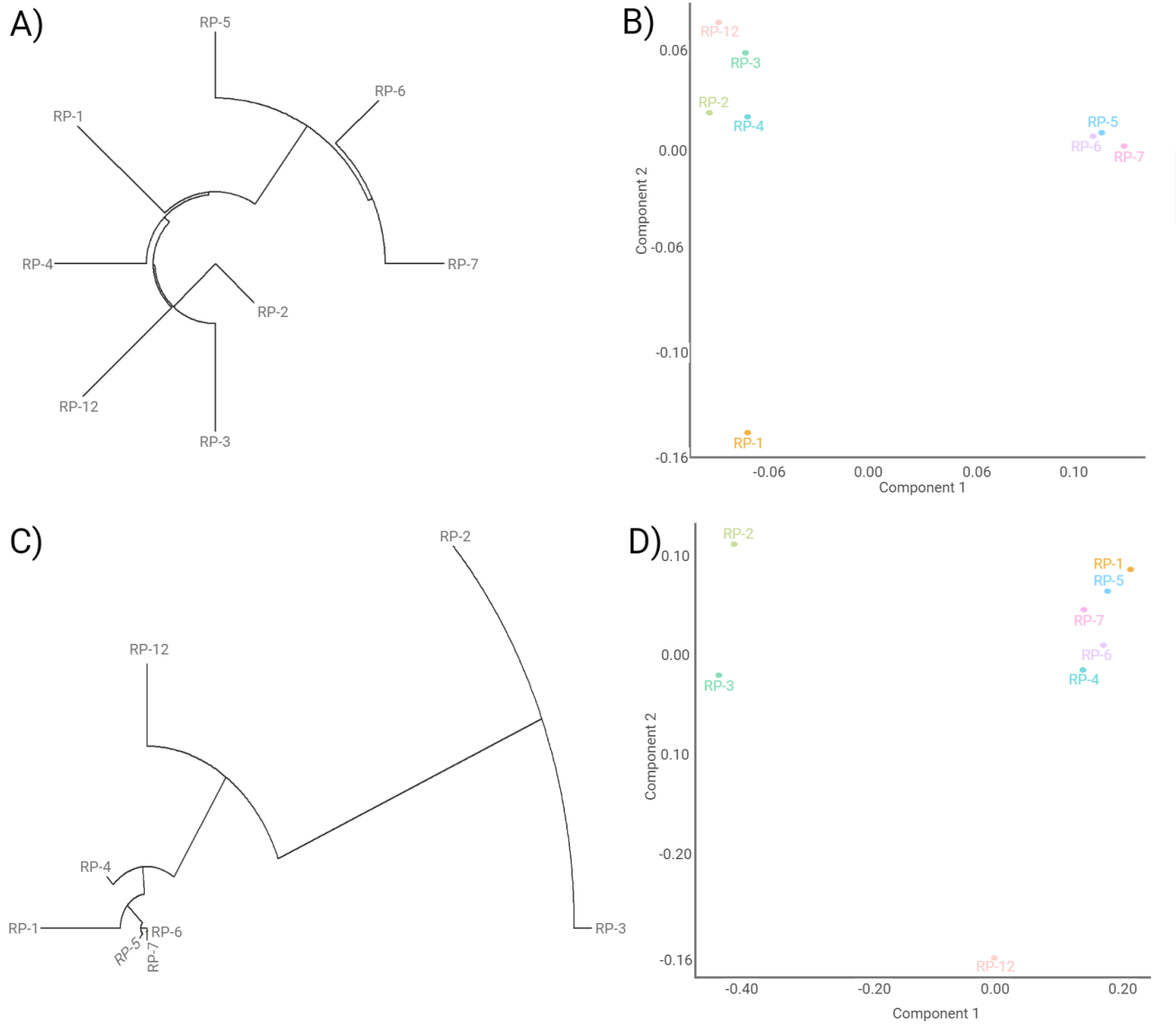
No effect of vector diversity on BYDV-PAV transmission in *S. avenae*





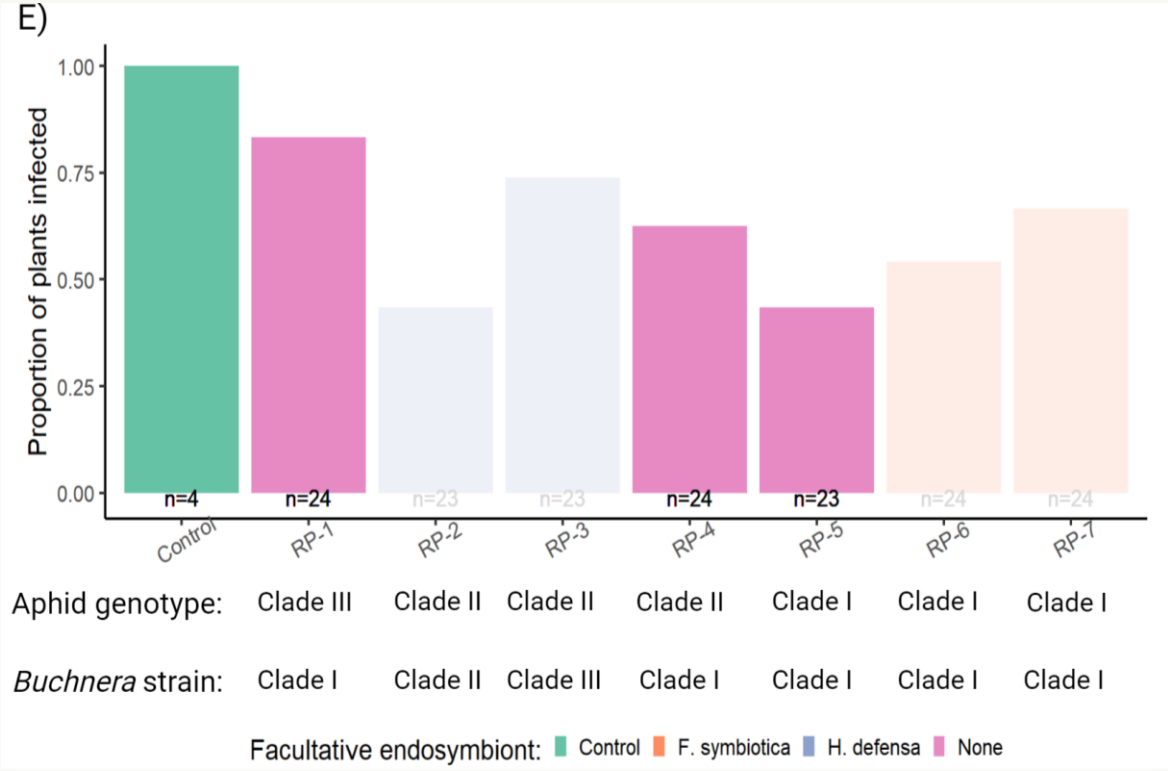
Leybourne, Whitehead, Will. 2024. *Biology Letters*

APHID DIVERSITY AND BYDV: R. PADI



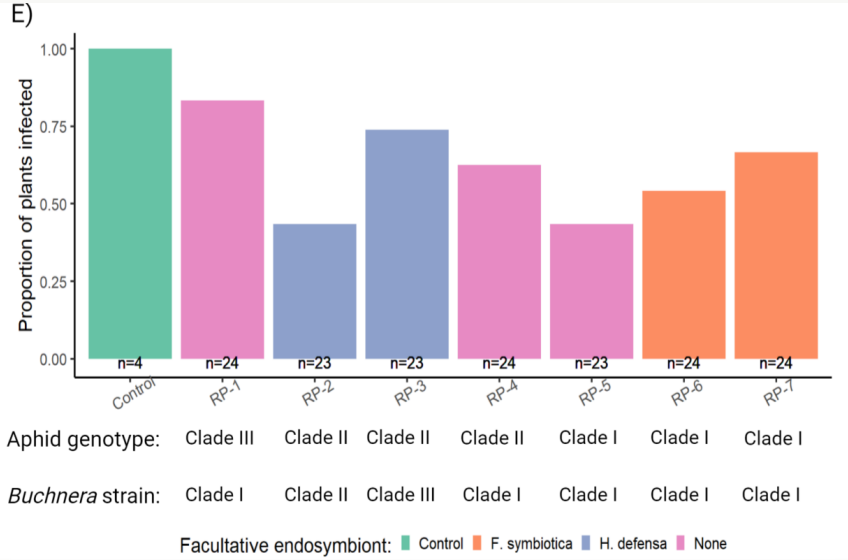
Vector diversity (aphid genotype) influences BYDV-PAV transmission in *R. padi*

>500 potential SNPs



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

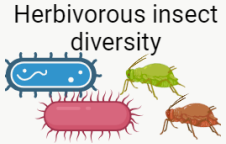
APHID DIVERSITY AND BYDV: NEXT STEPS



How do diverse vector life-history traits and transmission rates interact to affect BYDV infection in cereal crops?

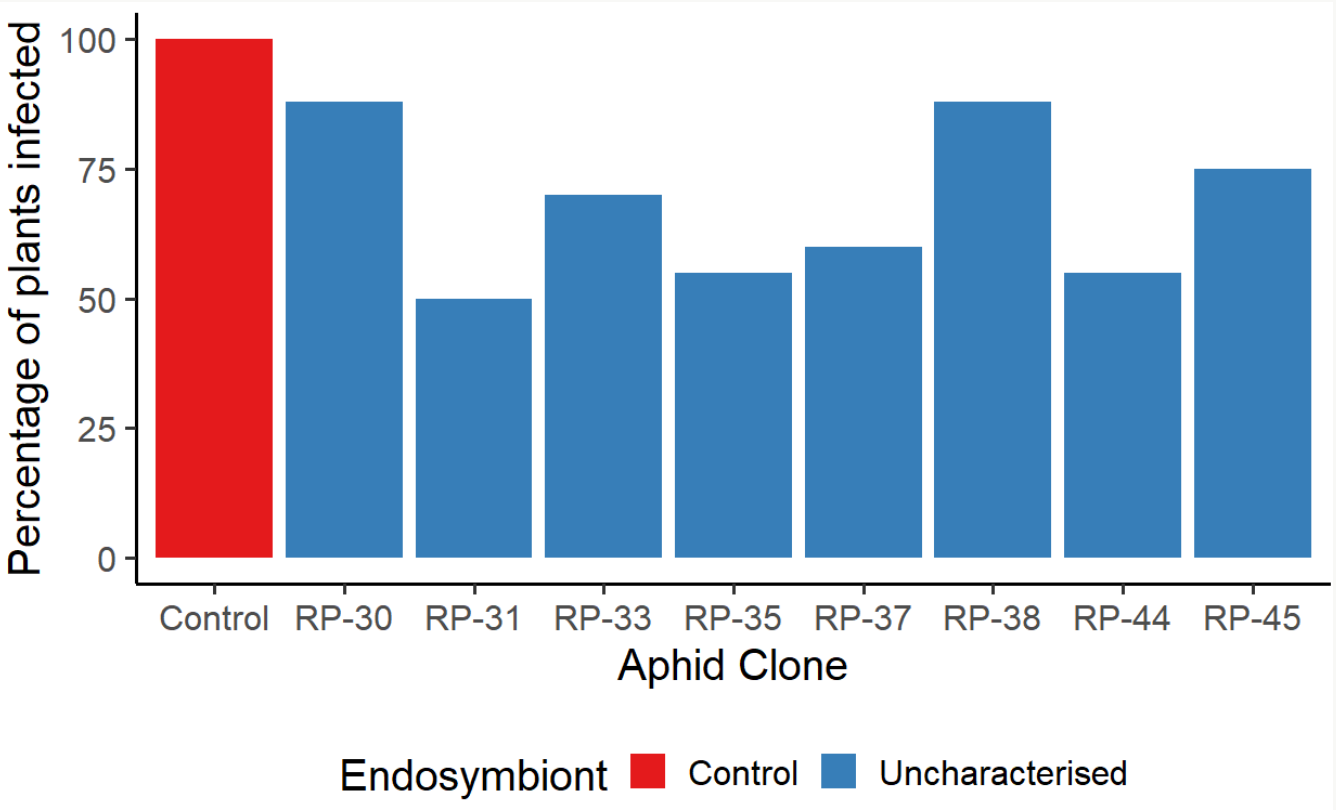
Katharine Preedy, Daniel Leybourne, Lawrence Bramham, Louise McNamara, Maximilian Schughart

945 - Thursday



Growing the *R. padi* – PAV dataset:

- 20 additional *R. padi* populations (8 analysed)
- BYDV-PAV transmission data
- Aphid genotype
- *B. aphidicola strain*
- Facultative endosymbiont presence



CONCLUSION

- Limited variation in transmission efficiency of BYDV-PAV (JKI variant) in *S. avenae* – an inefficient vector.
- Variation in BYDV-PAV (JKI variant) transmission efficiency in *R. padi* – potentially genetically linked.
- Growing the *R. padi* dataset – 20 new lines: 12 tested, 8 analysed, 8 starting next week!



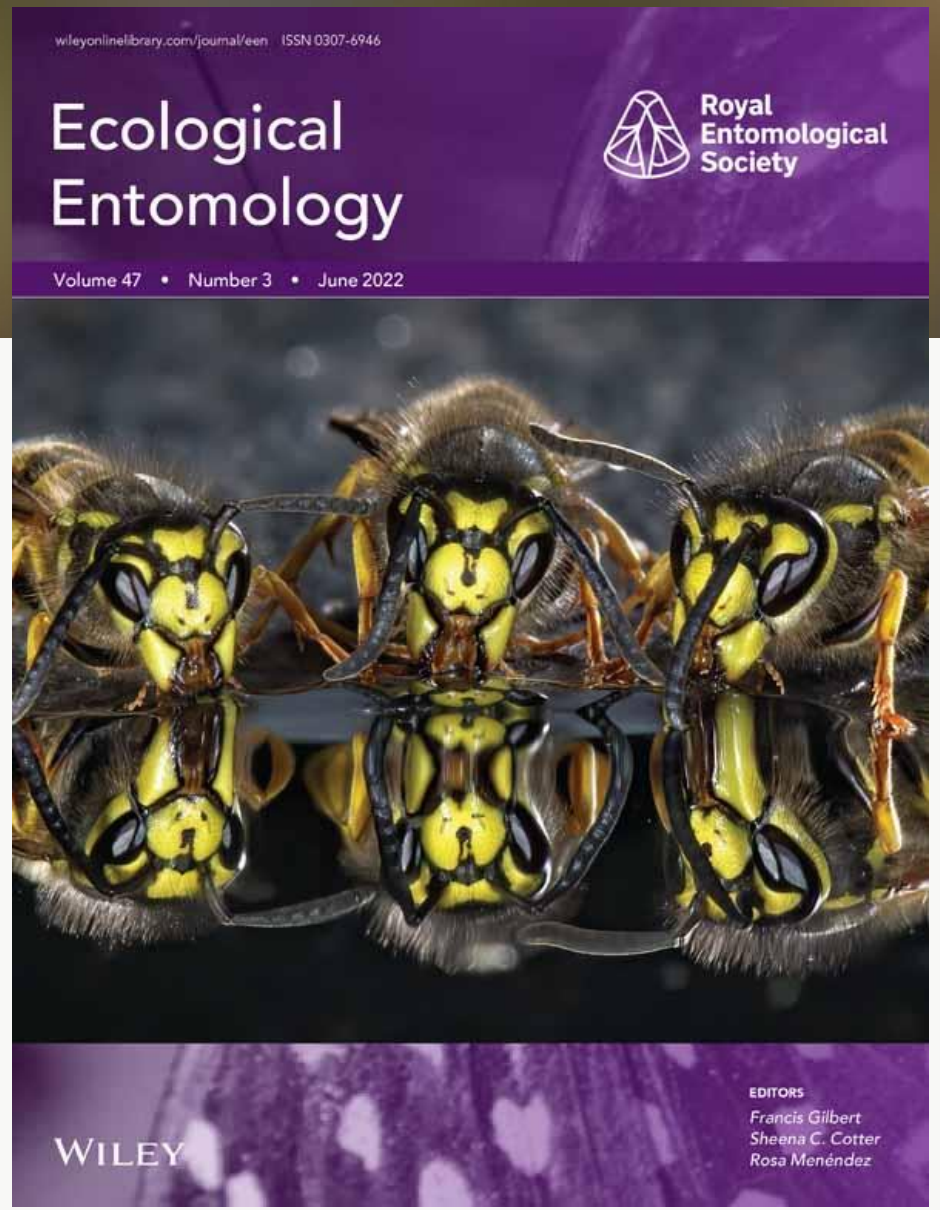


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