



ROTHAMSTED
RESEARCH



Aphid resistant wheat:
is it probable
or even possible?

Dr Gia Aradottir

Searching for insect resistance



ROTHAMSTED
RESEARCH

Biotype Differences for Resistance to Russian Wheat Aphid in Barley

Lynn S. Dahleen,^{*} Dolores Mornhinweg, Phil Bregitzer, Janine Vitou, and Mehmet Cakir

feeding on susceptible genotypes causes chlorosis and longitudinal streaking of leaves, and emerging leaves remain tightly rolled, which traps spikes and prevents their normal development (Mornhinweg, 2011). Screening of the more than 23,000 accessions in the USDA-ARS National Small Grains Collection (NSGC) has identified 116 accessions with some level of resistance to the United States biotype USA1 (Mornhinweg, 2011). From 40 of these accessions, 4 cultivars and 58 adapted germplasm lines have been developed and released (Mornhinweg et al., 2006, 2007a,

Cereal aphid pests in the UK



ROTHAMSTED
RESEARCH



Rhopalosiphum padi

- Host-alternates
- Sexual reproduction on bird-cherry trees in winter
- Populations migrate to grasses and all major cereals in May to early June
- Found on lower leaves or stem
- Direct feeding damage only at high infestation
- BYDV carrier
- Major pest: wheat, barley, oats and maize



Sitobion avenae

- Cereals and grasses all year round
- Mostly asexual reproduction
- Found on flag and upper leaves of cereals
- Reduces number of grains in ear if present before or after flowering
- BYDV carrier
- Major pest: wheat
- Moderate pest: barley, oats

Phenotyping modern wheat, landraces and wild relatives

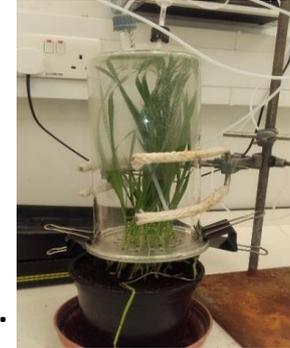


ROTHAMSTED
RESEARCH

Post-alighting (antibiosis) resistance: the plants morphology/biochemistry reduces aphid development, reproduction and/or survival.



Pre-alighting (antixenosis) resistance: affects aphid behaviour usually as a non-preference response.



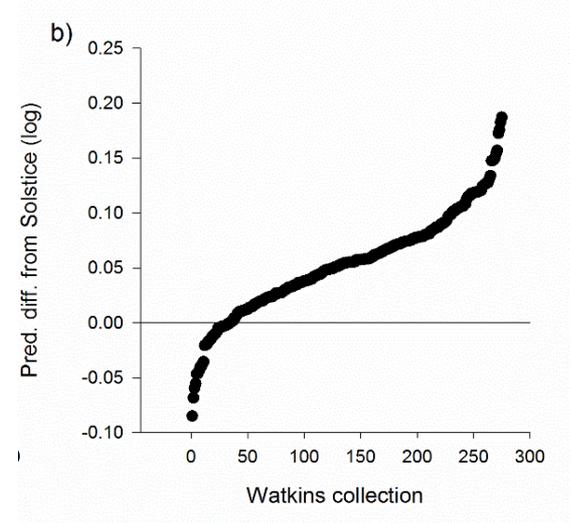
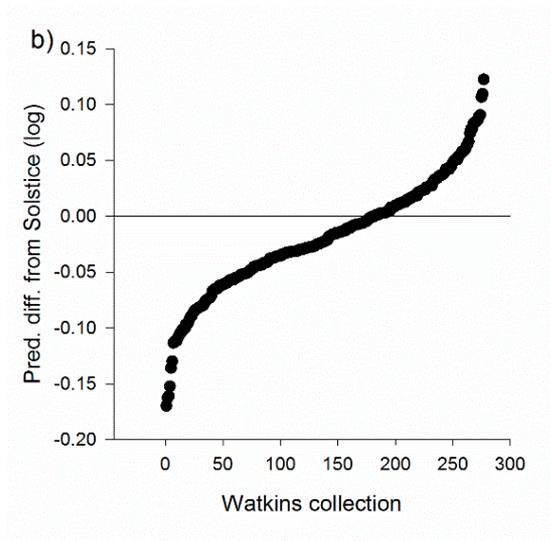
We screen germplasm for resistance to insects in controlled environment, glasshouse and field settings



Watkins collection



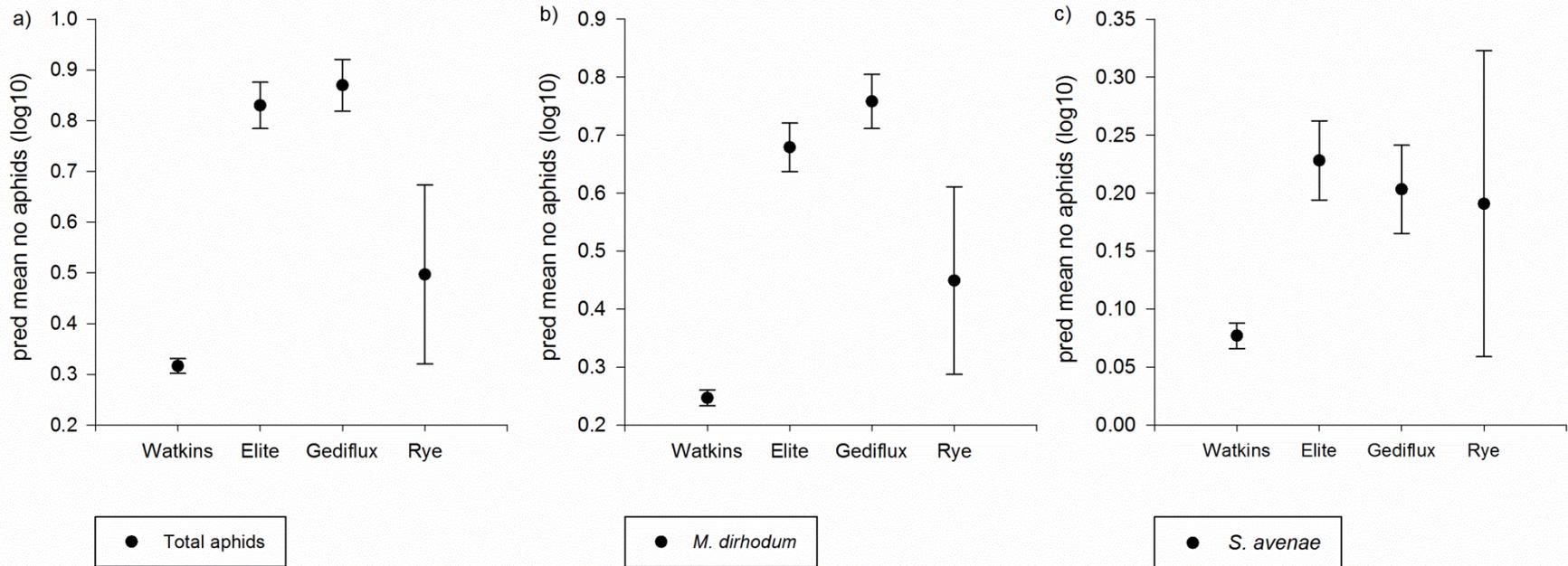
ROTHAMSTED
RESEARCH



Field populations of aphids



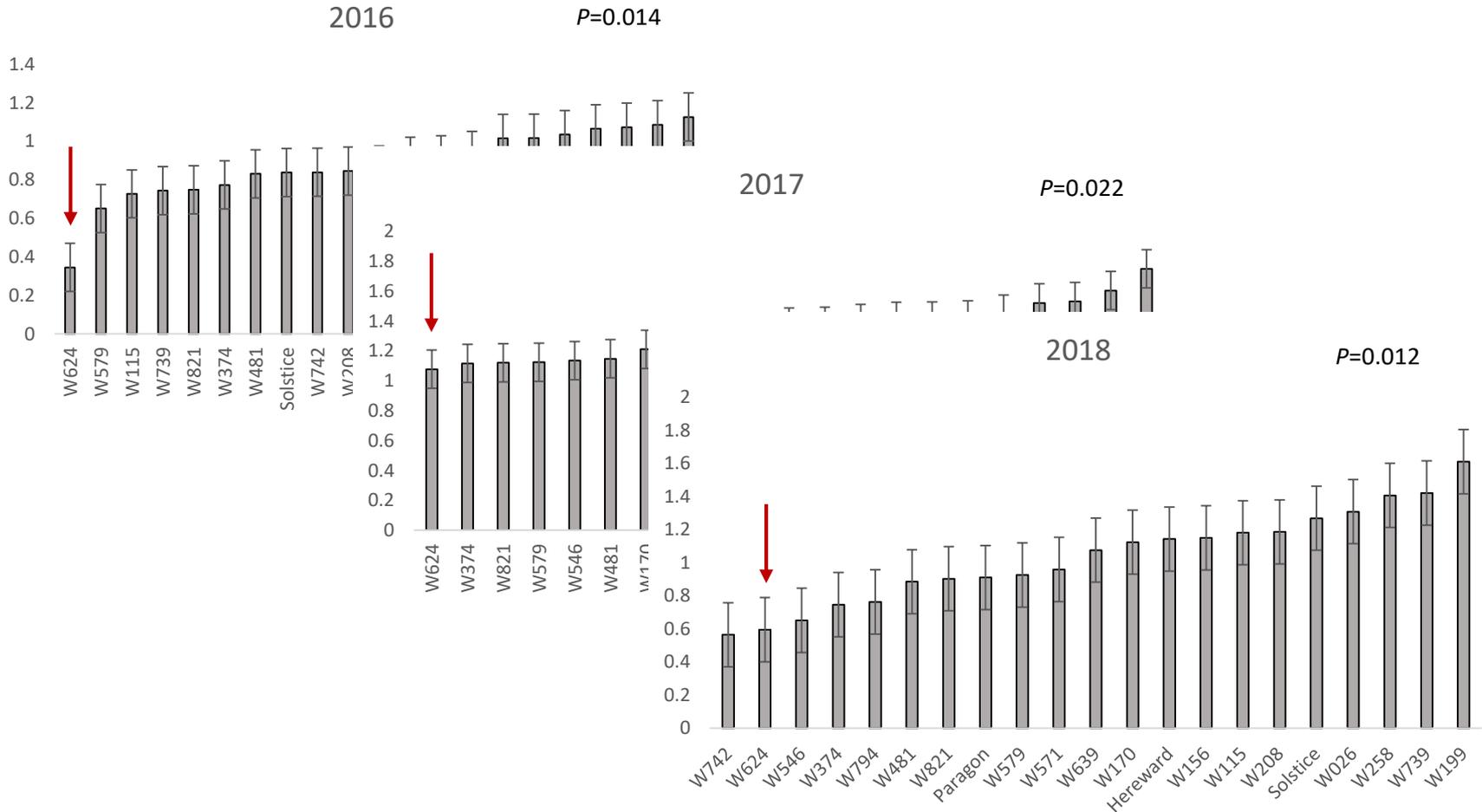
ROTHAMSTED
RESEARCH



Watkins field trials



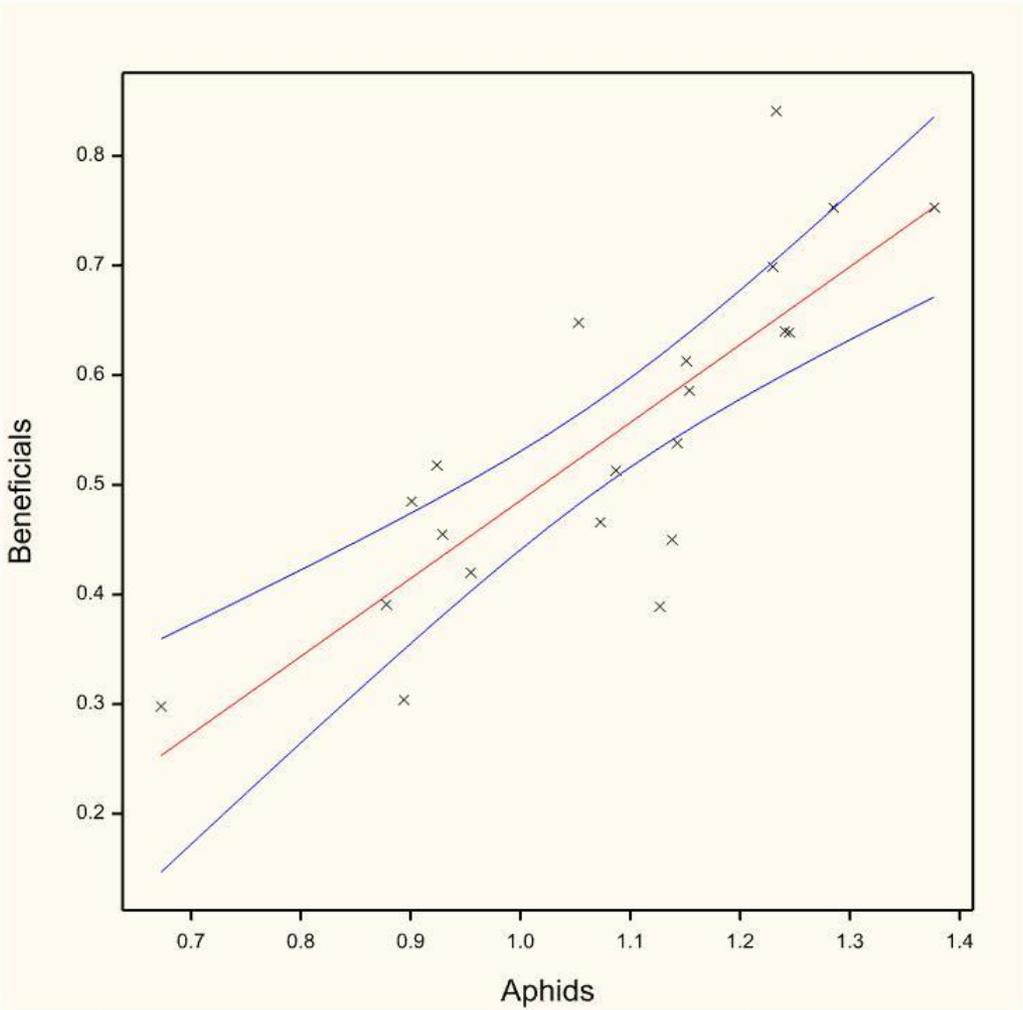
ROTHAMSTED
RESEARCH



Beneficials



ROTHAMSTED
RESEARCH



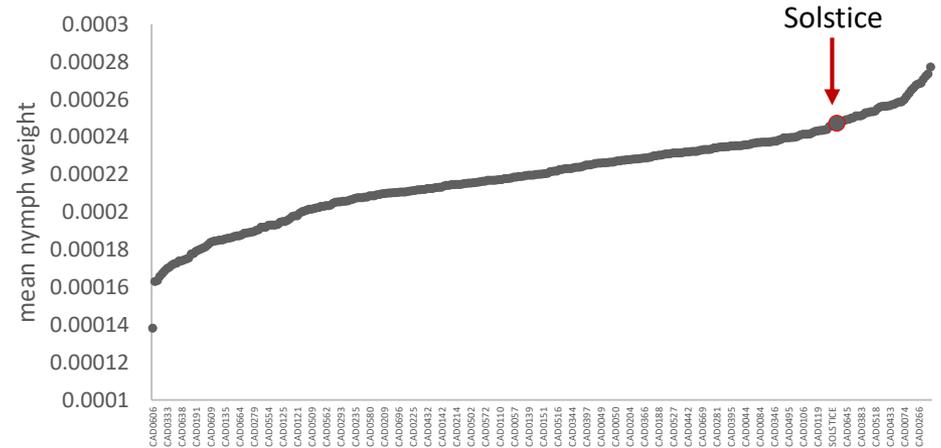
Cadenza



ROTHAMSTED
RESEARCH



Average nymph weight



Average nymph survival (% - logit)



Mapping populations



ROTHAMSTED
RESEARCH



Crosses

MDR037 x MDR045

MDR037 x MDR049

MDR037 x MDR657

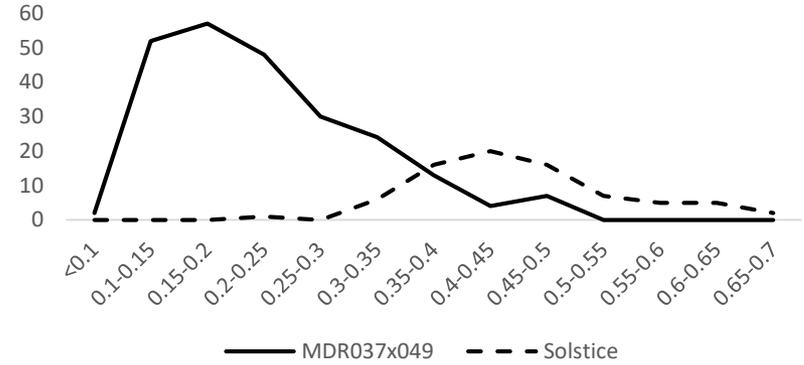
F1, F2 and F3 generations of these crosses have now been tested in the phenotyping screen against both aphid species.



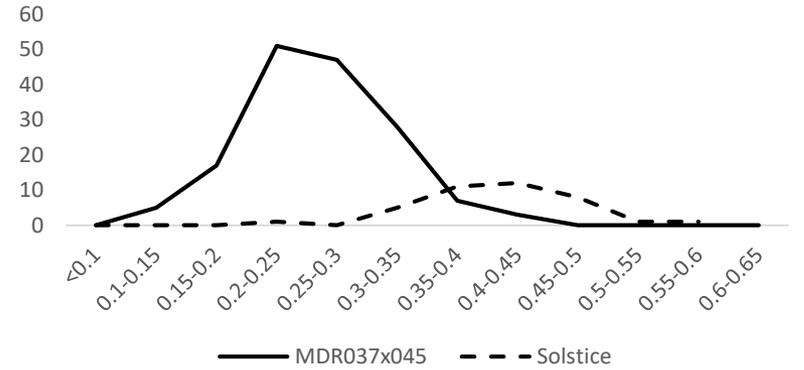


English grain aphid (*S. avenae*)

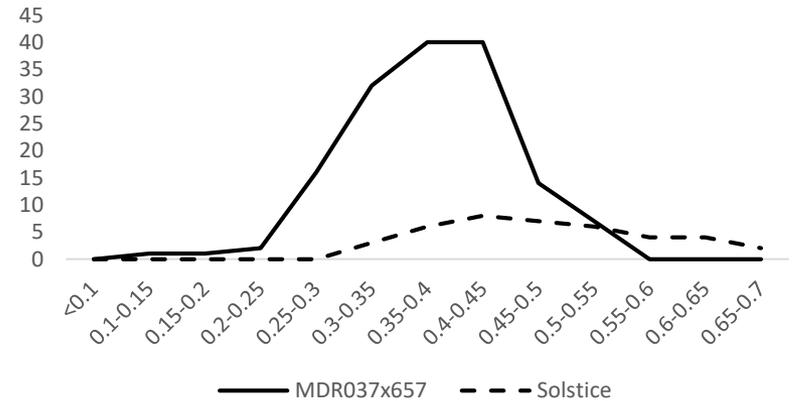
S. avenae on *T. monococcum* F3 crosses of MDR037 x 49



S. avenae on *T. monococcum* F3 crosses of MDR037 x 45



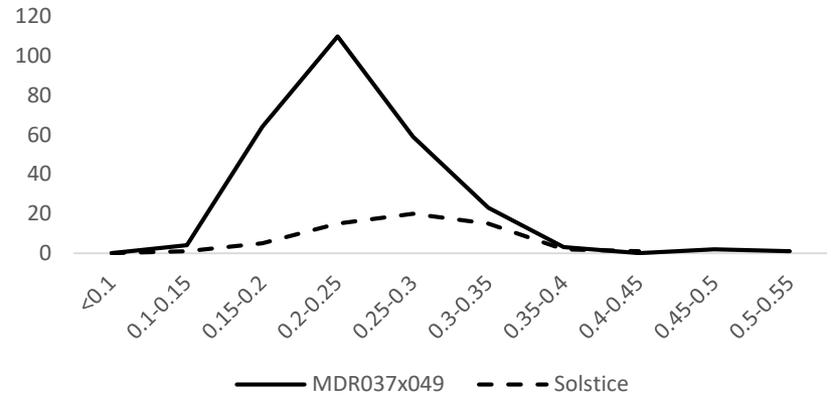
S. avenae on *T. monococcum* F3 crosses of MDR037 x 657



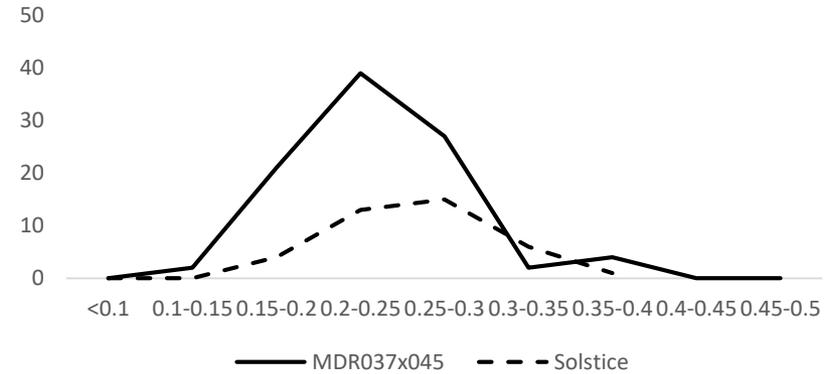


Bird cherry-oat aphid (*R. padi*)

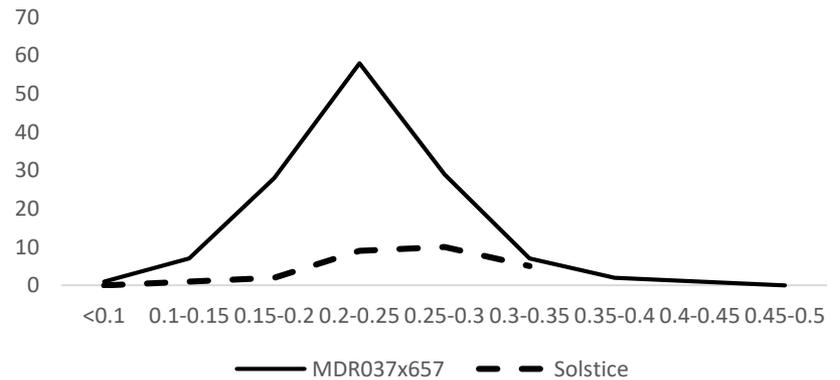
R. padi on *T. monococcum* F3 crosses of MDR037 x 49



R. padi on *T. monococcum* F3 crosses of MDR037 x 45



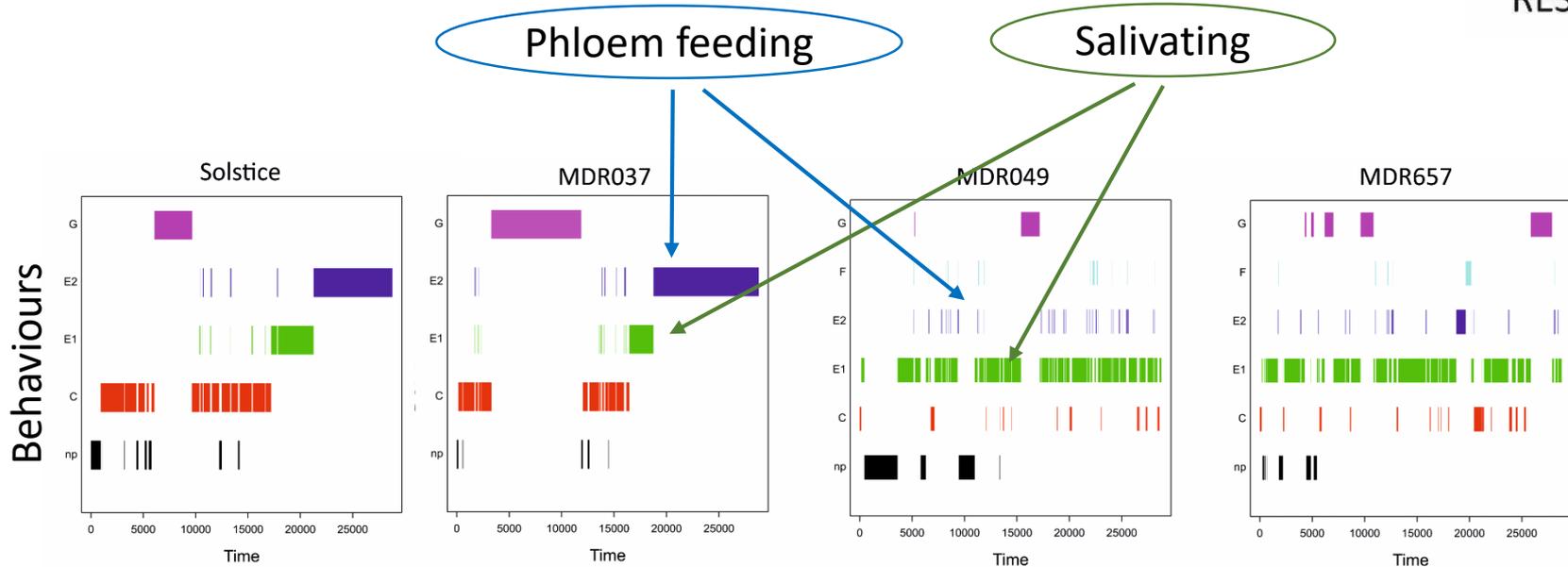
R. padi on *T. monococcum* F3 crosses of MDR037 x 657



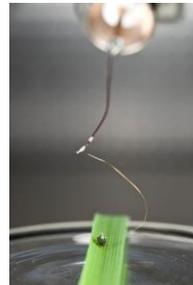
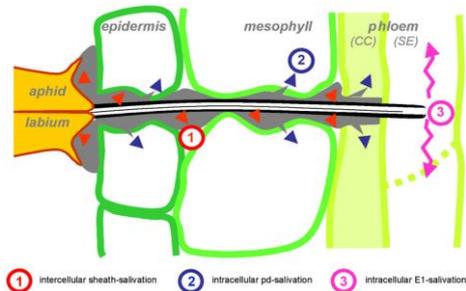
Aphid feeding disruption



ROTHAMSTED
RESEARCH



Eight hour continuous time (s) recordings for aphid feeding. Behaviours: np: not probing, C: pathway phase, E1: salivation, E2 phloem ingestion, F: derailed stylet mechanics, G: xylem ingestion.



Summary



ROTHAMSTED
RESEARCH

- Multiple leads
 - Watkins landraces – crossing this year
 - Cadenza – BC1F1 ready for phenotyping
 - *T. monococcum* F4 mapping population – phenotyped and ready for bulk segregant analysis
- Working towards marker identification
- How does it work:
 - Pre-alighting effect on aphids
 - Post-alighting effect on feeding, development, reproduction and survival
 - Plant chemistry



So...

..is it possible?

I am convinced it is

..is it probable?

Depends on resources
and collaborators



Cereal aphids & Barley Yellow Dwarf Virus



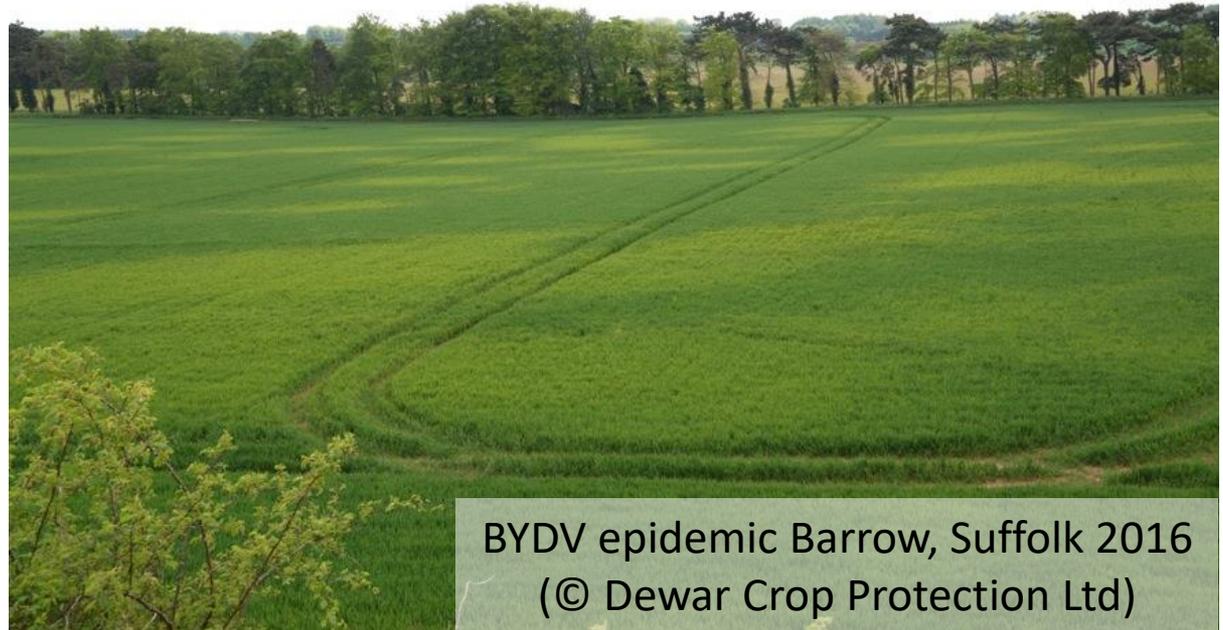
ROTHAMSTED
RESEARCH



Bird cherry-oat aphid



English grain aphid

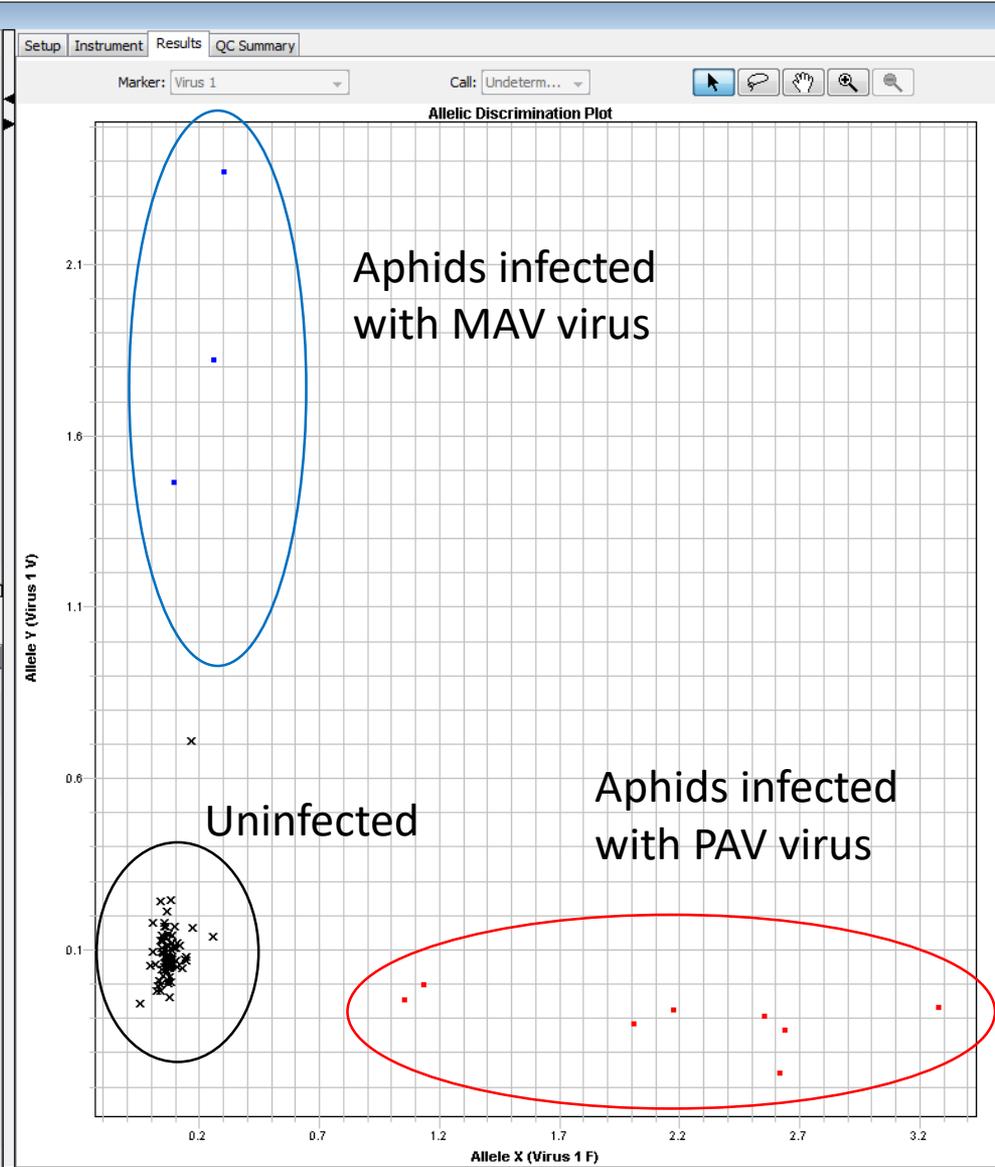
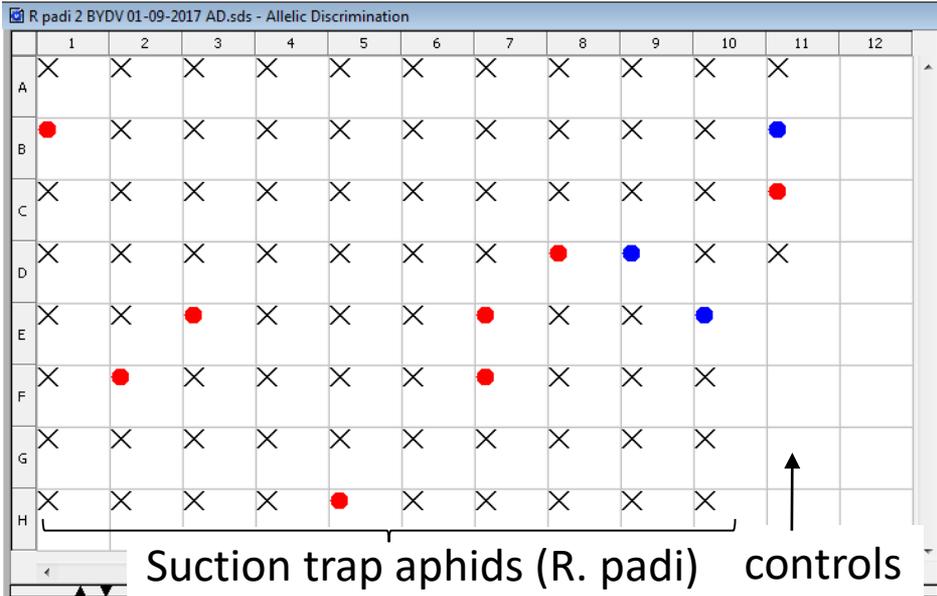


BYDV epidemic Barrow, Suffolk 2016
(© Dewar Crop Protection Ltd)

A real-time PCR assay for detecting BYDV in cereal aphids



ROTHAMSTED
RESEARCH



Acknowledgements

Rothamsted:

Jackie Freeman

Rowan Mitchell

Lesley Smart

Janet Martin

Toby Bruce

Alex Greenslade

Lucas Bruguier

Amma Simon

John Caulfield

John Pickett

Emmanuel Ziramba

Kim Hammond-Kosack

Mike Hammond-Kosack

Vanessa McMillan

Malcolm Hawkesford

Andrew Riche

Jane Ward

Suzanne Clarke

Stephen Goward and farm staff



Simon Griffiths

Simon Orford

Cristobal Uauy

Brande Wulff

and colleagues



Alison Bentley

Phil Howell



John Foulkes



Mark Winfield



Innovate UK

