

The wheat-rust conflict: Shifty enemies and the long reach of genomics



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Photo: Matt Heaton

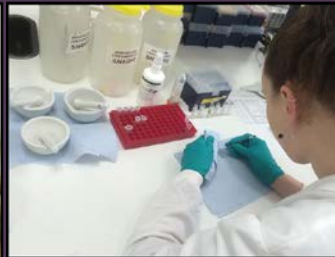
Field pathogenomics

Pathogen diagnostics & surveillance

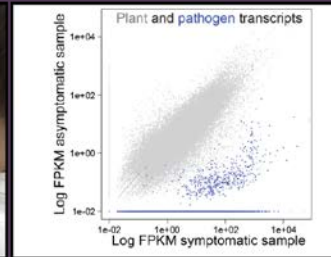
< 3 months



1 Field samples



2 Transcriptome sequencing



3 Data analysis

Pathogen & host: Genotype + Transcriptome

Confirm new
disease
outbreaks

Wheat blast

Track global
pathogen
dispersal

Yellow rust

Study host
responses in
the field

Yellow rust

Monitor
mutations in
fungicide
targets

Yellow rust

Evaluating
future threats

Stem rust

Wheat blast: led by TSL, BMC Biology, 14:84 (2016); Yellow rust: Genome Biology 26:23 (2015); GBE 12:1 (2017); Stem rust: Communications Biology: 13 (2018)

What can we learn from the wheat side of the interaction that could be useful for disease management?



= PATHOGEN
STRAIN



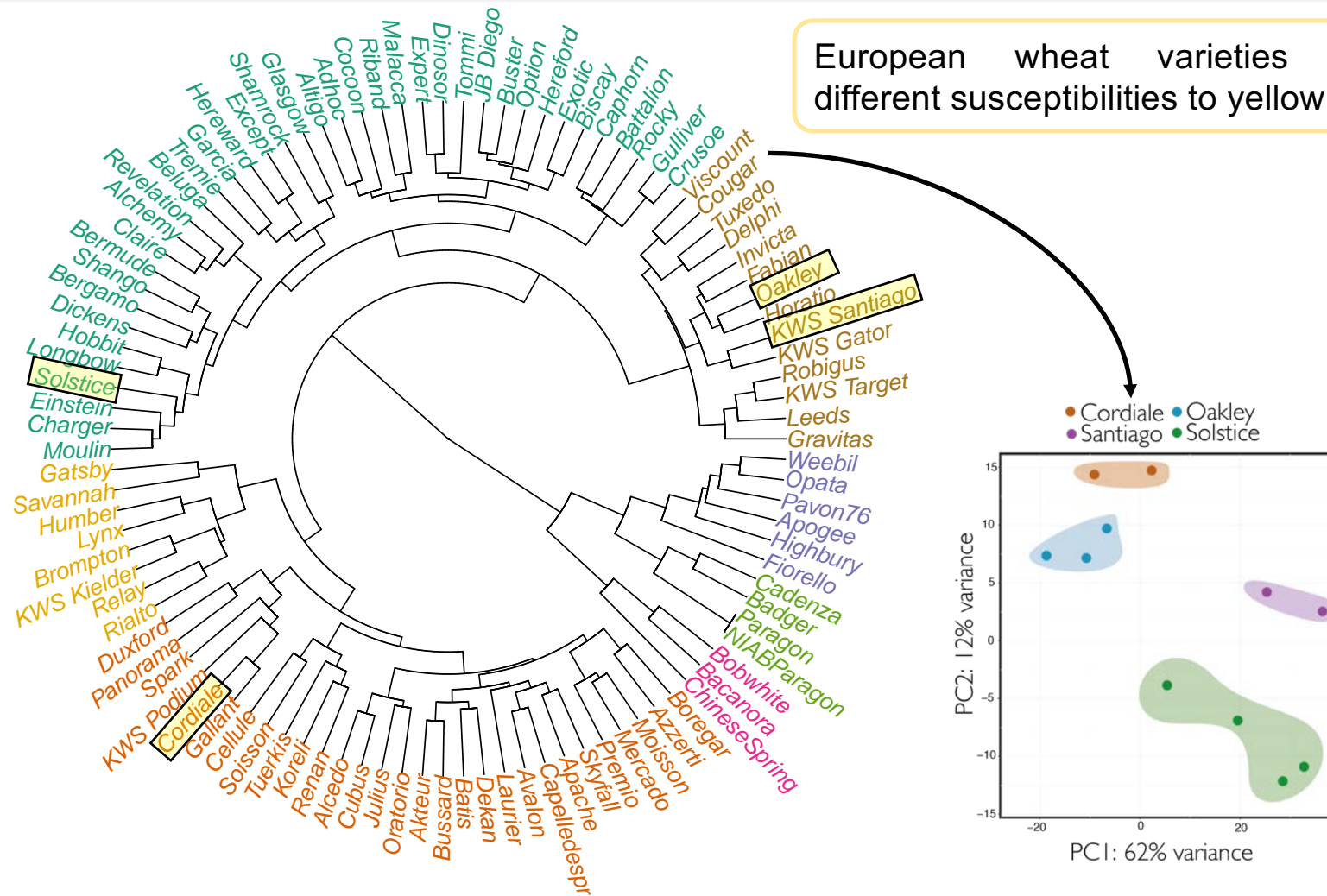
= WHEAT
VARIETY



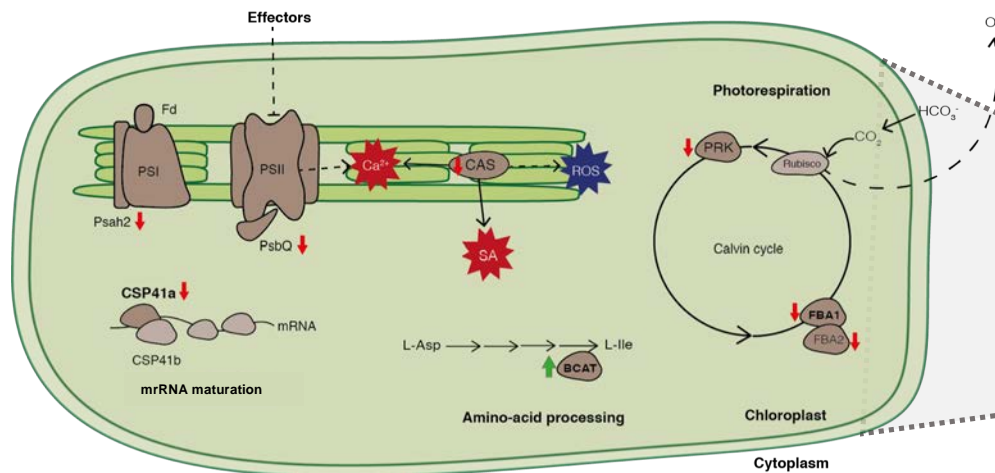
Pilar
Corredor-Moreno

Can we use field data to learn more about the Wheat - Yellow rust interaction?

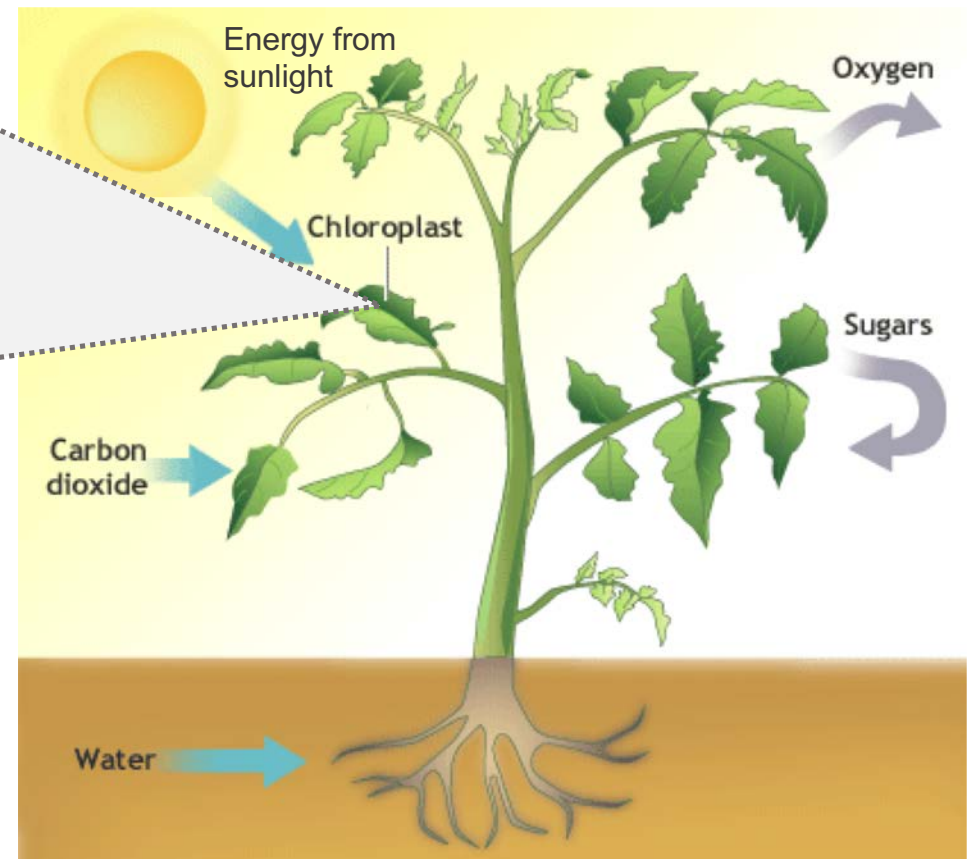
European wheat varieties with different susceptibilities to yellow rust



Gene expression altered during infection in chloroplast-related genes (the plants “food factories”)



TILLING mutants for certain nuclear-encoded chloroplast genes show a decrease in yellow rust susceptibility



Can we use field-based sequencing approaches to track "new" diseases: tackling the re-emergence of wheat stem rust

Lewis et al., & Saunders (2018) Communications Biology 1:13.

Dangerous outbreak of stem rust on wheat in southern Ethiopia

SeedQuest® Date: Wed 26 Mar 2014

News > UK > Home News

Wheat rust: The fungal disease that threatens to destroy the world crop

Experts in Europe and Africa are racing to develop resistant grain varieties as university researchers predict the likely spread across continents of the air-borne spores of the fungus

Christy Chamy | Saturday 19 April 2014 23:01 BST | 0 comments

Stem rust attacks in Sweden heralds the return of a previously vanquished foe

PUBLISHED: 01 NOVEMBER 2017

TTTTF, a kind of stem rust, damages tens of thousands hectares of crops in Sicily

F

Fears raised over stem rust risk to UK wheat crop

VINCE BAMFORD · 13 FEBRUARY, 2018

BritishBAKER

IRE | NEWS

Deadly new wheat disease threatens European crops

Researchers caution that stem rust may have returned to world's largest wheat-producing region.

Shaoni Bhattacharya

02 February 2017

UK > Home News

Wheat rust: The fungal disease that threatens to destroy the world crop

Experts in Europe and Africa are racing to develop resistant grain varieties as university researchers

Christy Chamy

Sicilian stem rust strain cause for concern

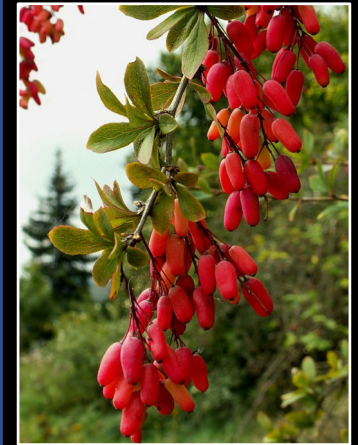
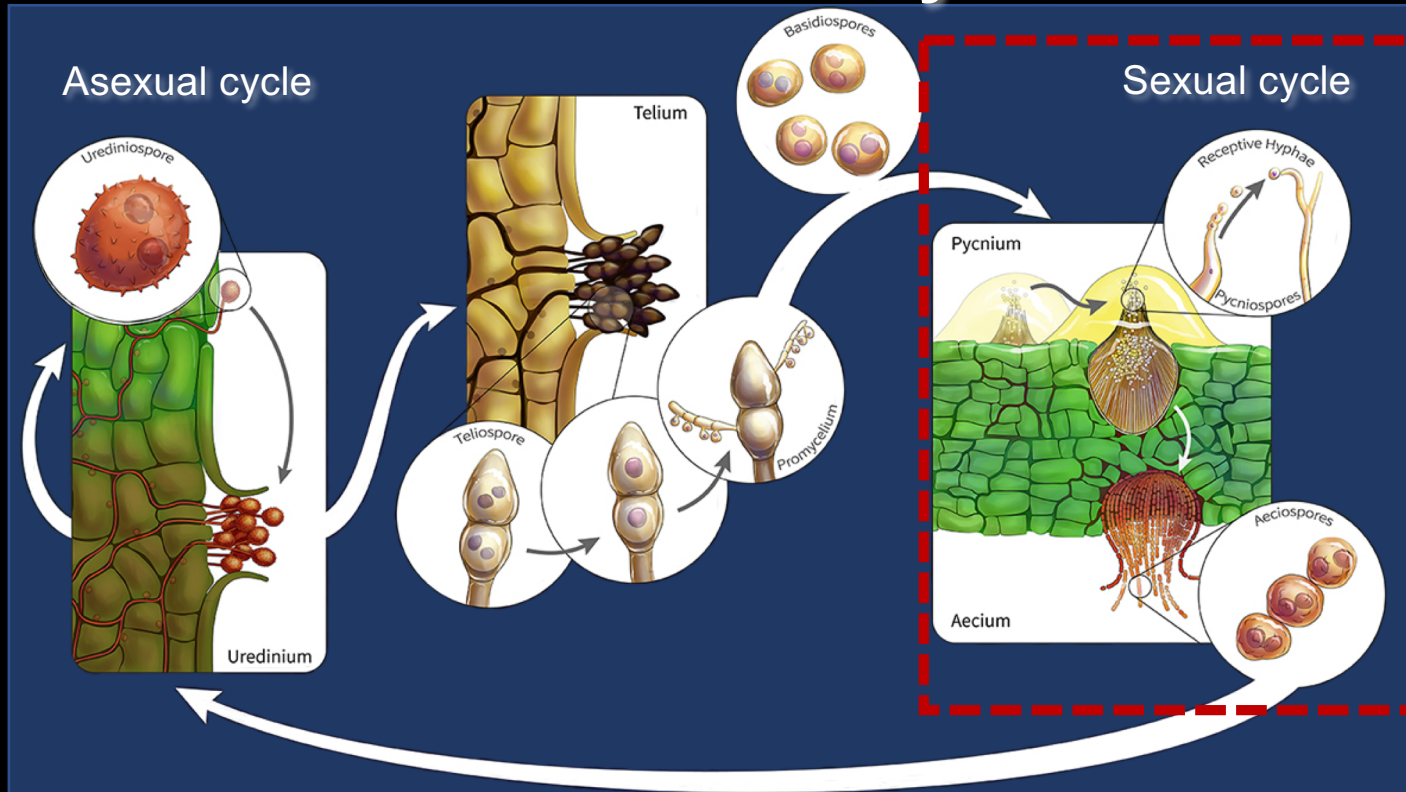
03 Feb 2017 < Share Categories: Frontdesk / Arable

 Farming Online

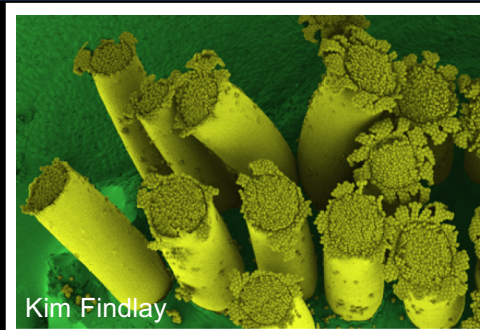
Wheat rust life cycle



Wheat



Common barberry



Kim Findlay

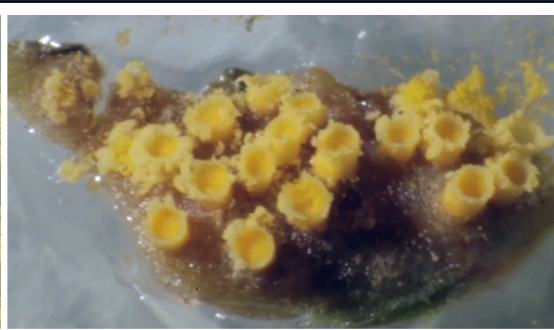


Image adapted from Wende Gu

What about the role of the alternate host?

Common barberry
(*Berberis vulgaris*)



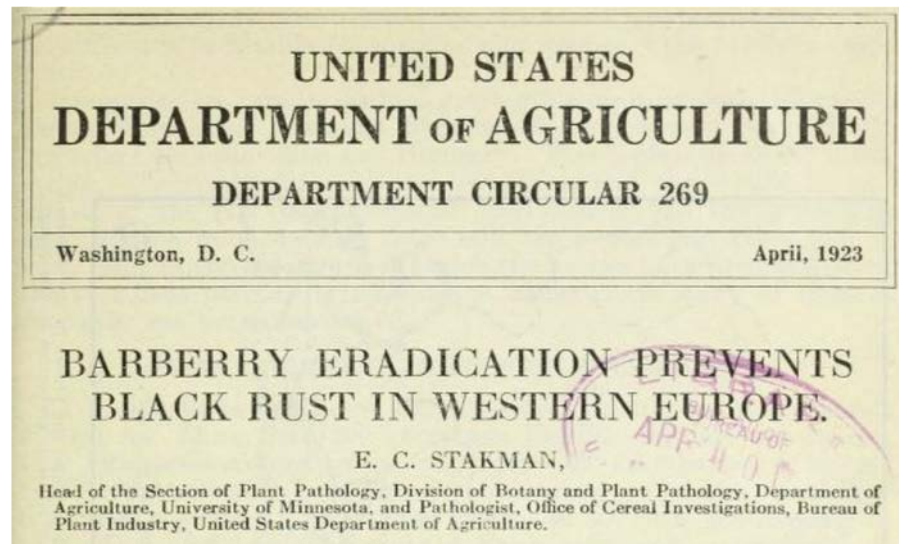
Elizabeth
Orton



Clare
Lewis

Image: Michael Meijer

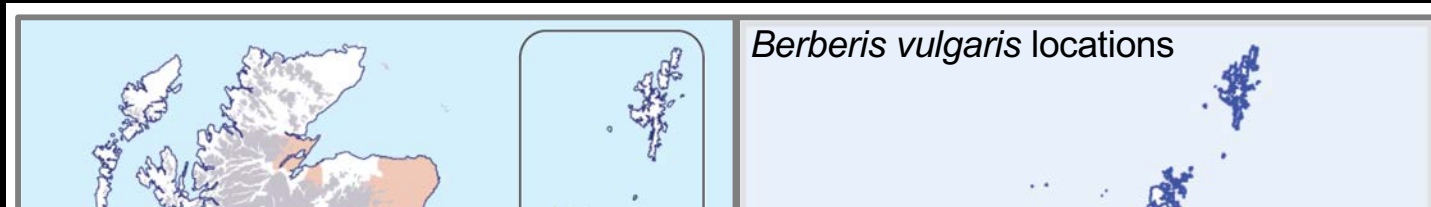
Common barberry removal campaign



Over 300 yrs ago "English farmers complained that black stem rust ruined crops growing near barberry bushes. So they showed their good sense by destroying the bushes"



Common barberry is increasing in prevalence across the UK



B. vulgaris re-planted to conserve the **barberry carpet moth**, a Priority Species in the UK Biodiversity Action Plan & protected under schedule 5 of the Wildlife and Countryside Act 1981

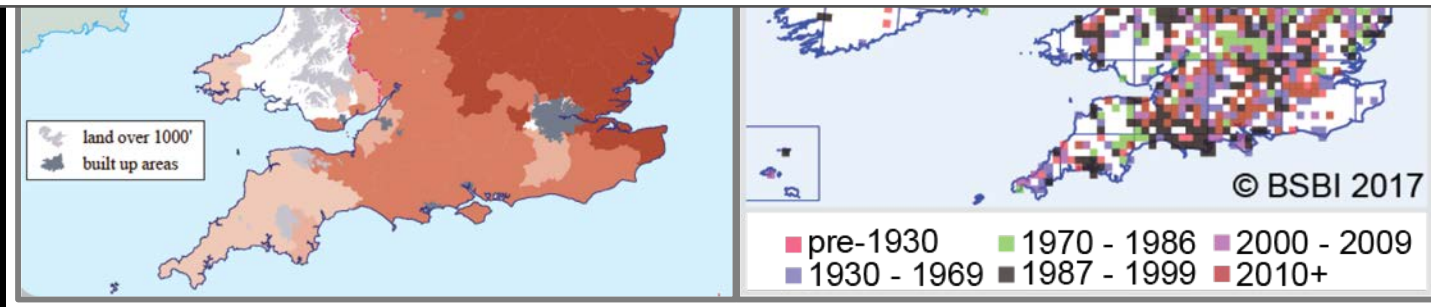
Barberry
carpet moth
(*Pareulype berberata*)



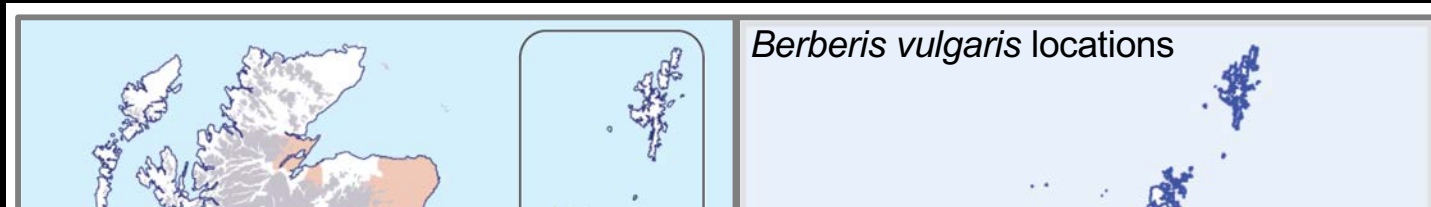
02 21/02/2017

CHESTER ZOO CALLING ON VISITORS TO HELP SAVE RARE UK SPECIES

British wildlife is under threat like never before – and Chester Zoo is helping visitors join the fight to protect a rare species of moth by giving away free plants, as part of a Wildlife Connections campaign.



Common barberry is increasing in prevalence across the UK



Need to balance risks of re-planting with potentially escalating cereal rust diversity and protection of habitat for the carpet moth

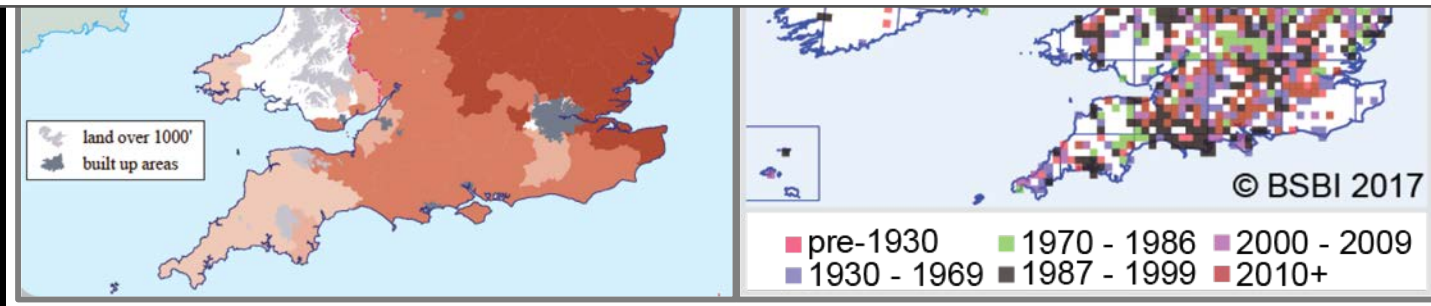
Barberry
carpet moth
(*Pareulype berberata*)



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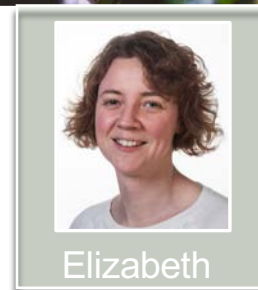
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BarbRE

Barberry Rust Explorer



Elizabeth

Join a community tracking barberry bushes to inform conservation and UK wheat food security

We need your help to map barberry bush locations

<https://barbre.co.uk/launch/>

3rd April 2019 at JIC conference centre



WHAT'S NEXT?

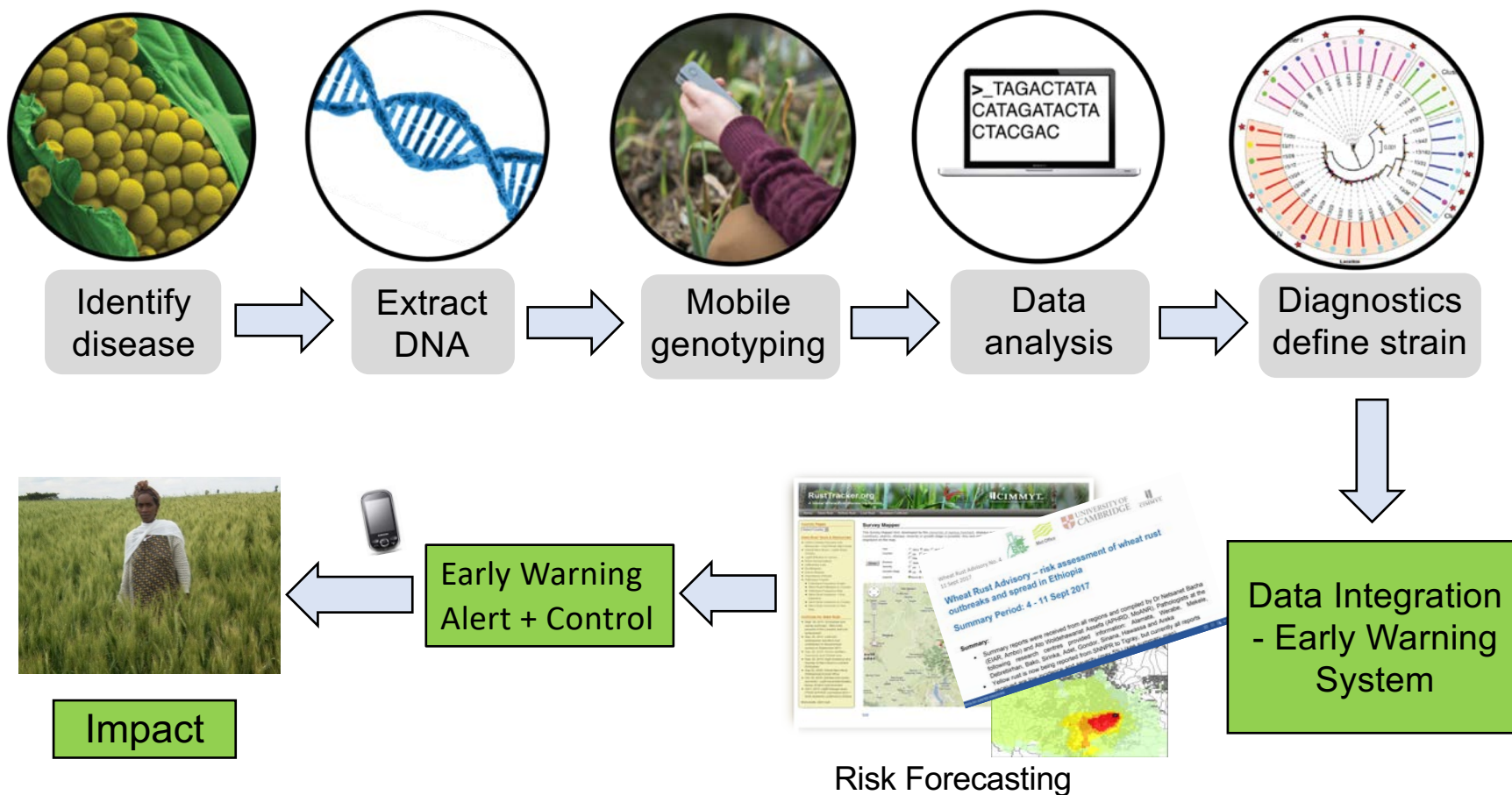


Mobile And Real-time PLant disEase diagnostics

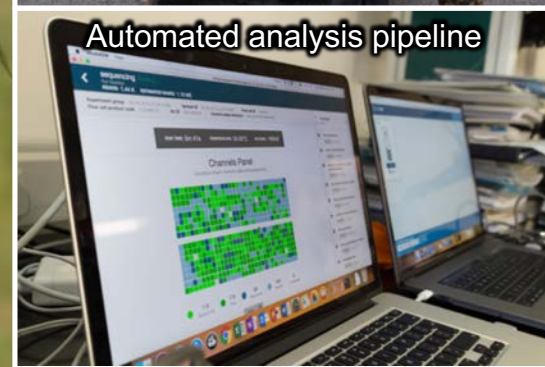
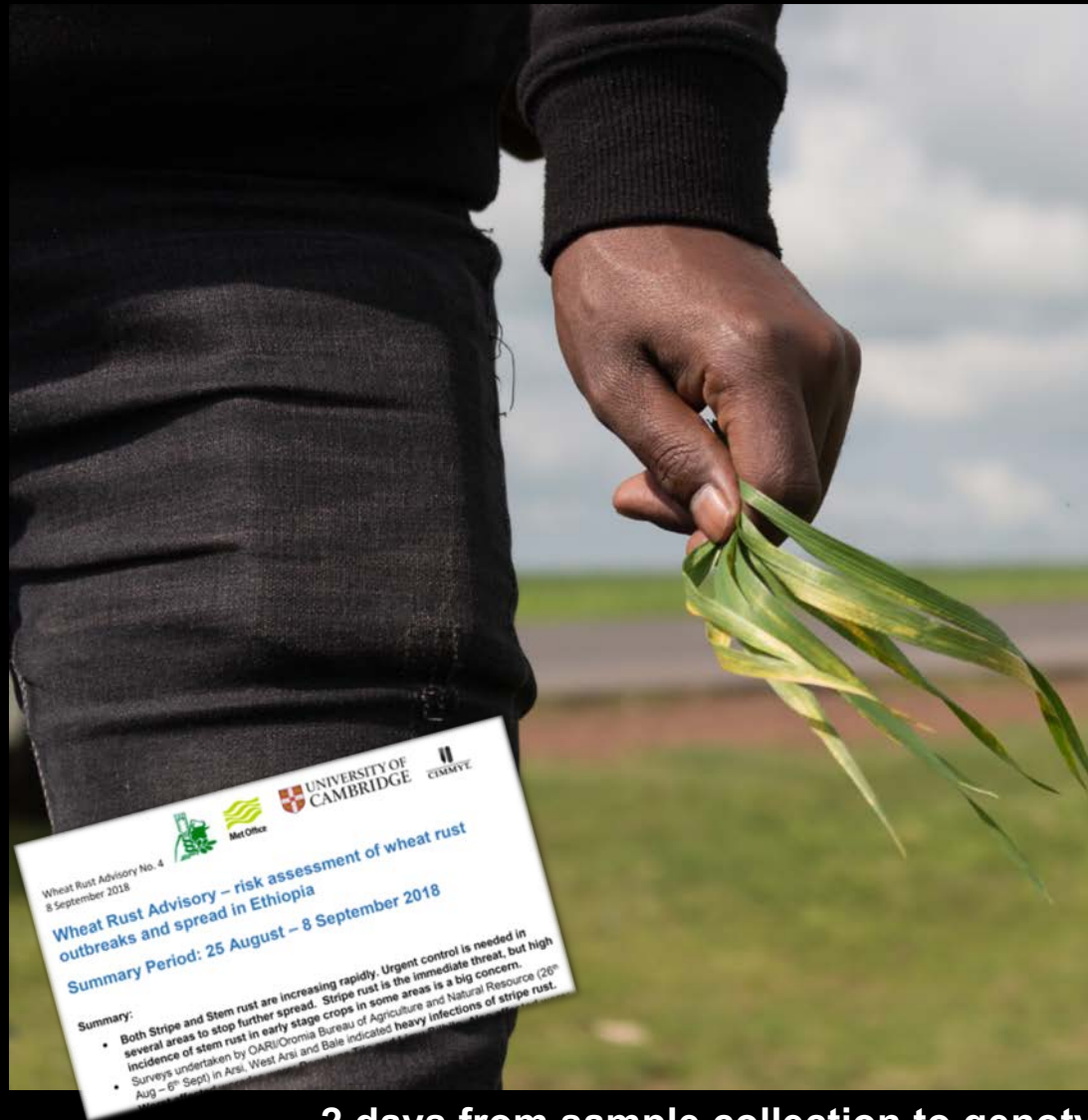
MARPLE: Mobile And Real-time PLant disEase diagnostics



Collaboration: Diane Saunders (JIC), Dave Hodson (CIMMYT) & EIAR

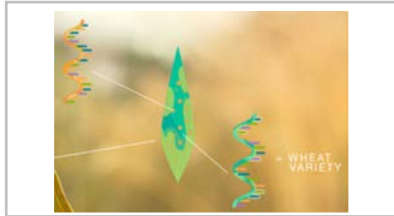


MARPLE Diagnostics deployment in Ethiopia



2 days from sample collection to genotyping results

Summary



- “Field pathogenomics” powerful tool to assess pathogen-host interactions directly in the field



- Stem rust is frequently identified on common barberry in the UK, new research is underway to assess its significance



- First large-scale program to map barberry locations across the UK and develop associated risk models: **Launch event 3rd April @ JIC**



- New mobile genotyping platform being deployed in Ethiopia and can be integrated into the UKCPVS in future (funds permitting)

Acknowledgements



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David Hodson



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