



The Vegetable Genetic Improvement Network (VeGIN)

A multidisciplinary crop improvement pipeline for a competitive UK vegetable industry

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WARWICK
THE UNIVERSITY OF WARWICK

Enhancing access to UKVGB Plant Genetic Resources

Location of UKVGB within Wellesbourne hub of vegetable crop breeding and research

Collaborative development of Core Collections

But limited evaluation work

Heterozygous, heterogeneous accessions hinder trait-based research

SOLUTION – partnership with researchers to develop germplasm further and undertake detailed genotyping and sequencing



EU project RESGEN CT99 109



Vegetable Genetic Improvement Network

....a stakeholder network to facilitate use of genetic resources (2009-present)

- ...a pipeline to deploy genetic resources and tools to accelerate breeding for “sustainability traits” in field vegetables
- an effective network with industry, for knowledge transfer to promote market delivery of R&D



 Brian Smith Leanne Coates	 Katie Tyeall	 Cecy Sirtoris	 Inge The Guy Warren Charles Giddens	 Liam Terry	 Sarah Brown Kath Balbridge*	 Robin Wood Susan Kennedy
 John Allan	 Lutz Seber	 Dave Hob Paul Hunt Paul Hurley Jim Mulaghan*	 Jim Dainhoff	 Richard Milner*	 Ralf Harik	 Aurelie Boel
 Roy Roberts Judith Roberts	 Abdoh Brandt Tareer Ahmad	 Bruce Nijter	 Reinout de Vries	 Bruce Coulsen Philipp Elffinghant* Elena Gerrard* Dave Samuels*	 Gert Glava*	 Jackie Barker
 Brandon Hill	 Peter Dawson Cheryl Yeo Yulix Lancaster Kathie Young* Frances Gaetjens*	 Brian Ford-Lloyd	 John Hammond Neil Graham*	 Carol Wagstaff Martin Chadwick Emma Bennett Alicia Martin-Sanchez	 Gail Taylor	 Willy Buchanan-Walston Brian Thomas Bessmary Collier Graham Tackie Guy Barker Peter G. Taylor Andy Taylor Charlotte Allender
 Graham Clarkson	 Bessmary Collier Graham Tackie Charlotte Allender	 Wendy Steel*				

Stakeholders – feedback, interaction and inputs in kind

Stakeholder interactions

- Communication via mailing list, annual meeting, website
- Nomination of priority target traits
- Open days
- Industry inputs in kind
 - Production of fixed lines
 - Seed multiplication
 - Genotyping



Vegetable Genetic Improvement Network: focal crops and key associated resources

- *Diversity Sets* and *Diversity Fixed Foundation Sets* – pre-breeding resources



Brassica

- *Brassica oleracea* DFFS
- Wild species DFFS



Lettuce

- Lettuce Diversity Set (CGN germplasm also)



Carrot

- Carrot Diversity Set
- Wild x cultivated crosses



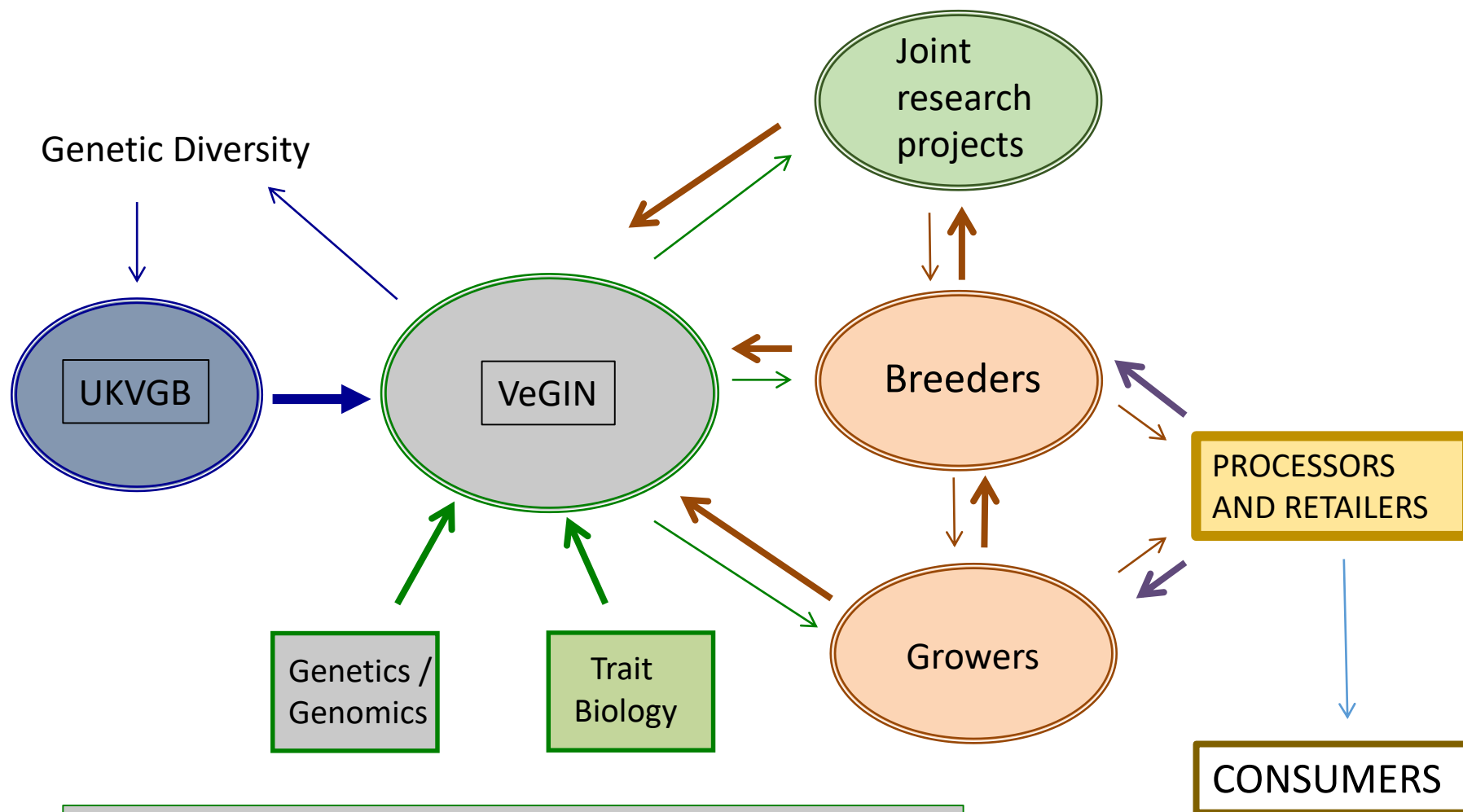
Onion

- Onion Diversity Set

Other resources

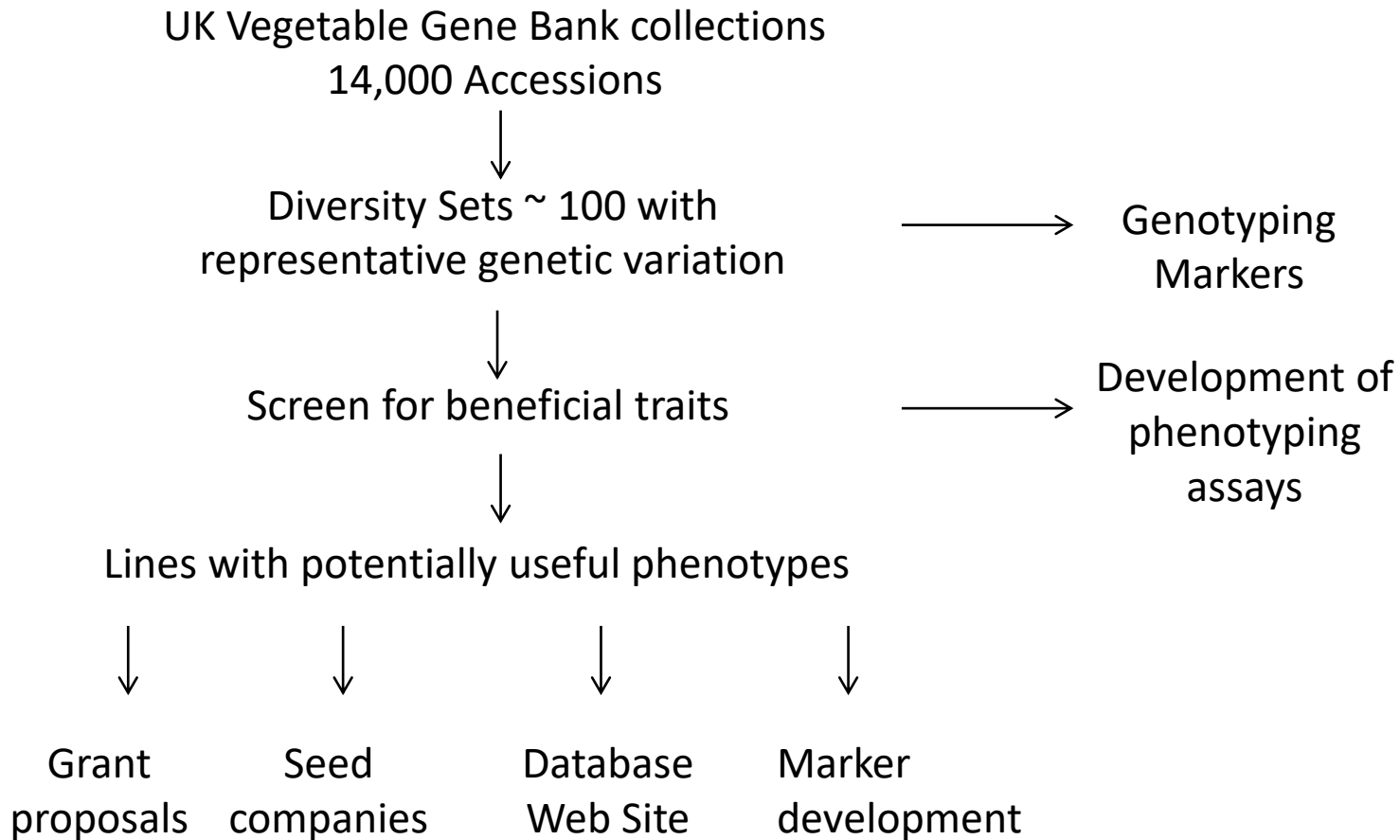
Genetic mapping populations, TILLING populations, substitution lines are associated with the project

Resource and information flow through VeGIN

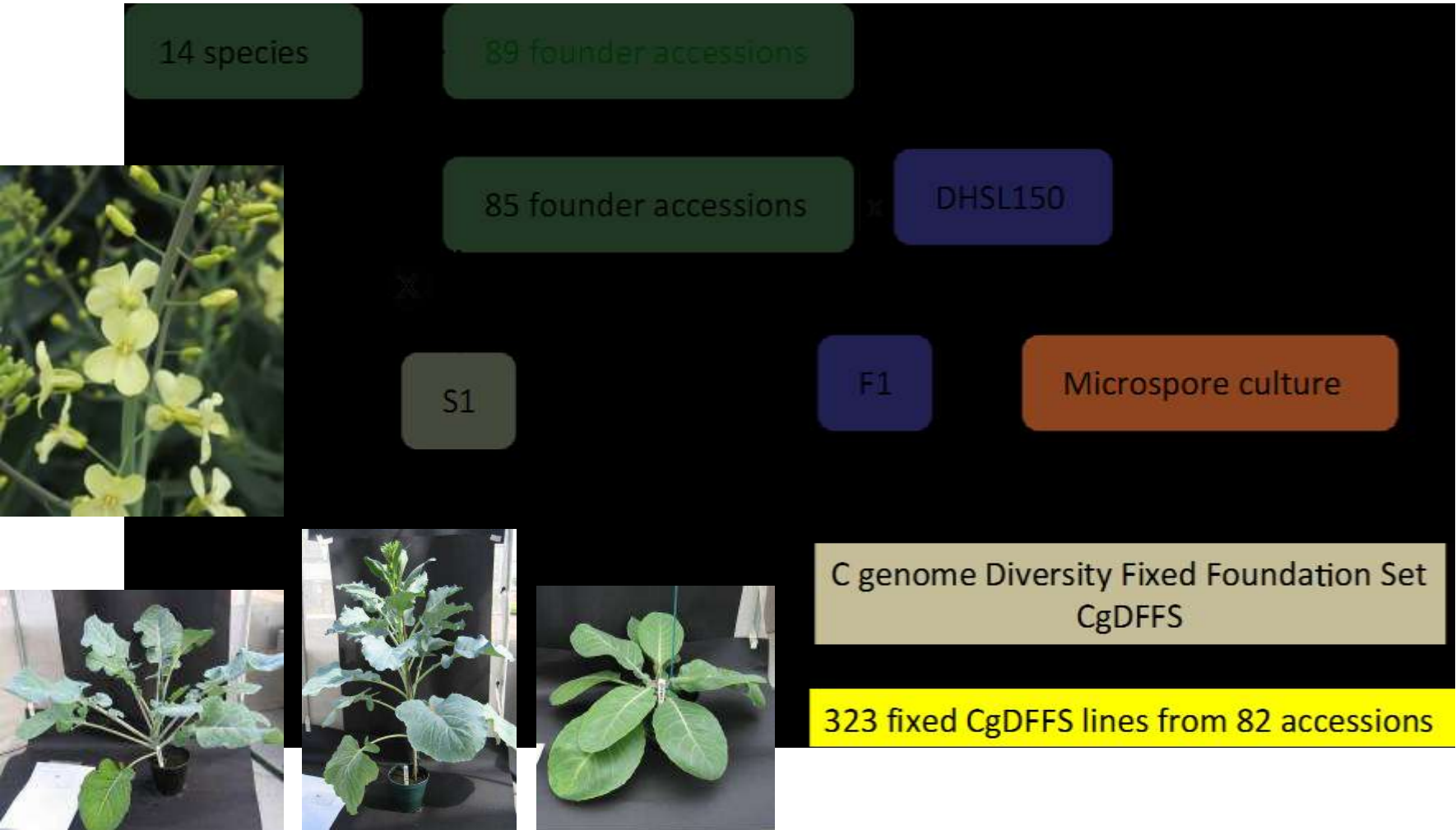


University of Warwick, Harper Adams University

Facilitating the use of genetic resources within VeGIN



Resource development: accessing genepool diversity in *Brassica oleracea* wild relatives



Capturing genomic regions of wild *B. oleracea* relatives

Assessment of genetic contribution using 1566 SNP markers

Chromosome 1 – reciprocal crosses of *B. oleracea* x *B. cretica*

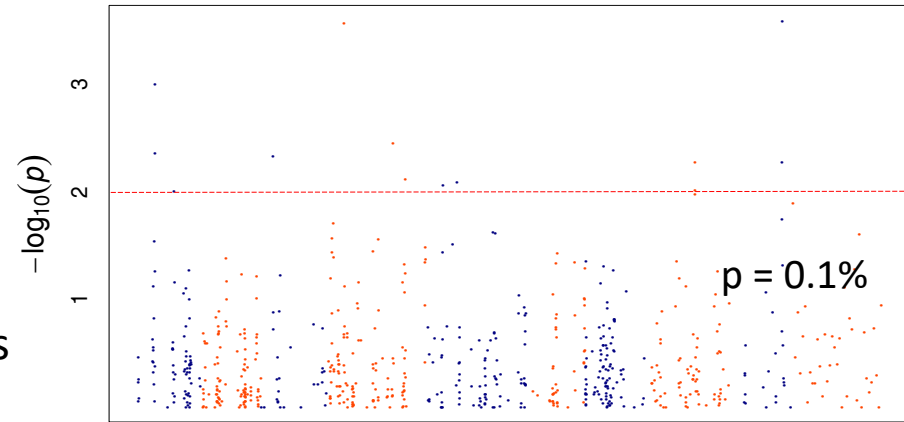


GWAS of resistance to *Nasonovia ribisnigri* (currant-lettuce aphid) developmental stage

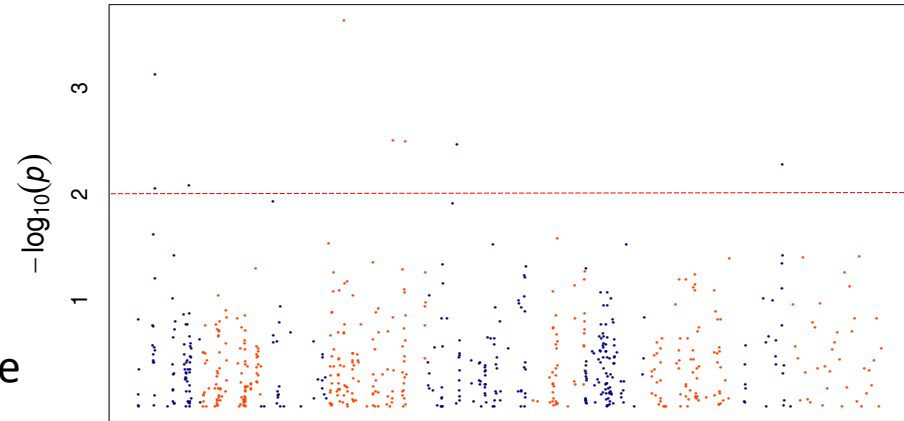
Walley et al (2017) Towards new sources of resistance to the currant-lettuce aphid (*Nasonovia ribisnigri*). *Molecular Breeding*, 37:4



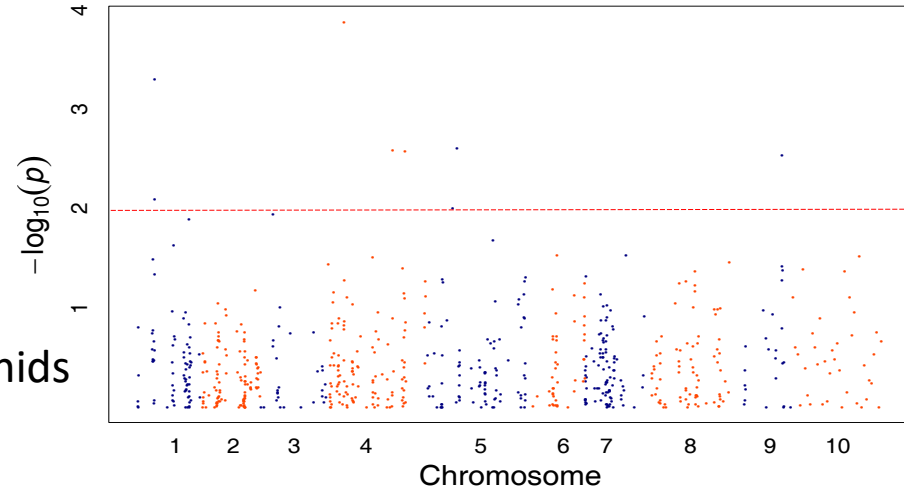
Alates



Apterae



Total aphids



Trait analysis and development through follow on research with industry partners



“Exploiting next generation sequencing technologies to understand pathogenicity and resistance in *Fusarium oxysporum*”



Figure 3: Onions grown on agar for transcriptome studies; uninoculated control (left), inoculated with FOC (right) eight days after inoculation at 25°C.

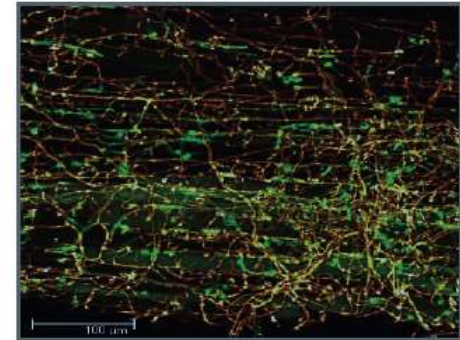


Figure 4: Colonisation of onion root by FOC after 96h.

Outputs and added value

1. Funding – current and recent competitive grants

1. Exploiting sources of resistance to Turnip yellows virus for deployment in oilseed rape. (BBSRC CIRC 2012 -2016, £487 k). John Walsh
2. Exploiting next generation sequencing technologies to understand pathogenicity and resistance in *Fusarium oxysporum*, lead John Clarkson, (BBRSC HAPI: £812 k)
3. Developing genetics and genomics interface in mustard (BBSRC/DBT grant (2014-2017 £1.2 m) Guy Barker, Eric Holub.
4. Developing integrated approaches for pest and disease control in horticultural field crops (IAPAD). Dr John Walsh, Mr Martin Williamson, (£925,000).
5. A genetic approach to improving post-harvest quality. Professor David Pink , Dr Carol Wagstaff, and Dr Guy Barker, (£1,024,000)
6. A systems approach to disease resistance against necrotrophic fungal pathogens. Dr Katherine Denby, Dr Carol Wagstaff and Dr Paul Hand (£881,891)

Total ~ £5.3 M

Outputs and added value

2. Training and knowledge transfer

- Knowledge transfer partnership (KTP) with Elsoms Seeds Ltd on Developing Marker assisted selection in Parsnip.
- KTP with Elsom Seeds Ltd on pathology – related phenotyping. (April 2014 – 2016)
- 9 PhD studentships using VeGIN resources since 2006
- Dr Andrew Taylor, Warwick. HDC Fellowship – developing diagnostics for detection of different *F. oxysporum* formae speciales.
- TSB grant ‘Digital Imaging for phenotyping root crops’ – with Elsoms.
- International Brassica C genome sequencing project in collaboration with NRC (Canada), AAFC (Canada), JCVI (USA), INRA (France)(Missouri University) University of Queensland (Australia).

Summary

- Accessing specific traits in large genebank collections can be challenging
 - Right germplasm + right traits + expertise (phenotyping assays)
 - Collaborative approaches required
- VeGIN has allowed development of public domain pre-breeding resources
- Stakeholder interaction leads to further bilateral projects and other outputs

Acknowledgements



VeGIN

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Graham Teakle

John Clarkson

Rosemary Collier

Andrew Taylor

Jim Monaghan

Andrew Beecham

