# VeGIN: The Vegetable Genetic Improvement Network

A multidisciplinary crop improvement pipeline for a competitive UK vegetable industry.

Department for Environment Food & Rural Affairs

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Harper Adams University

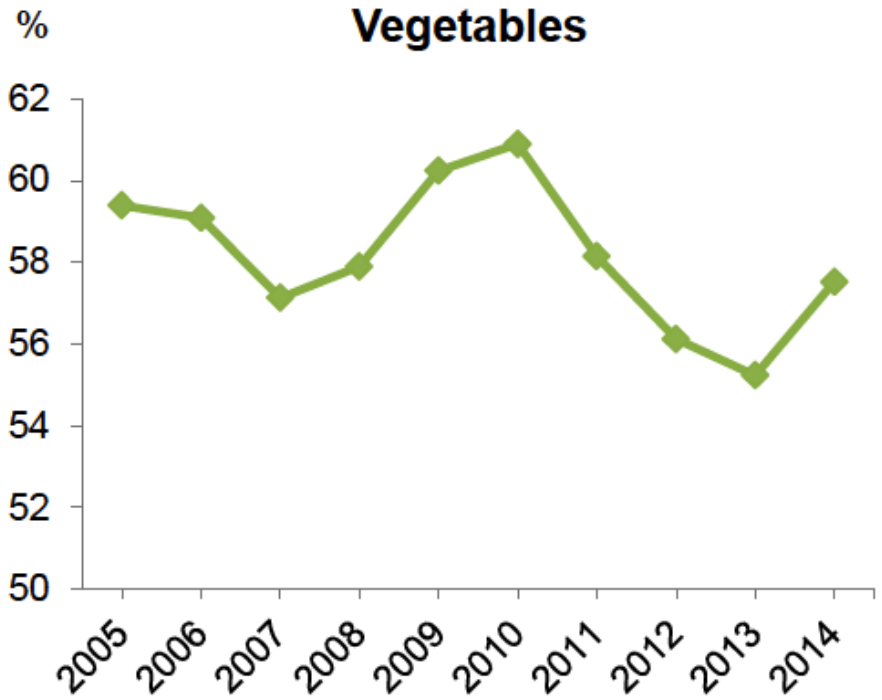
# UK Vegetable Industry

- Essential part of healthy, nutritious diet
- Consumed raw, cooked and partially processed
- Deliver dietary components with unique health benefits (vitamins, fibre, phytochemicals)
- Wide industry base – breeders, growers, processors, retailers

# UK Vegetable Industry

- UK Vegetable production valued at £1.2 billion in 2014
- Significant added value through to retail

- UK production as a percentage of total supply ~ 55% and declining
- Significant opportunities to increase production and exports




https://www.gov.uk/government/statistics/horticulture-statistics-2014

# VeGIN Crops

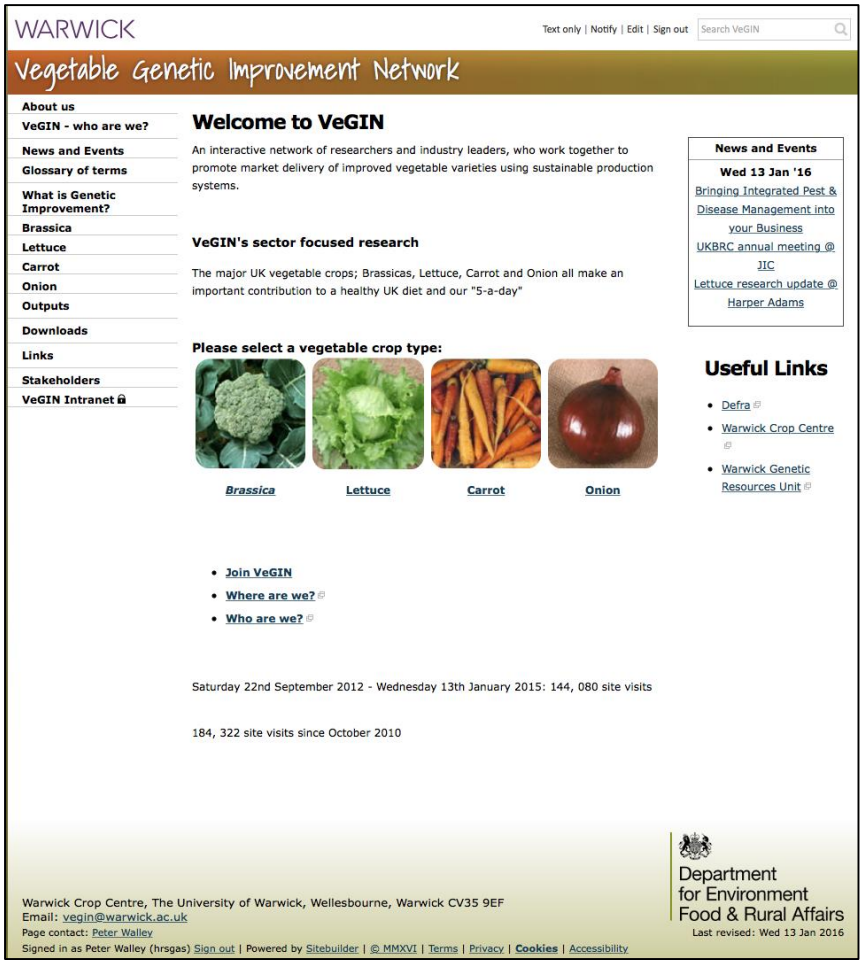
| Brassicas | Leafy Vegetables | Carrot | Onion |
|---|---|---|---|
|  |  |  |  |
| Cauliflower<br>Broccoli<br>Calabrese<br>Cabbage<br>Sprouts<br>Kale | Lettuce<br>Rocket | Parsnip | Bulb onion<br>Spring onion<br>leeks |

A reservoir of diversity
Current and Old varieties
Landraces
Crop wild relatives

# VeGIN Aims

- To establish an effective network of researchers with industry, for knowledge transfer to promote market delivery of R&D
- To develop the genetic resources and tools to accelerate breeding for improved, sustainable marketable yield in field vegetables
  - Pest and disease resistance – reduction of pesticides, varieties for IPM
  - Crop resilience - stress resistance for enhanced consumer quality, waste reduction, adaptation to climate change
  - Genotypes, genetic maps and molecular markers

# Communication and Stakeholders




ALLIUM AND BRASSICA CENTRE
AHDB HORTICULTURE
BBSRC bioscience for the future
Department for Environment
Elsoms
Emmett
Harper Adams University
Hazera Seeds of Growth
IFR Institute of Food Research
KeyGene
Knowledge Transfer Network Biosciences
MRL (SEEDS) LTD
Newcastle University
NIAB
Organic Growers Alliance
RIJK ZWAAN
syngenta
TOZER SEEDS
UK Plant Sciences Federation
UNIVERSITY OF BIRMINGHAM
University of Reading
UNIVERSITY OF Southampton
VITACRESS
SAKATA SEED
+ others
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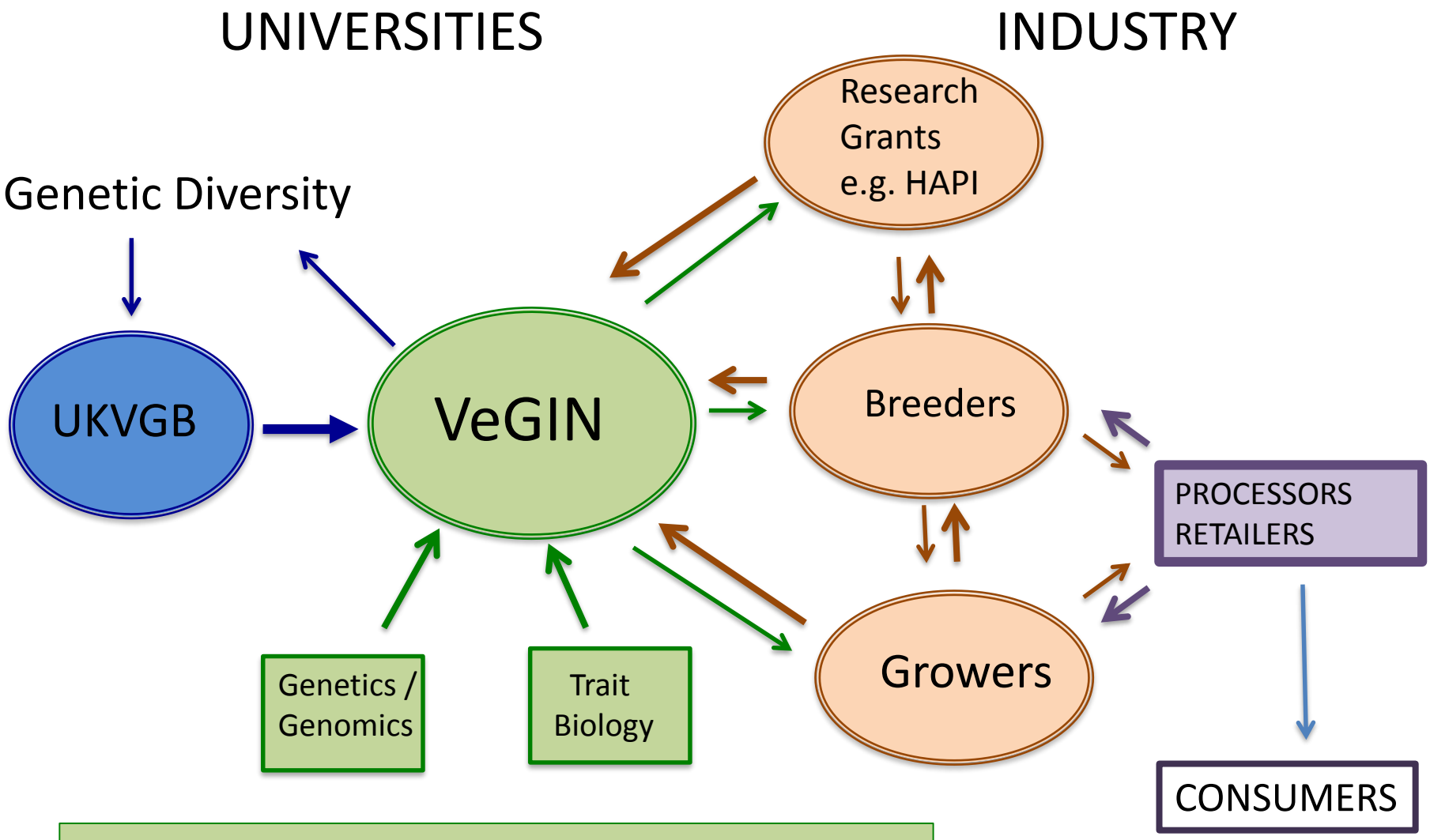
# VeGIN Pipeline

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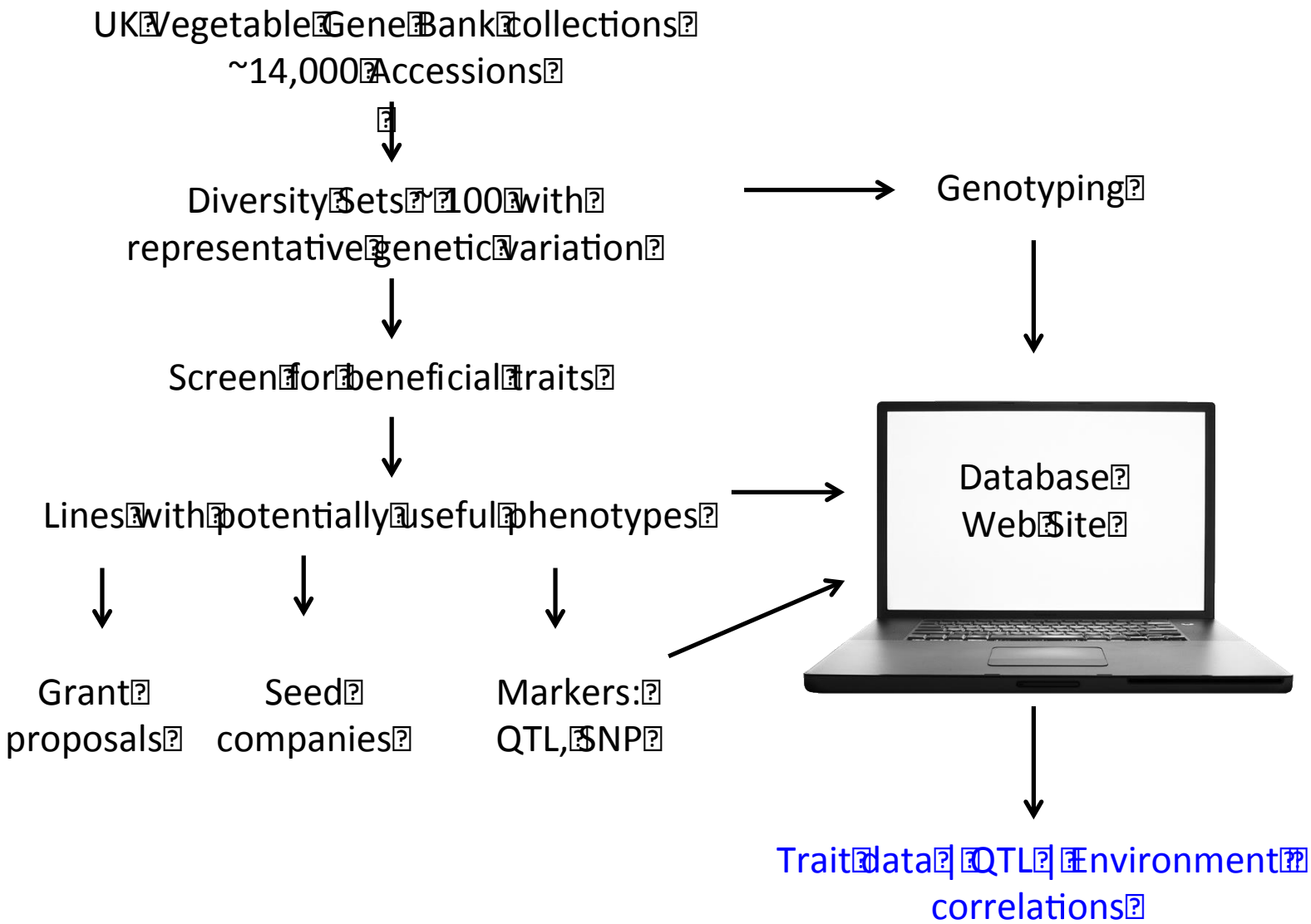
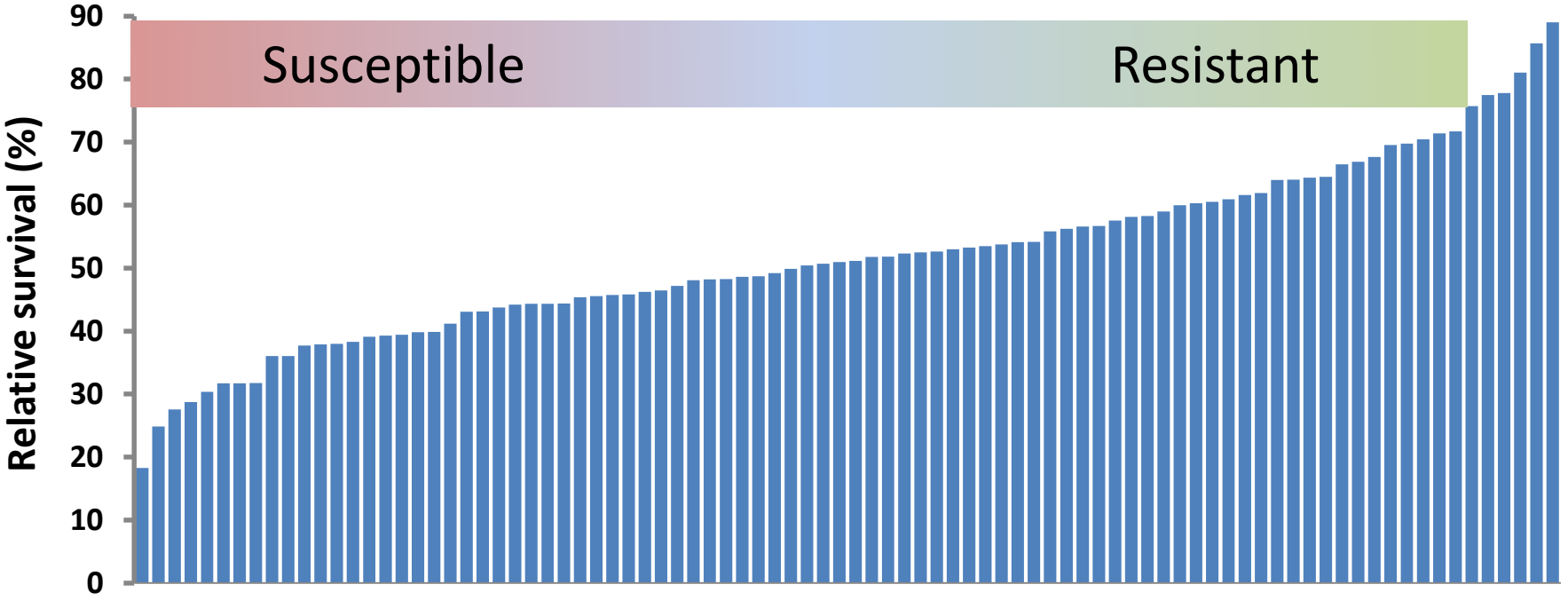
# Exploiting Genetic Resources



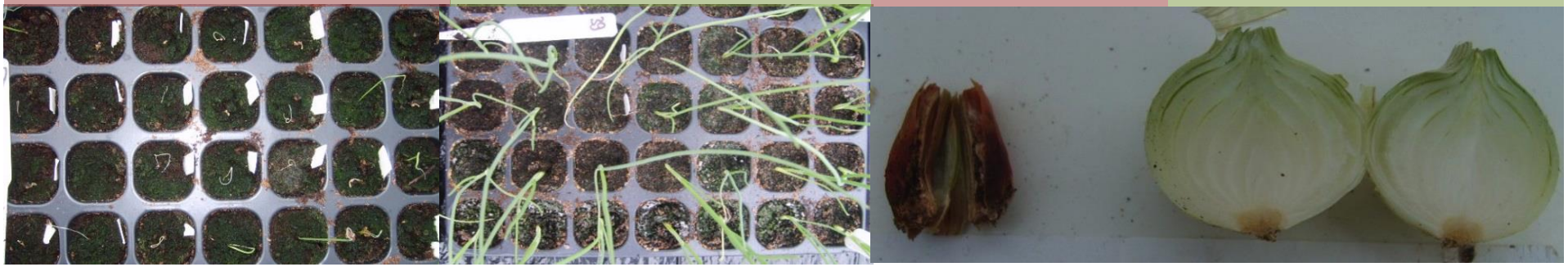
# Example 1: *Fusarium* basal rot of onion

- Disease caused by the soilborne fungus *Fusarium oxysporum* f.sp. *cepae* (FOC), a global problem for onion growers
- Few control options: withdrawal of soil fumigants and lack of effective fungicides
- New sources of resistance are required
- Onion diversity set developed at Warwick using lines derived from the UK Vegetable Gene Bank
- Onion seedling and bulb tests were carried out using inoculation with highly pathogenic FOC isolate

# FOC resistance




Susceptible line | Resistant line | Susceptible line | Resistant line

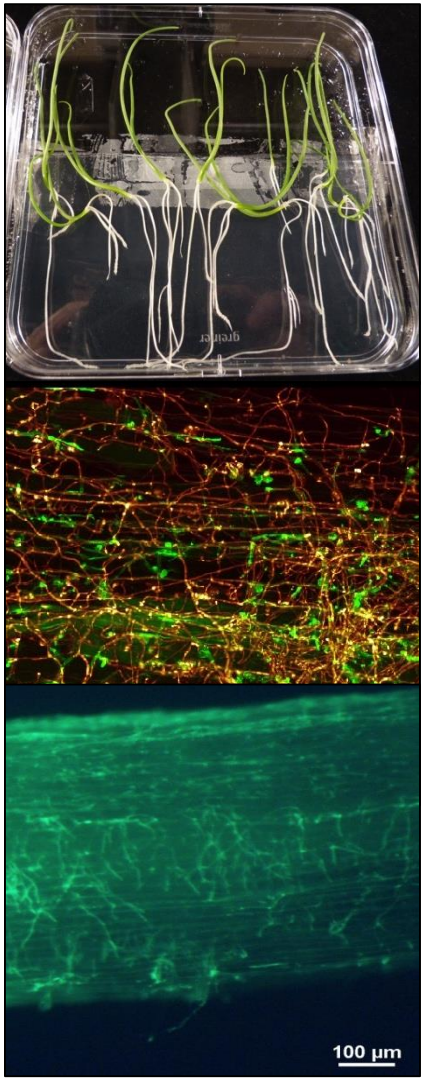


# BBSRC HAPI Project

- Next generation sequencing being used to understand pathogenicity and resistance in *Fusarium oxysporum* on onion

- **Onion resistance**
  - New sources of FOC resistance confirmed and associated markers being identified for breeding
  - New onion lines and populations being developed for genetic analysis and development of resistant cultivars

- **Fusarium pathogenicity**
  - Pathogenicity genes identified which will enable FOC to be distinguished from other pathogenic *F. oxysporum* affecting different hosts and non-pathogenic isolates




BBSRC HAPI · HORTICULTURE AND POTATO INITIATIVE
AHDB HORTICULTURE
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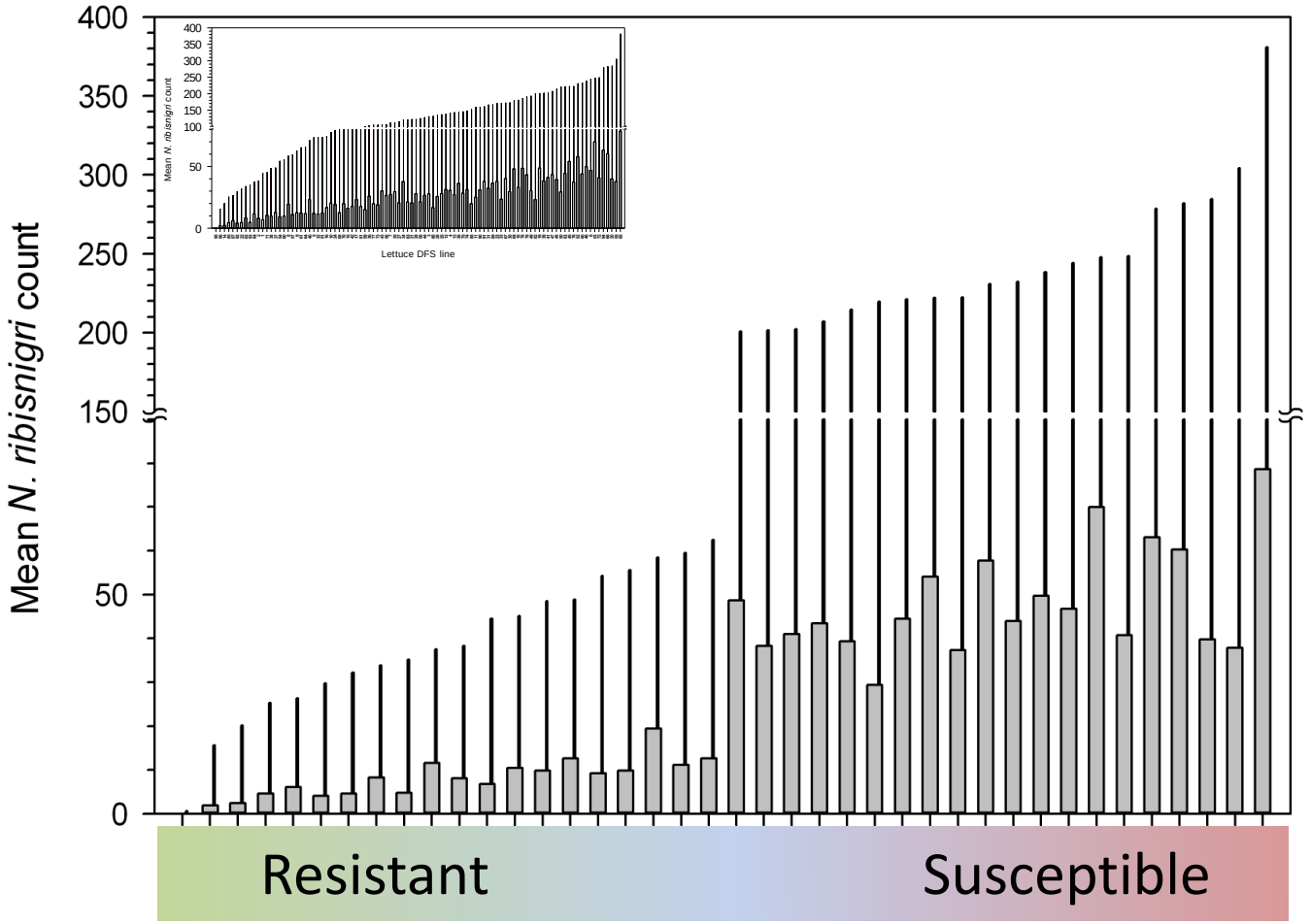
# Example 2: Currant-lettuce aphid – *Nasonovia ribisnigri*

Producers of high value salad packs require high quality raw material free from blemishes and ‘foreign’ bodies including insects.

Problem for growers: aphids prefer to feed at the centre of lettuce heads where they are difficult to control with foliar insecticides.

# Screen of VeGIN lettuce DFFS for *Nasonovia* resistance

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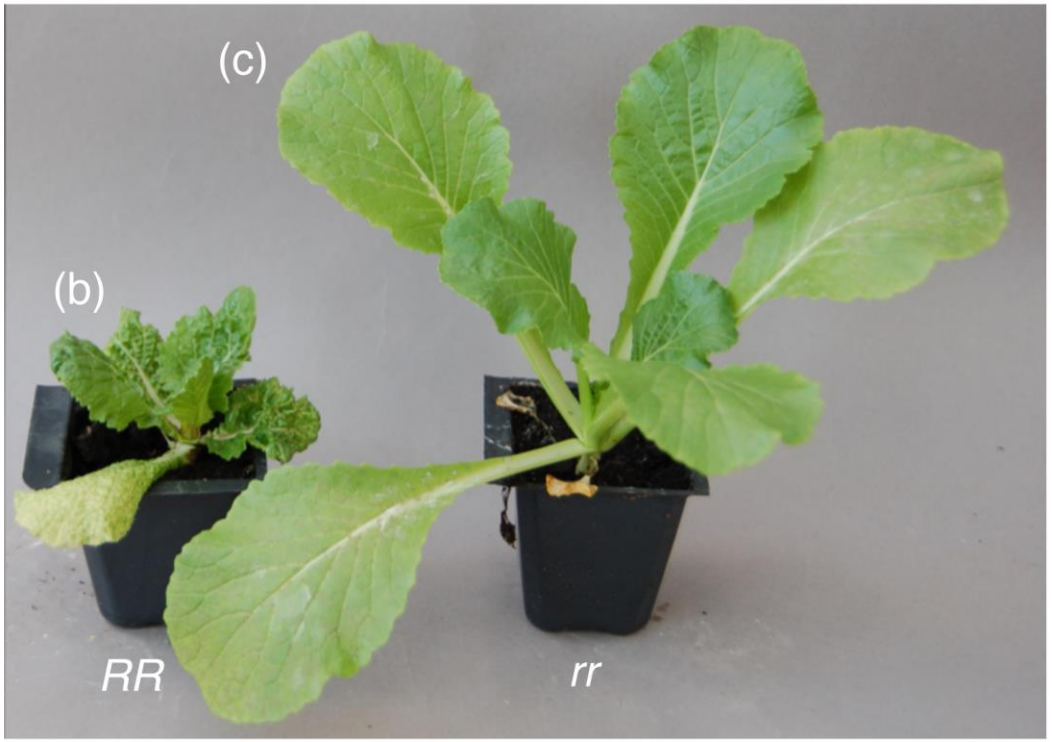
# Example 3: Durable broad spectrum resistance to Turnip mosaic virus

- VeGIN research resulted in the identification of resistance to the important virus, Turnip yellows virus (TuYV).
- Particularly prevalent in the UK and the rest of northern Europe and can cause up to 30% yield loss.

These TuYV resistances are being evaluated further in projects funded by BBSRC, and a number of industry partners including Syngenta, Tozer, Limagrain, Sakata, Enza Zaden, Rijk Zwaan for exploitation in vegetable brassicas and oilseed rape.

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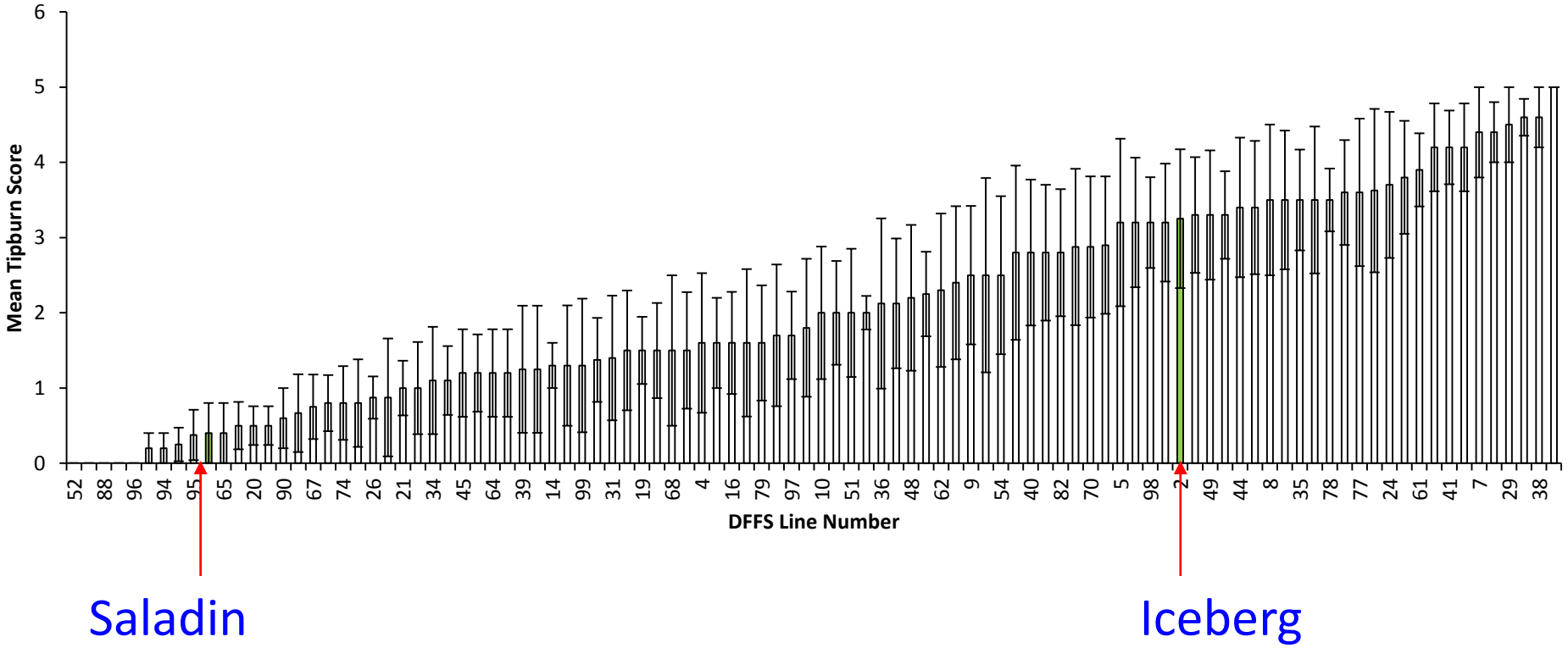
# Example 4: Lettuce Tipburn Assay

- Screening the VeGIN lettuce Diversity Fixed Foundation Set (DFFS) for tipburn tolerance – genetic material for breeding
- We have developed a hydroponic screen for tipburn to assess the diversity of symptom development within the 96 DFFS lines

# Tipburn Symptoms across the VeGIN Lettuce DFFS Lines




VeGIN Saladin x Iceberg mapping population currently under assay.

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# Outputs / Added Value

- **Funding – current competitive grants**

1. Exploiting sources of resistance to Turnip yellows virus for deployment in oilseed rape. John Walsh (BBSRC CIRC, 2012 -2016, £487 k)

1. Exploiting next generation sequencing technologies to understand pathogenicity and resistance in Fusarium oxysporum. John Clarkson (BBRSC HAPI, £812 k)

1. Developing genetics and genomics interface in mustard. Guy Barker, Eric Holub (BBSRC/DBT, 2014-2017, £1.2 m)

1. Developing integrated approaches for pest and disease control in horticultural field crops (IAPAD). John Walsh, Martin Williamson (BBSRC HAPI, £925 k)

1. A genetic approach to improving post-harvest quality. David Pink , Carol Wagstaff, Guy Barker (BBSRC HAPI, £1.024 m)

1. A systems approach to disease resistance against necrotrophic fungal pathogens. Katherine Denby, Carol Wagstaff, John Clarkson, Paul Hand (BBSRC HAPI, £882 k)

**Total ~ £5.3 M**

# Outputs / Added Value

**Examples of Training and Knowledge Transfer**

- Multiple regular presentations at Industry conferences and international Symposia
- Several Knowledge Transfer Partnership (KTP) with Elsoms Seeds Ltd
- 9 PhD studentships using VeGIN resources since 2006
- Multiple requests for VeGIN seed resources
- Dr Andrew Taylor, Warwick. HDC Fellowship – developing diagnostics for detection of different *Fusarium oxysporum* species
- 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)

# VeGIN for the Future

- Successful future Rural Economy
  - Improved crop varieties with markers, open access to phenotype and marker data
  - Innovation, competiveness, knowledge transfer
  - Interaction with Agri-Tech Centres
- Maintaining food security
  - Diverse, resilient supply chains
- Leading the world in R&D, innovation
  - Agri-Food and Food Innovation

# The VeGIN Team

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