

WGIN : Wheat Genetic Improvement Network

Overview of a Public - Private Partnership Project 2003 - 2017



Kim Hammond-Kosack
Rothamsted Research



Department
for Environment
Food & Rural Affairs

30th November 2016, 14th Stakeholder meeting, RRes, Herts

The Defra Crop Genetic Improvement Networks

Announced July 2002

Dr Donal Murphy-Bokern

**Arable Crop Sciences & Pesticide
Safety Unit**

Science Directorate

Defra



Department
for Environment
Food & Rural Affairs

Overall Objectives

To recreate the best of the past

- **Each Crop Genetic Improvement Network =**
Virtual Plant Breeding Institute
- **To use crop breeding for the sustainable development of the arable sector**
- **To connect public sector science to the private sector**

The longer-term vision

- **A strong crop breeding sector deploying the best technologies science can offer**
- **A strong strategic and applied research base competing effectively for resources**
- **A strong base for international partnerships**
- **More resource efficient and productive crops**



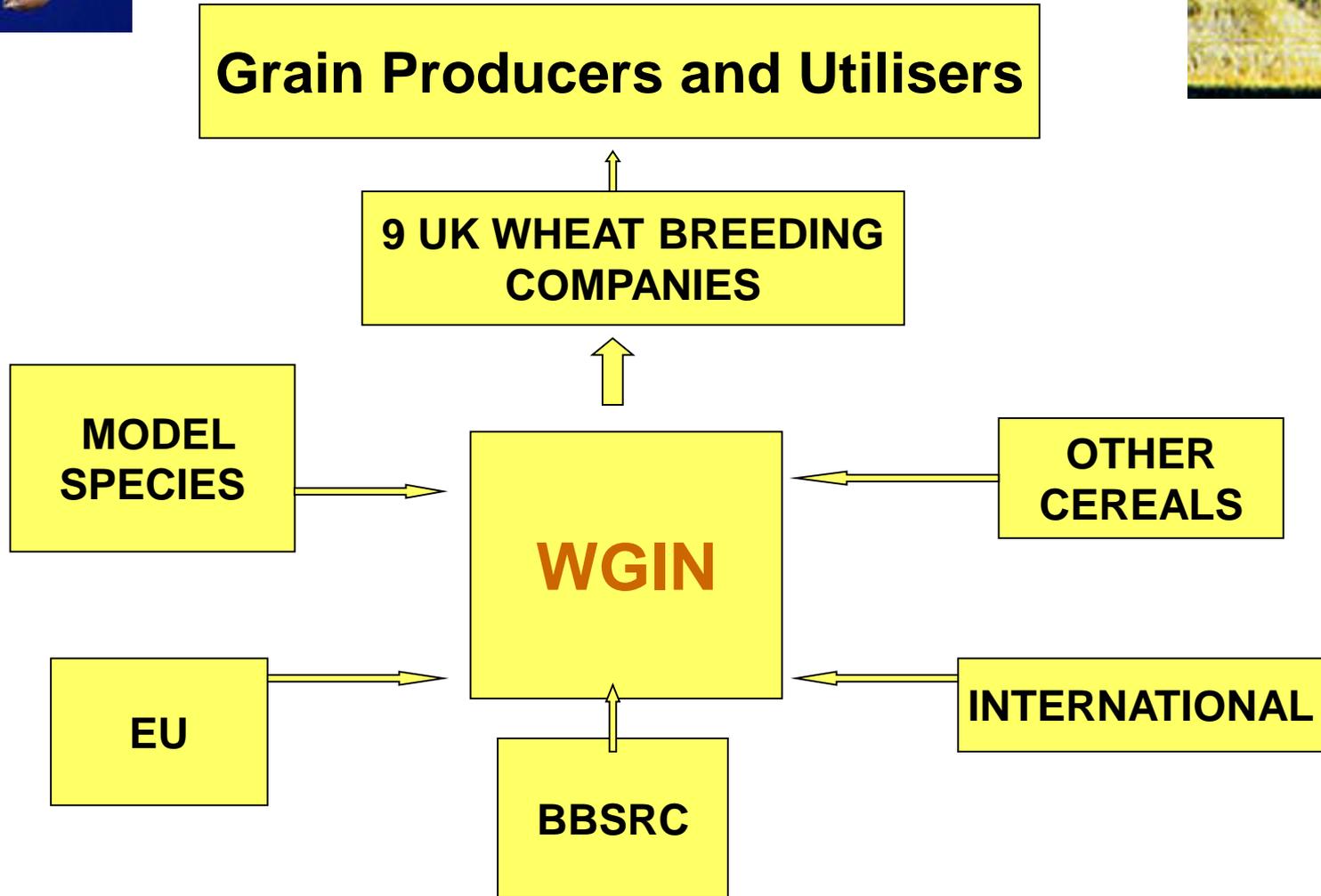
Networks established

- Wheat (**WGIN**) 2003
- Oilseed rape (**OREGIN**) 2003
- Short rotation coppice (**BEGIN**)
- Pulse crops (**PCGIN**) 2005
- Miscanthus
- Oats
- Leafy Vegetables (**VeGIN**) 2009





The Defra WGIN



The modest WGIN funds would attract additional funds to wheat research by other sponsors

Projects of 5 years and 2 years duration

The WGIN 1 project (2003 – 2008) - £1.80 million

The WGIN 2 project (2008 – 2014) - £2.05 million

The WGIN 3 project (2015 - 2017) - £669, 938

£4.52 million

**WGIN 1 project
funded partners**

John Innes Centre

Rothamsted Research

+ 2 pilot projects (2 yr)

WGIN 2 project

funded partners

John Innes Centre

University of Nottingham

Rothamsted Research

+ 2 pilot projects (1 yr / 2 yr)

WGIN 3 project – funded partners

John Innes Centre

Rothamsted Research

+ Bristol Genomics Facility, Univ. Bristol, UK

+ MYcroarray, Michigan, USA

Mission statement - WGIN 2003 to 2014

Improving the **environmental footprint of farming through crop genetics and targeted traits analysis**

Mission statement - WGIN 2015 to 2017

Improving the **resilience of the wheat crop through genetics and targeted traits analysis**

What is WGIN ?

- **New genetic resources and tools**
- **Defining new traits for wheat improvement**
- **Maintaining and enhancing the public – private network**

New resources / tools developed in WGIN

THE BIG FIVE

- A reference UK mapping population
Avalon x Cadenza (DH popⁿ, 203 lines + 584 lines)
- **Restoration of the AE Watkins wheat collection**
> 1200 lines from 31 countries
never previously used in modern breeding
- EMS mutagenised TILLING populations
Cadenza and Paragon (> 5000 lines + 1200C lines DNA)
- **A global collection of *T. monococcum* accessions (AA genome)** ~ 323 lines, 34K breeders array + 5 F₆ popⁿ
- Grain samples from WGIN cultivar diversity trials since 2003 (3 or 4 nitrogen treatments / all plots)

Trait identification

Consecutive years of field trials

1. Improved nitrogen use efficiency (NUE)
2. Grain quality (QTLs) linked to NUE
3. Improved water use efficiency (WUE)



Malcolm Hawkesford, RRes



John Foulkes, U Nott

Trait identification – RRes

2. Reducing pest and disease pressure

Aphids



***Septoria* leaf blotch**



Take-all fungus



Annually all crops at high risk

**A major problem
for 2nd / 3rd wheat
crops**

2nd wheat syndrome

Wheat Genetic Improvement Network (WGIN3) 2015-2017

Red text -
new to WGIN3

WP1 Management meetings (3 per year) – The Network

WP3 Tools and Resources

Maintain and further develop, mapping popⁿ,
Watkins/Gediflux, *T. monococum* collections (3.1)

Create an A x C NIL TILING popⁿ (3.2)

T. monococum introgression (3.3)

WPs 2 & 4 Genetic and QTL analyses

For each of the targeted traits

Gene-specific marker development (2.4)

WPs 2, 3 & 4 Targeted Traits

Aphid resistance (2.2)

Take-all resistance (2.2, 3.4)

Septoria, mildew and rust resistance (2.2)

Yield and quality resilience (2.2, 3.4)

Yield components (2.2)

Drought tolerance (2.2, 3.4)

Root system function (3.4)

Sub-contractors – WP1.3 & 4.2 NGS genome / promoter analyses

WP1 Enhancing the network and communication of results

Website (1.2)

Annual Stakeholders forum (1.1)

International collaborations (1.4)

Publications + data deposits (1.4)

Electronic Newsletter (1.4)

Focussed workshops (1.1)

Public outreach

Industry-led forum (1.5)

The Networking objectives

8 of the 20 activities



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WGIN



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Welcome to WGIN 3rd Phase (2015-2017)

Defra Wheat Genetic Improvement Network - Improving the resilience of the wheat crop through genetics and targeted trait analysis

WGIN 3 has been funded by Defra until March 2017

IMPORTANT:

1) The next WGIN Stakeholders' Meeting will be held at Rothamsted Research, Harpenden on

Wednesday, November 30th 2016

You can still register via Eventbrite by following [this link](#).

The full programme for the day is now available [here](#).

2) A joint GINs Stakeholders Event was held at JIC on February 22nd to highlight the decade of science done within all four Defra funded GINs - WGIN, OREGIN, VeGIN and PGIN. For an appraisal of the event by Defra's Giulia Cuccato and David Cooper please click [here](#). The agenda and GIN presentations can be found in 'meetings' under the 'Information' tab.

site guide

The site is grouped into the following four sections:

[ABOUT](#) - for general information about WGIN, including news items and contacts.

[INFORMATION](#) - for more detailed information about WGIN, including reports and information tools.

[RESOURCES](#) - for experimental resources and research related tools

[STAKEHOLDERS](#) - for information on the Stakeholders Forum

Please use our interactive dropdown menus, the side menus, or the link tracker to navigate the site.

--see [site-map](#) for overview



RECENT UPDATES

OLD Site - The old site is still available [here](#).

Disclaimer: WGIN is a publicly funded project and the data and resources it generates are freely available to the research community, providing that the use of any WGIN data and resources are acknowledged.

wgin.defra@rothamsted.ac.uk

**Project assistant
1 day / week**

**All research
powerpoint
ppts available
from all meetings**

**Accessible via the
MONOGRAM
website**

**BSPB – British
Society for
Plant Breeders**

The Defra WGIN: Dissemination, Liaison and Communication

Annual “Stakeholders’ Forum” (Nov) 70-90 attendees

Focussed Workshop – 2009, 2013 ‘A x C mapping popⁿ’

2010 – DArT marker analysis

Workshops with overseas partner organisations:

Six in total funded by BBSRC

Web Site (www.WGIN.org.UK)

Electronic Newsletters

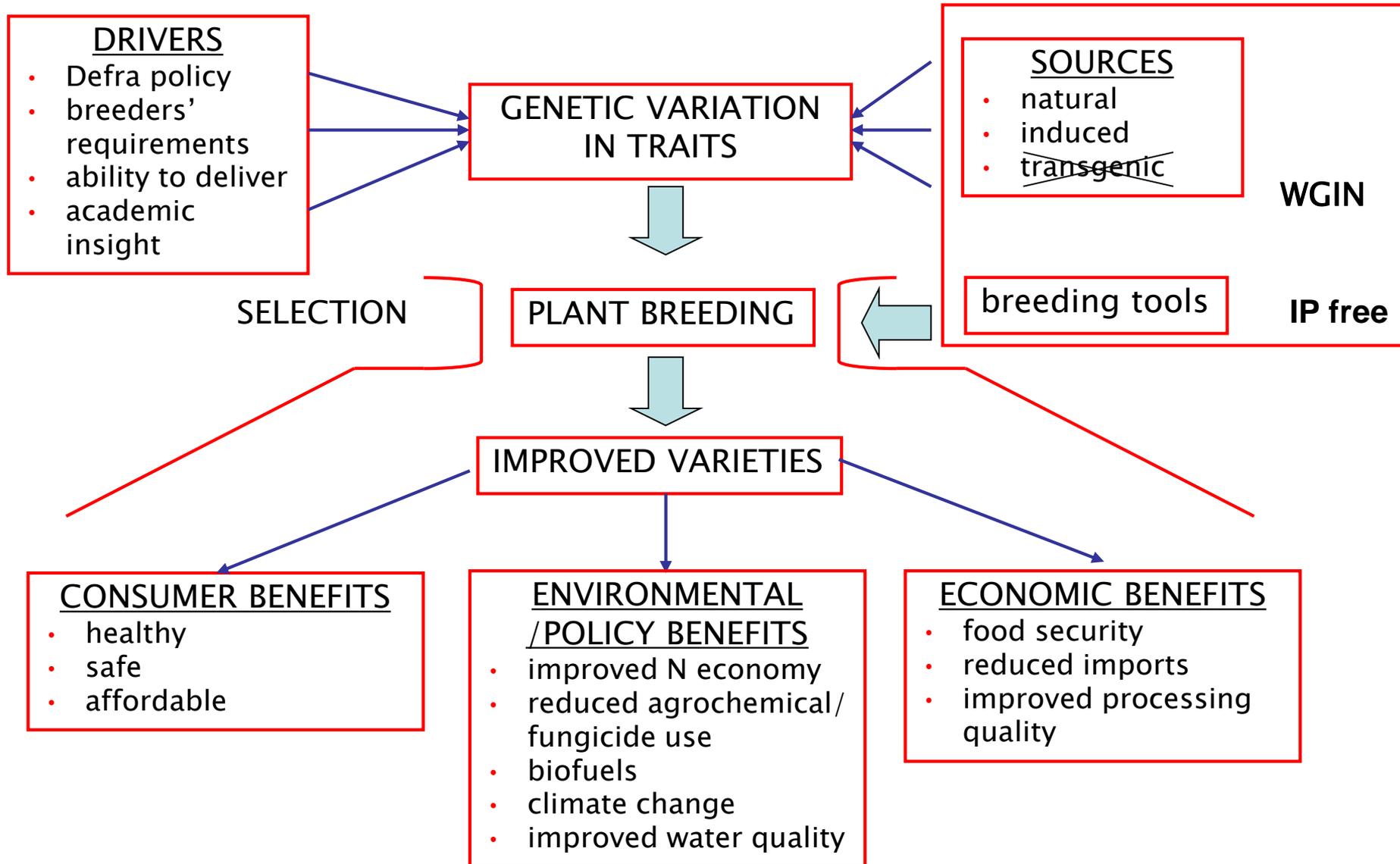
Scientific publications ~ 50 articles

Annual displays at ‘Cereals’

E. mail:wgin.defra@bbsrc.ac.uk



WGIN in the wider context



The WGIN legacy so far

Scientific publications - 54 peer reviewed articles

Helped in the training of 20 PhD students

**£4.52 million from defra has generated in excess of
£41 million for 48 new wheat projects involving
various sponsors (mid 2014)**

29 projects on new topics

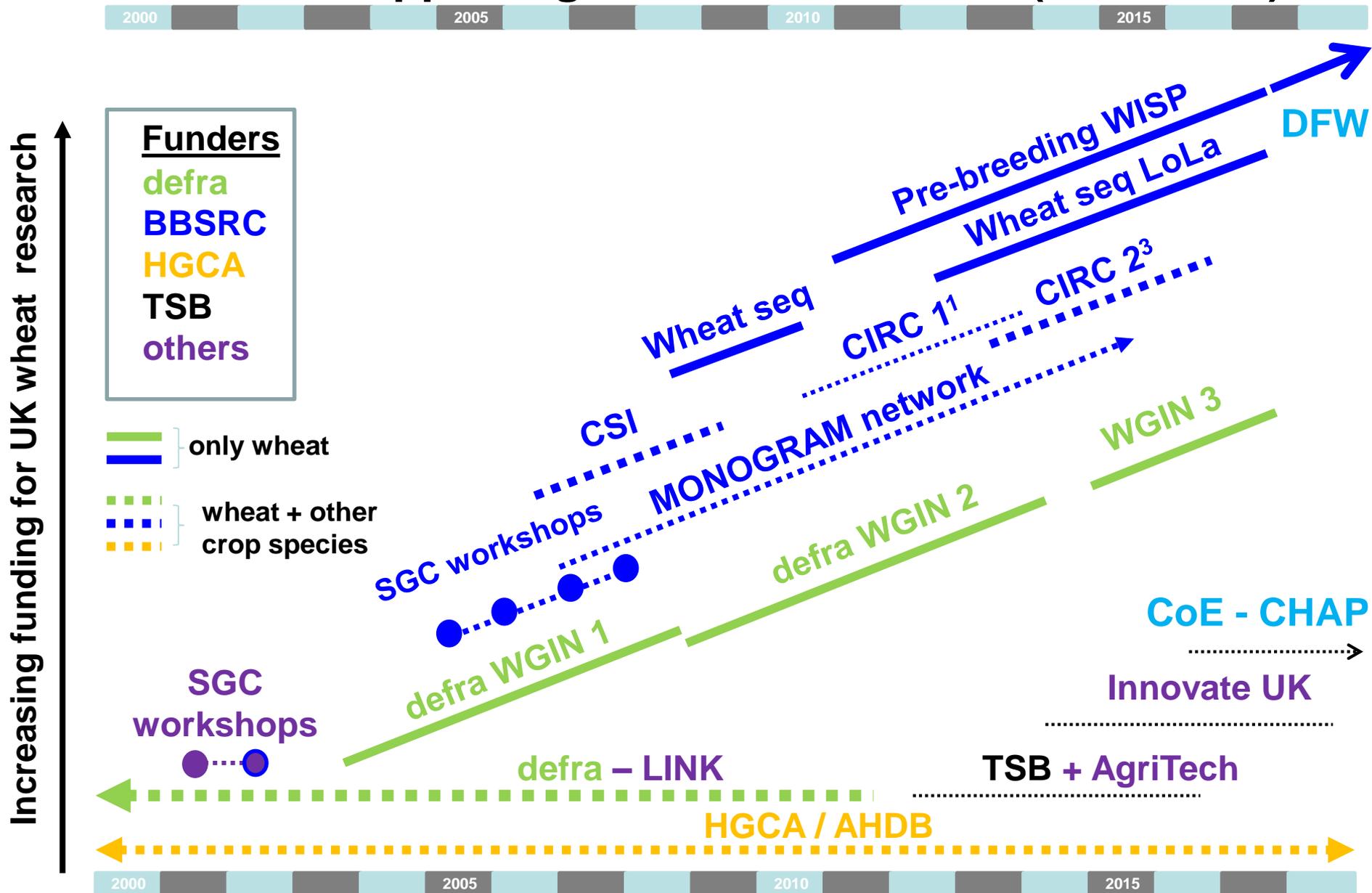
£11.0 million lead by PIs not sponsored in WGIN

Under evaluation is the BBSRC [Designing Future Wheat Institute Strategic Programme Grant \(2017-2022\)](#)

– combines Institutes and selected Universities

£10.75 million (PI Graham Moore, JIC)

The relationship between WGIN and the **major funding initiatives** supporting UK wheat research (2000-2017)



Central storage of grain from the field trials

11 years of field trials (24-31 cultivars / 4 N regimes)

The stored samples - 500 g / 1 kg grain at - 20 C

~ 8,000 samples with associated metadata

Key biological resources for new projects
and / or pilot studies



Joint GINs stakeholder event @ JIC in Jan/Feb 2016

- **Wheat (WGIN) 2003**
- **Oilseed rape (OREGIN) 2003**
- **Pulse crops (PCGIN) 2005**
- **Leafy Vegetables (VeGIN) 2009**

Showcased - the top research achievements

All ppts on the WGIN website



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Defra

Martin Cannell, Giulia Cuccato and David Cooper

WGIN 3

**RRes - Kim Hammond-Kosack
Peter Shewry
Malcolm Hawkesford
Vanessa McMillan
Kostya Kanyuka
Lesley Smart
Michael Hammond-Kosack**

**JIC – Simon Griffiths
Clare Lister**

UoN - John Foulkes

**Bristol Genomics – Jane Coghill’s team
MYcoarray – Michigan, USA**

**The Management team
The Plant Breeders (9)
ADAS
AHDB
Camden BRI
NIAB
Univ Bristol
Defra**

The farm / trials staff at all the sites used



- Establish a reference UK mapping population

Avalon x Cadenza

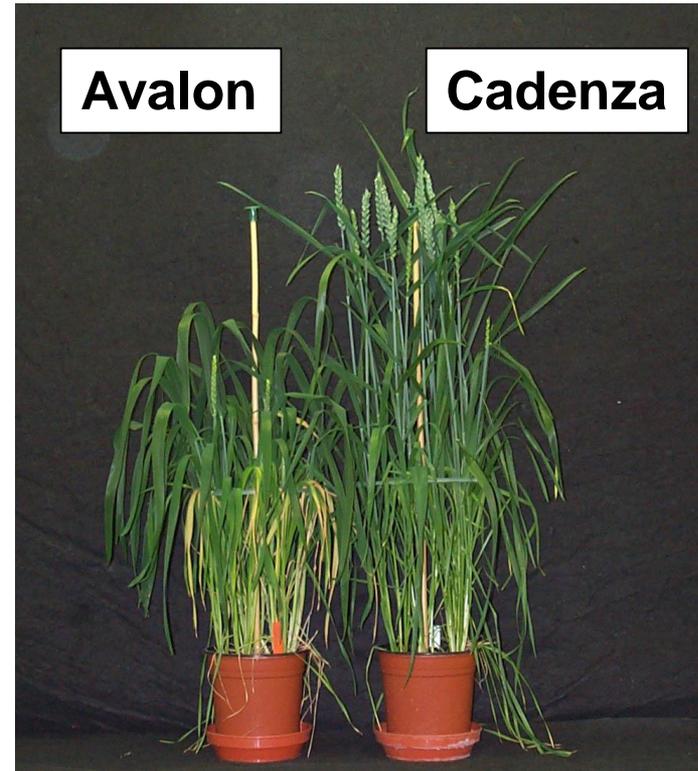
203 double haploid lines

- Switch to 'within the gene'

KASPar molecular markers

Axiom® SNP markers

- Extended A x C population
for fine mapping - 574 lines



Two WGIN workshops solely on this population

2013@JIC ~ 60 participants

Restoration of the AE Watkins wheat collection

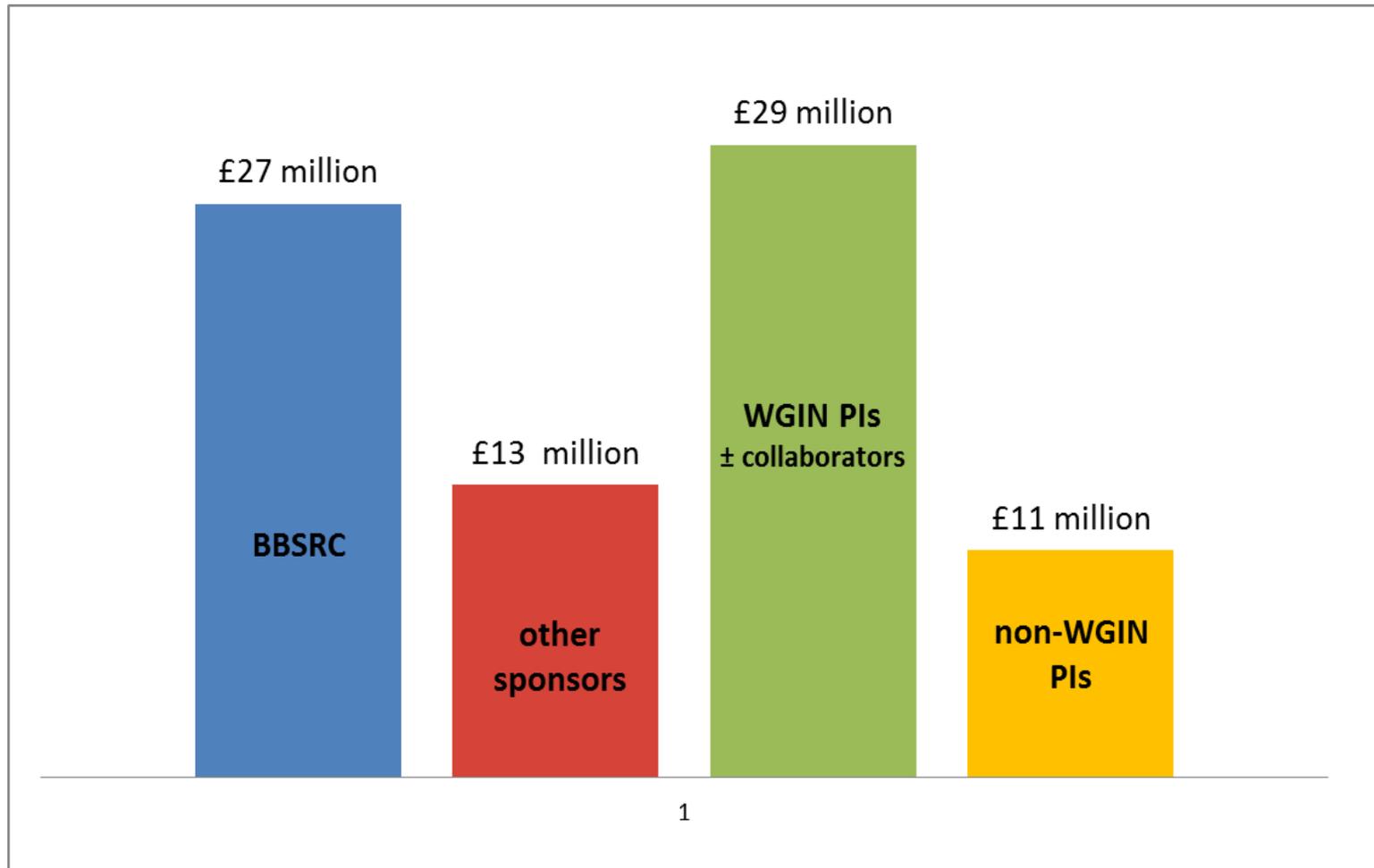
~ 1200 lines collected in the 1930 from ~ 31 countries surrounding the Mediterranean, genetically purified by the JIC (WGIN 2**)**

Germplasm never previously used in modern wheat breeding

Highly relevant to a changing climate and crop resilience

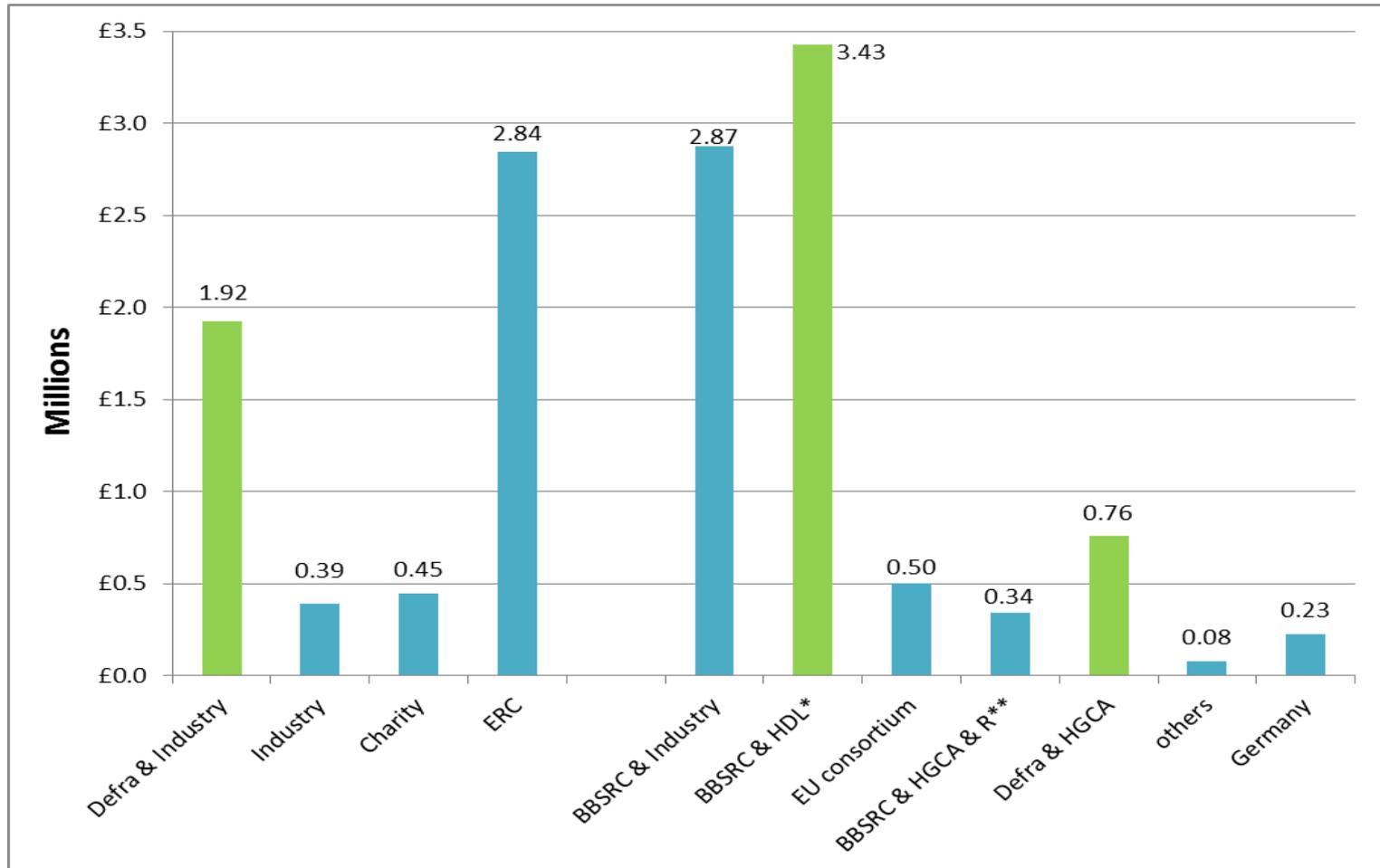
New funds won for wheat research using WGIN resources and knowledge

The main funding sources and PIs



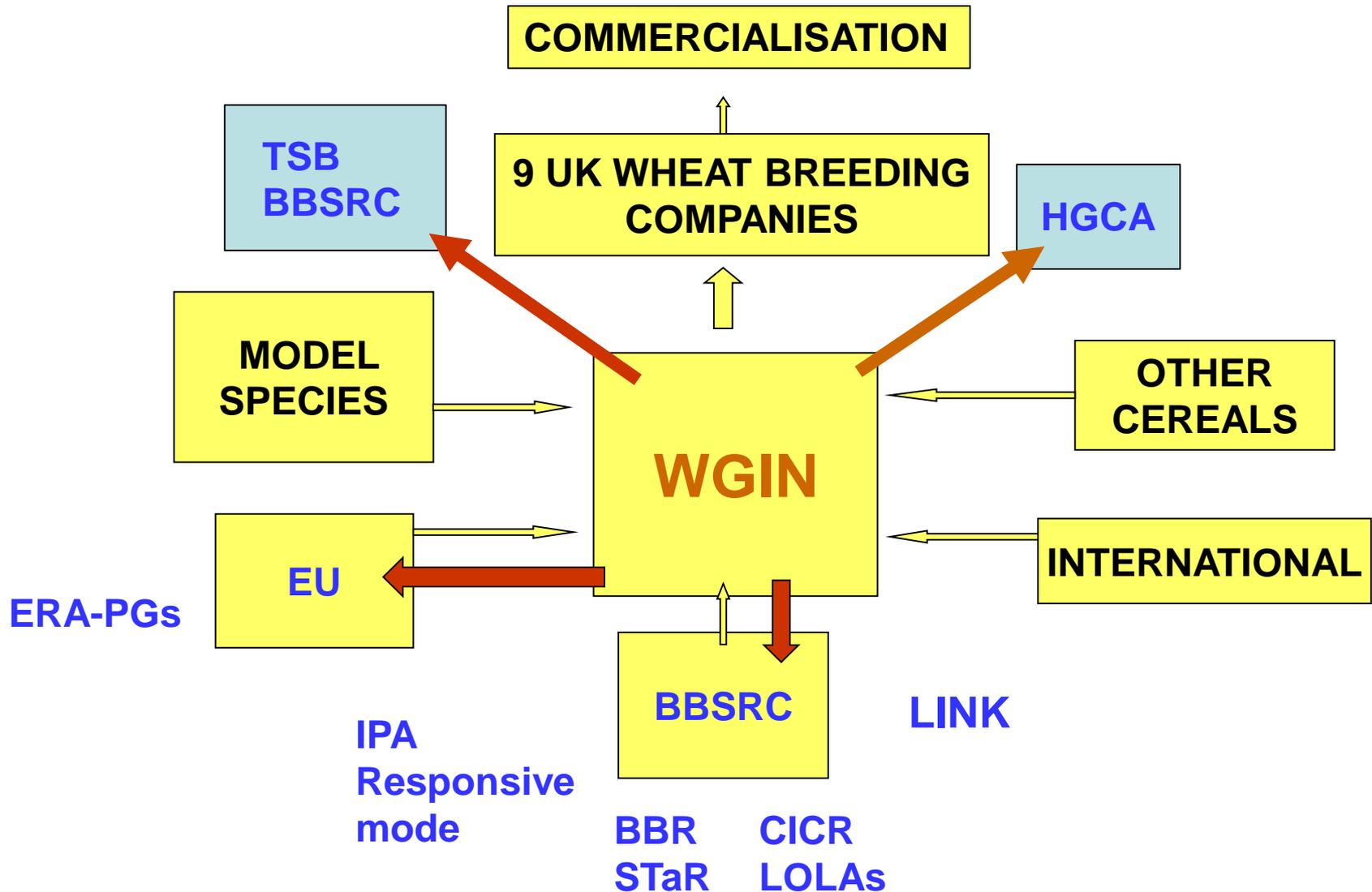
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Details of the other sponsors



Abbreviations: HDL* - HGCA, Defra and LINK and R** - Scottish Government (RESAS)

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Wheat Genetic Improvement Network (WGIN) 2003-2014

6,7,9,12 = WGIN 2 only

Tools and Resources

2. Near Isogenic lines (NILs) *

3. The Avalon x Cadenza Mapping popⁿ

4. Paragon gamma and EMS popⁿ
TILLING

5. AE Watkins and Gediflux collections

6. New mapping popⁿ for WUE (9) and 2
new popⁿ to align WGIN 2 with the
international wheat genome sequencing
effort

Targeted traits

7. Insect resistance (RRes) *

8. Nitrogen use efficiency (NUE) *
Quality QTLs linked to NUE (RRes)

9. Drought tolerance (UoN) *

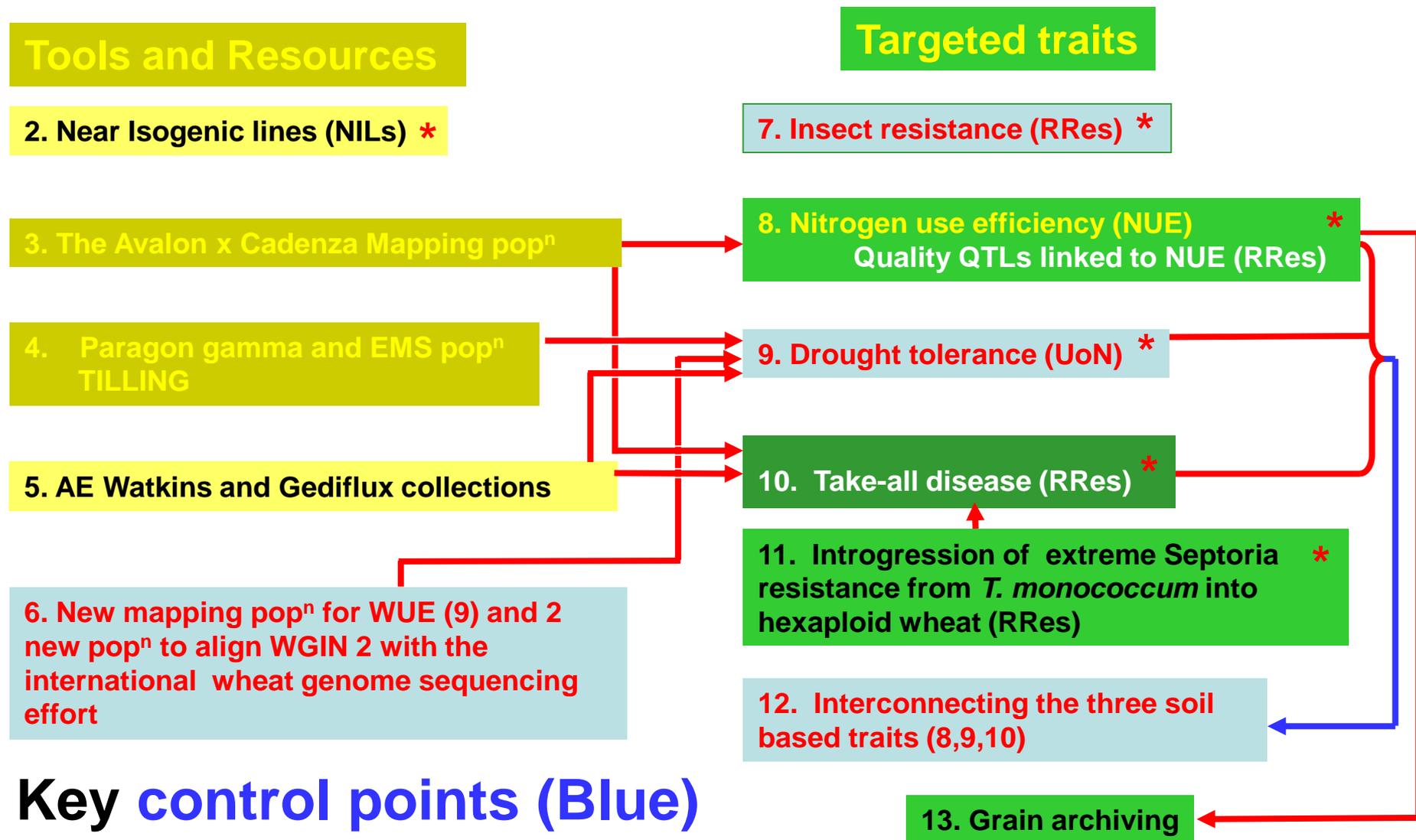
10. Take-all disease (RRes) *

11. Introgression of extreme Septoria
resistance from *T. monococcum* into
hexaploid wheat (RRes)

12. Interconnecting the three soil
based traits (8,9,10)

13. Grain archiving

Key control points (Blue)
cross connections (Red)



Defra

**Donal Murphy-Bokern, Bruno Viegas, Kath Bainbridge,
Farhana Amin, Giulia Cuccato and [David Cooper](#)**

WGIN 2

**RRes - Kim Hammond-Kosack
Peter Shewry
Malcolm Hawkesford
Vanessa McMillan
Kostya Kanyuka**

**JIC – Simon Griffiths
Susan Freeman
Cathy Mumford
Claire Lister**

**UoN - John Foulkes
Jayalath DeSilva**

S/C ADAS – Richard Weightman

WGIN 1

**RRes – Andy Phillips Lesley Smart
Katie Tearall Ruth Gordon-Weeks
Peter Barraclough Elke Anzinger
Hai-Chun Jing Richard Gutteridge**

**Carlos Bayon
Sam Irving / Suzanne Thrussell**

**JIC - John Snape Simon Orford
Robert Koebner Michelle Leverington
Liz Sayers
Christian Rogers
Pauline Stephenson
Leodie Alibert**

S/C ADAS - Neil Paveley NIAB- Rosemary Bayles

The farm / trials staff at all the sites used

**The Plant Breeders
The Management team**

www.WGIN.org.UK