WGIN : Overview and update on RRes WGIN research

Wheat Genetic Improvement Network

Kim Hammond-Kosack

Rothamsted Research

defra
Department for Environment Food and Rural Affairs

11th WGIN Stakeholders Meeting
4th December 2013

The Defra Crop Genetic Improvement Networks

Announced July 2002

Dr Donal Murphy-Bokern

Arable Crop Sciences & Pesticide Safety Unit

Science Directorate

Defra

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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**

Networks established

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

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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**

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The Defra WGIN

Grain Producers and Utilisers

9 UK WHEAT BREEDING COMPANIES

MODEL SPECIES

OTHER CEREALS

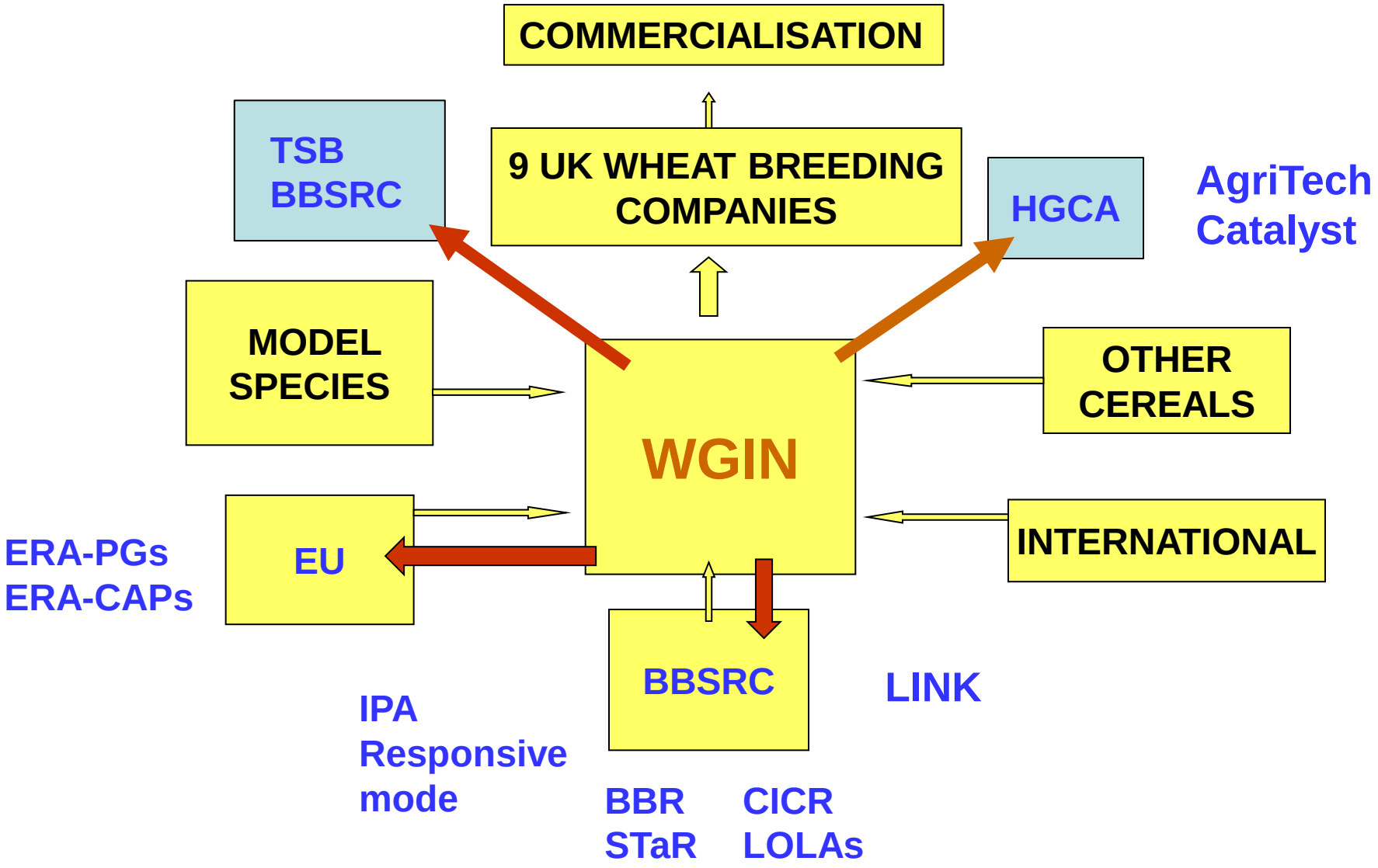
WGIN

EU

INTERNATIONAL

BBSRC

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



Projects of 5 years duration

The WGIN 1 project (2003 – 2008) - £1.80 million
The WGIN 2 project (2008 – 2013) - £1.95 million

WGIN 2 project – funded partners

John Innes Centre
University of Nottingham
Rothamsted Research
+ 2 pilot projects (1 yr / 2 yr)

Mission statement - WGIN 2008 to 2013

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

Defra's current policy priorities addressed by WGIN

1. **Support and develop British farming and encourage sustainable food production**

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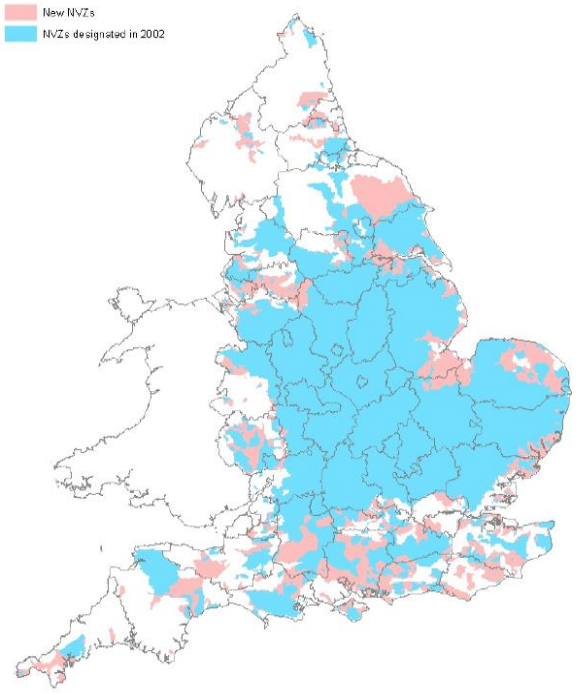
Defra's current policy priorities addressed by WGIN

2. Help to enhance the environment and biodiversity to improve the quality of life



Increase in England of Nitrate Vulnerable Zones (NVZ) due to arable activities 2002 (blue) to 2009 (pink)

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Defra's current policy priorities addressed by WGIN

3. Support a strong and sustainable green economy, resilient to climate change

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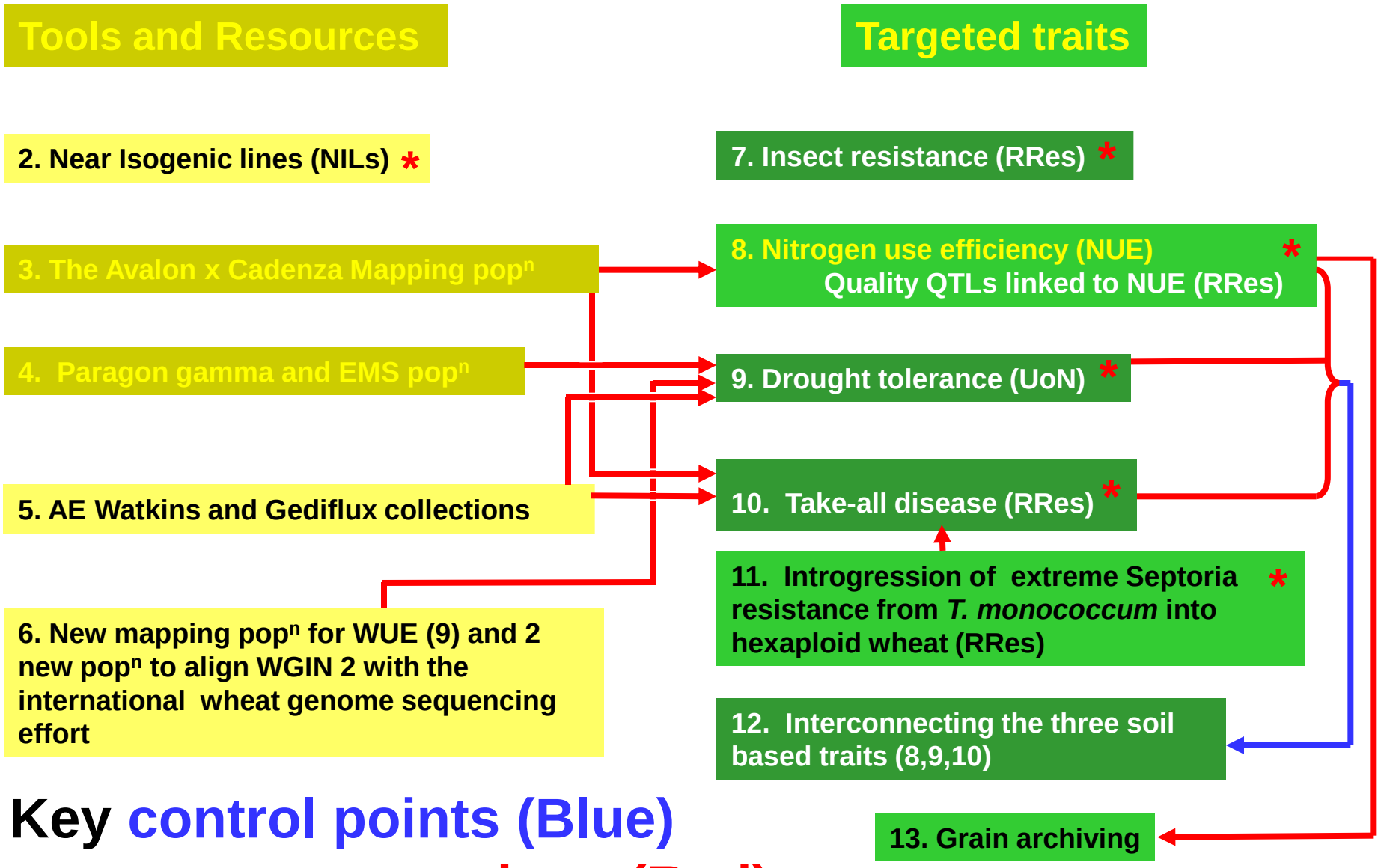
Wheat Genetic Improvement Network (WGIN) 2008-2013

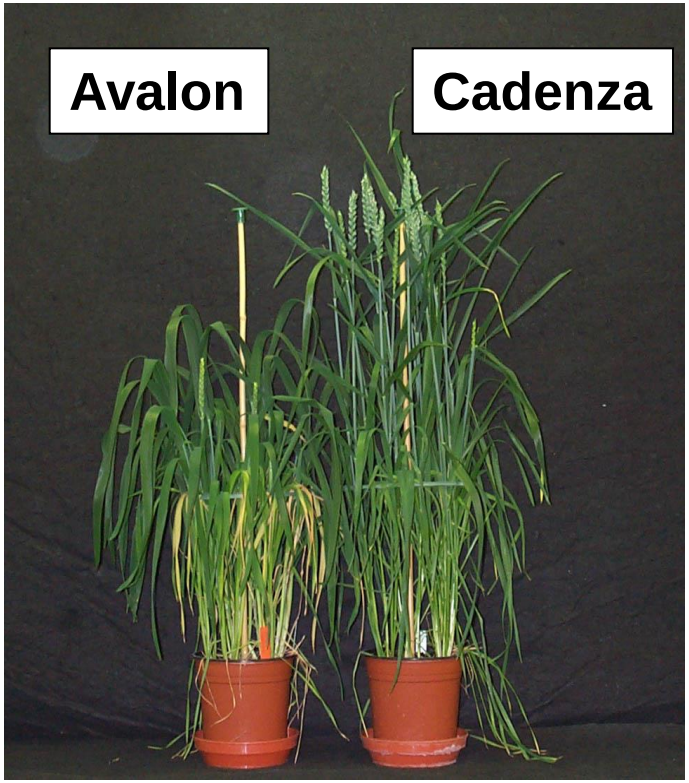


Genetic mapping and marker development

- **Establish a reference UK mapping population**

Avalon x Cadenza

203 double haploid lines



- **Switch to 'within the gene'**
  KASPar molecular markers
- **Extended A x C population for fine mapping - 574 lines**

Two WGIN workshops solely on this population
2013@JIC ~ 60 participants

Avalon x Cadenza – Near isogenic lines (NILs)

Large plot trial 2012/2013 – 3 reps

QTLs for different traits

Avalon Background	Cadenza background
225 No of lines	342 No of lines
1B ear emergence	1B ear emergence
1D ear emergence	1D ear emergence
2A height	2A height
2D height	2D height
2D yield	3A height
3B height	3B height
5A yield	3B yield
6A height	6A height
	6B ear emergence & height
6B height	
6B height &7D yield	
1D ear emergence & 5A yield	
7B yield	
7D yield	

Simon Griffiths, JIC

Characterisation and provision of genetic resources

The AE Watkins spring and winter wheat collection (JIC)

Simon Griffiths

Trait identification

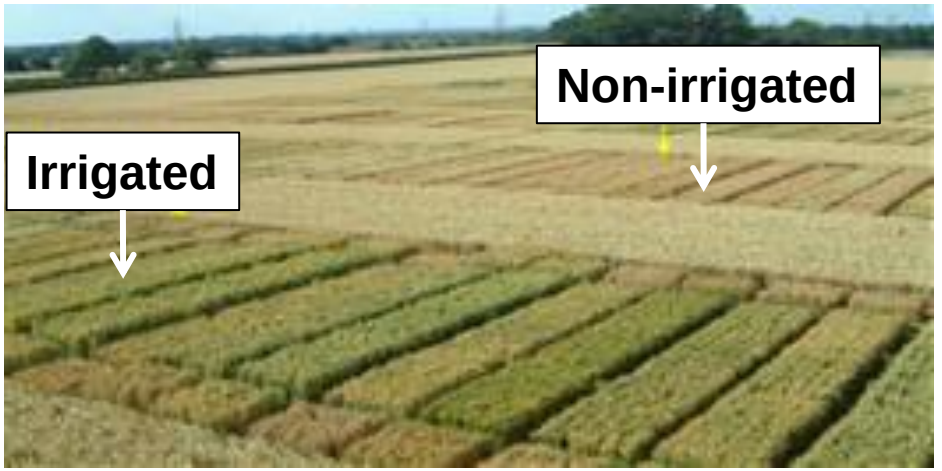
1. Improved nitrogen use efficiency (NUE)

2. Grain quality (QTLs) linked to NUE

3. Improved water use efficiency (WUE)

Consecutive years of field trials

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

WGIN 1 winter wheat soil core bioassay

(4 year means from the diversity trial)

New trait is called TAB (Take-All inoculum Build-up)

1st wheat

1. Soil core taken angled underneath row

2. Core inverted into plastic cup

THE SOIL CORE BIOASSAY

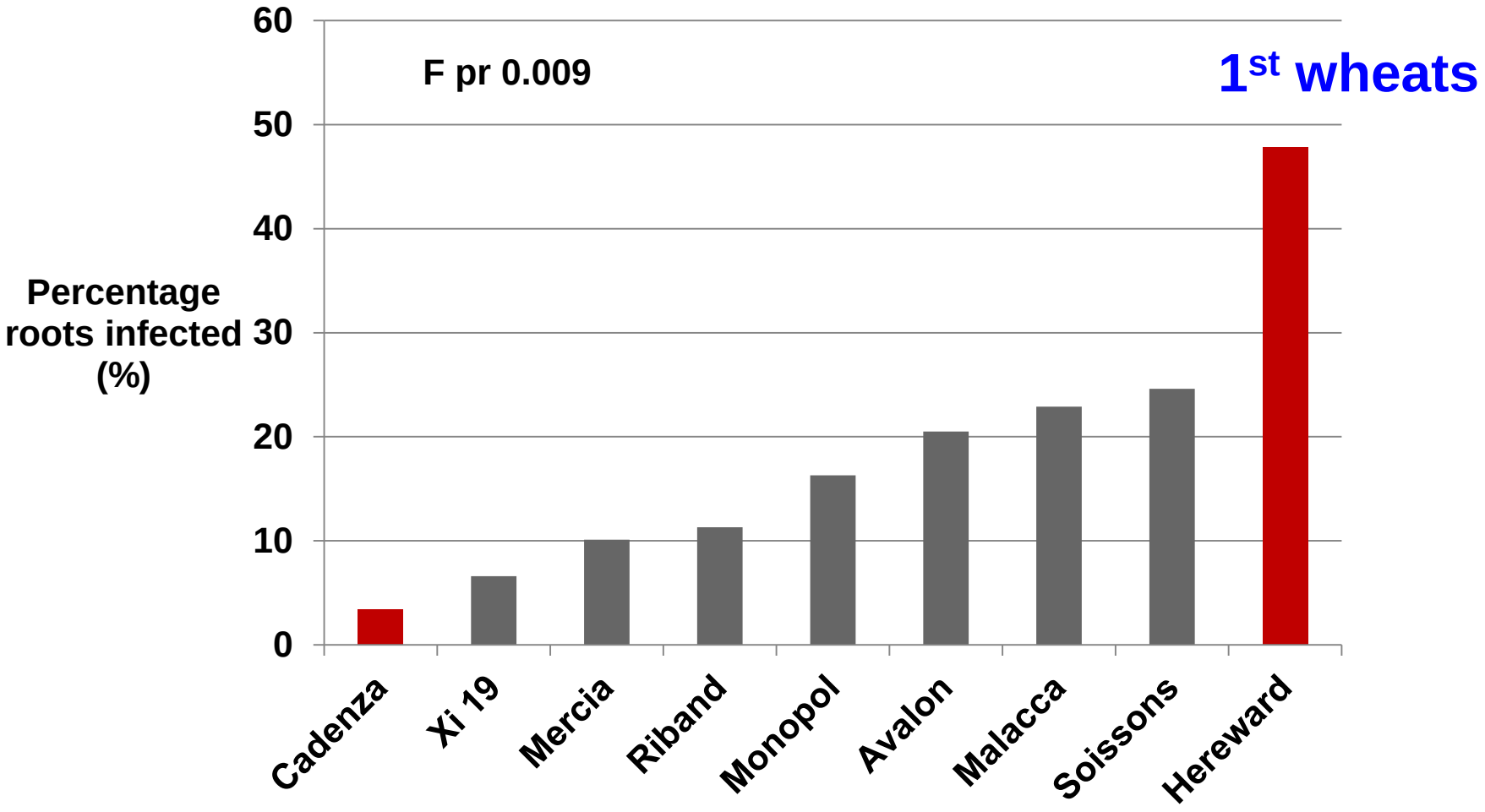
3. Ten bait wheat (cv Hereward) seeds sown

4. Growth room for 5 weeks

WGIN 1 winter wheat soil core bioassay

(4 year means from the diversity trial)

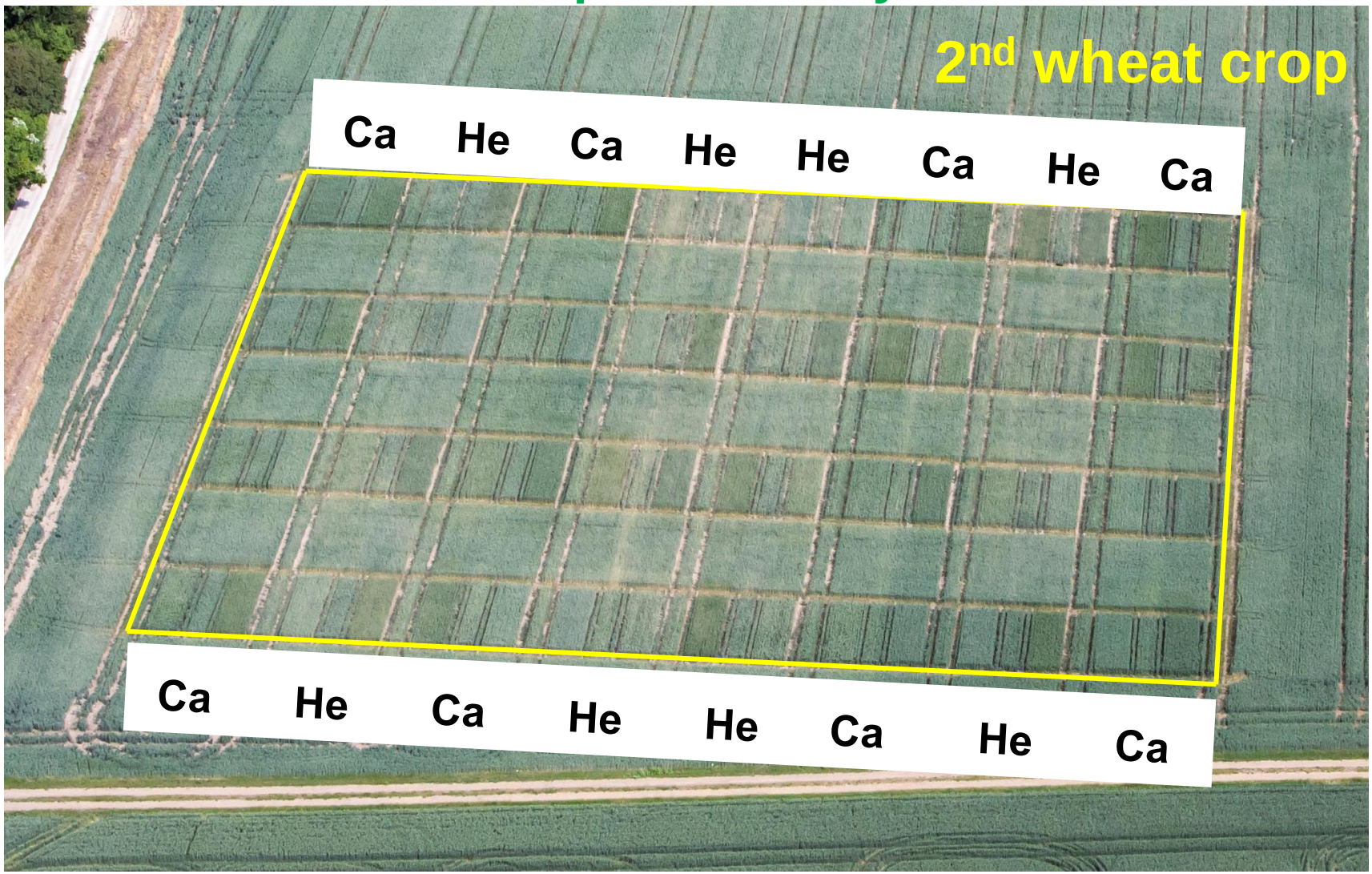
New trait is called TAB (Take-All inoculum Build-up)



McMillan *et al*. 2011, Plant Pathology, 60, 200-206

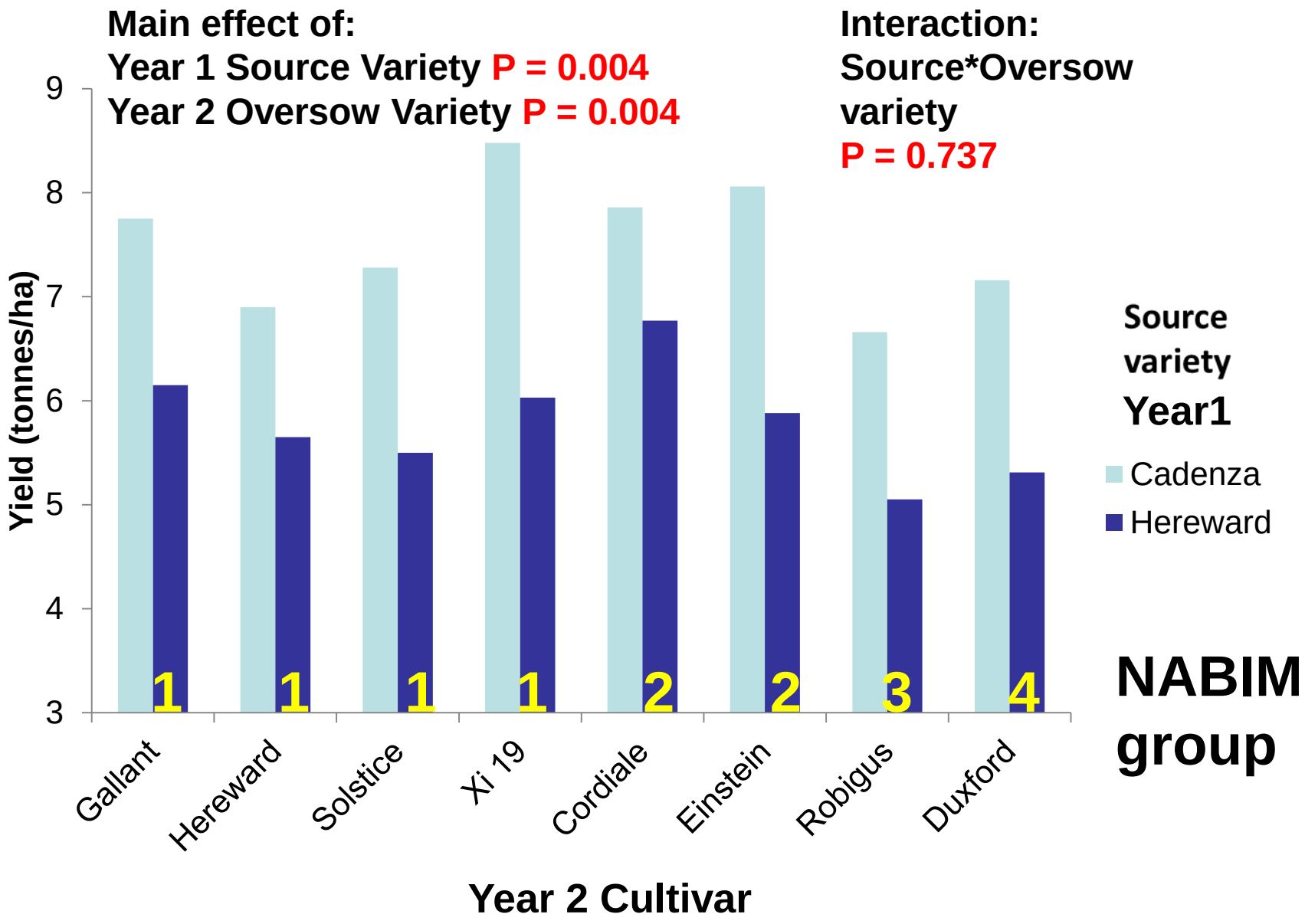
The WGIN 2 Cultivar Rotation Trial – 2nd year over sown with 8 cultivars

Field: Drapers July 2013



Rotation trial: harvest years 2012 and 2013

Second wheat yields



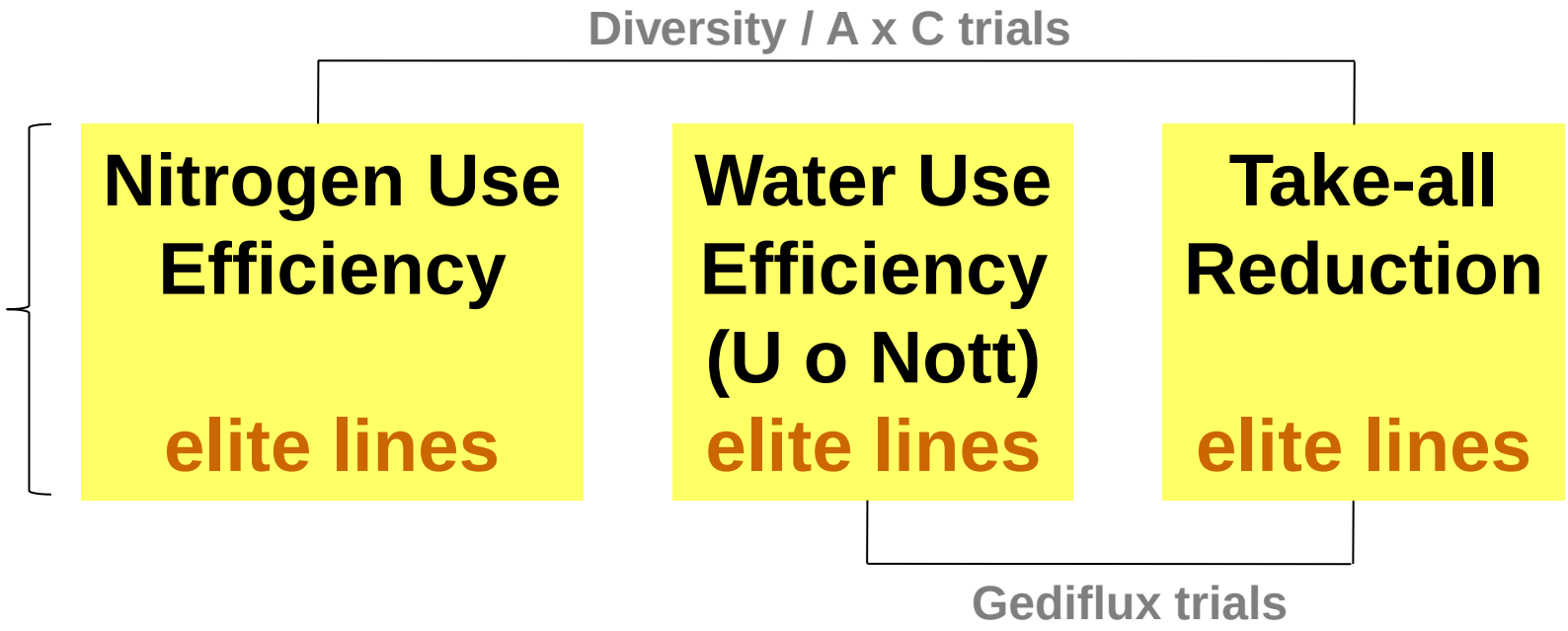
Take-all inoculum build-up trait

Using 1st wheat genetics to improve 2nd wheat crop yield performance

- **Fewer plants infected and less severe root disease in the 2nd wheat crop**
- **Improved performance is 2nd wheat cultivar independent**
- **Grain yield advantage in the 2nd wheat crop**

0.2 t /ha (2011)	very dry	low take-all
2.42 t /ha (2012)	very wet	very high take-all
1.73 t /ha (2013)	average	high take-all

WGIN 2 Interconnecting the three soil based traits



Aim: To identify the lines with good tolerance to multiple stresses **(years 4 – 5)**

What are the similarities / differences between the three traits ?

Accessing the WGIN germplasm

Two routes:

RRes – by E. mailing directly to WGIN

JIC - Genetic Resources Unit – National Capability

Mike Ambrose

BBSRC

Collections / Databases

What's New

People

GRU Publications

Links

Return to Genetic Resources

Genetic Resources Unit

The Centre is custodian of a number of key germplasm collections which serve academic, industrial and non-industrial groups both within the UK and internationally. They are the subject of research in their own right as well as being involved in a range of collaborative programmes. The collections housed within a purpose built facility maintained at 1.5 ^{0}C and 10%RH with some 600m^{3} of storage capacity.

Material from the collections is available on request to research, academic and commercial communities subject to availability. A material transfer agreement is required before seed is released. Please email for details of the agreement.

For further information relating to the collections please contact: Mike Ambrose John Innes Centre, Norwich Research Park Colney Lane, Norwich, NR4 7UH. TEL: +01603 450630 EMAIL:JIC.geneticresources@bbsrc.ac.uk

Accession numbers over 40,000 for RRes WGIN accessions

Central storage of grain from the field trials

9 years of field trials

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

~ 7,350 samples with associated metadata

Key biological resources for new projects and / or pilot studies

The Networking objectives

8 of the 20 activities

The Defra WGIN: Dissemination, Liaison and Communication

Annual “Stakeholders’ Forum” (Nov-eDec)

Focussed Workshop – 2009, 2013 ‘A x C mapping pop^{n}’

2010 – DArT marker analysis

Workshops with overseas partner organisations:
CIMMYT, INRA, 2010 – Serbia / Eastern Europe
2011- Brazil, 2014 – Hungary

Web Site (www.WGIN.org.UK)

Six Monthly Electronic Newsletter

Scientific publications

Annual displays at ‘Cereals’

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

Wheat Genetic Improvement Network

www.WGIN.org.UK

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WGIN

monogram

Wheat Genetic Improvement Network

ABOUT | INFORMATION | RESOURCES | STAKEHOLDERS

HOME >

Welcome to WGIN 2nd Phase (2009-2013)

Defra Wheat Genetic Improvement Network - Improving the environmental footprint of farming through crop genetics and targeted traits analysis

Background

The UK government is committed to more sustainable agriculture but this vision is facing an ever expanding range of environmental, energy and climate change challenges. Wheat is grown on a larger area and is more valuable than any other arable crop in the UK. Established in 2003, the Wheat Genetic Improvement Network (WGIN) arose directly from a realisation in the early 2000s that over the preceding two decades there had been a widening disconnection between commercial plant breeding activities and publicly funded plant and crop research. The overall aim of WGIN is to generate pre-breeding material carrying novel traits for the UK breeding companies and to deliver accessible technologies, thereby ensuring the means are available to produce new, improved varieties. An integrated scientific 'core' which combines underpinning work on molecular markers, genetic and genomic research, together with novel trait identification, are being pursued to achieve this goal.

BSPB promoting innovation

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.

The University of Nottingham | John Innes Centre | ROTHAMSTED RESEARCH

Maintained by Pierre Carrion

Accessible via the MONOGRAM website

Economic impact of WGIN

1st - Special focus Newsletter May 2008

- £4.3 M new grants + £2.95 M existing grants

The cost of WGIN 1 was £1.8 M over 5 years

2nd WGIN project impact audit done in late 2011

- 20 new projects described in Nov 2011 Newsletter

14 projects partially industry funded

- £15 M new grants

The cost of WGIN 2 is £1.95 M over 5 years

3rd WGIN project impact audit is in progress

To be completed by March 2014

Training impact of WGIN (in progress)

Using data, genetic resources, field trials, grain samples

UK registered PhD students – 8 completed, 7 in progress

Overseas registered PhD students – 4 completed, 3 in progress

RRes	Take-all Vanessa McMillan (BBSRC-HGCA), Sarah Jane-Osborne (BBSRC-UoN-DTP, HGCA + Agrii) Joe Moughan (Syngenta)
	Aphids Henriett Elek (KWS)
	NUE Adinda Derkx, Caihong Bai
	Grain quality Jibin He, Byoung Min (CIRC)
	TILLING Barbora Gallova (BBSRC-UoR), Francesco Sestili (U. Bologna), Linda Botticella (U. Bologna), Huijun Guo (CAAS), Samuela Palombieri (U. Bologna), Cuneyt Ucarli (U.Istanbul), Gizaw Wolde (Ethiopia), Sajida Bibi (Pakistan)
JIC	Plant height / COS markers Debora Gasperini
	Paragon deletion lines Nichola Hart, Laurent Herry, Ania Kowalski
	Gediflux Phil Tailby (Limagrain)
UoN	Drought tolerance Yadgar Mamhood

Additional Training Impacts of WGIN (in progress)

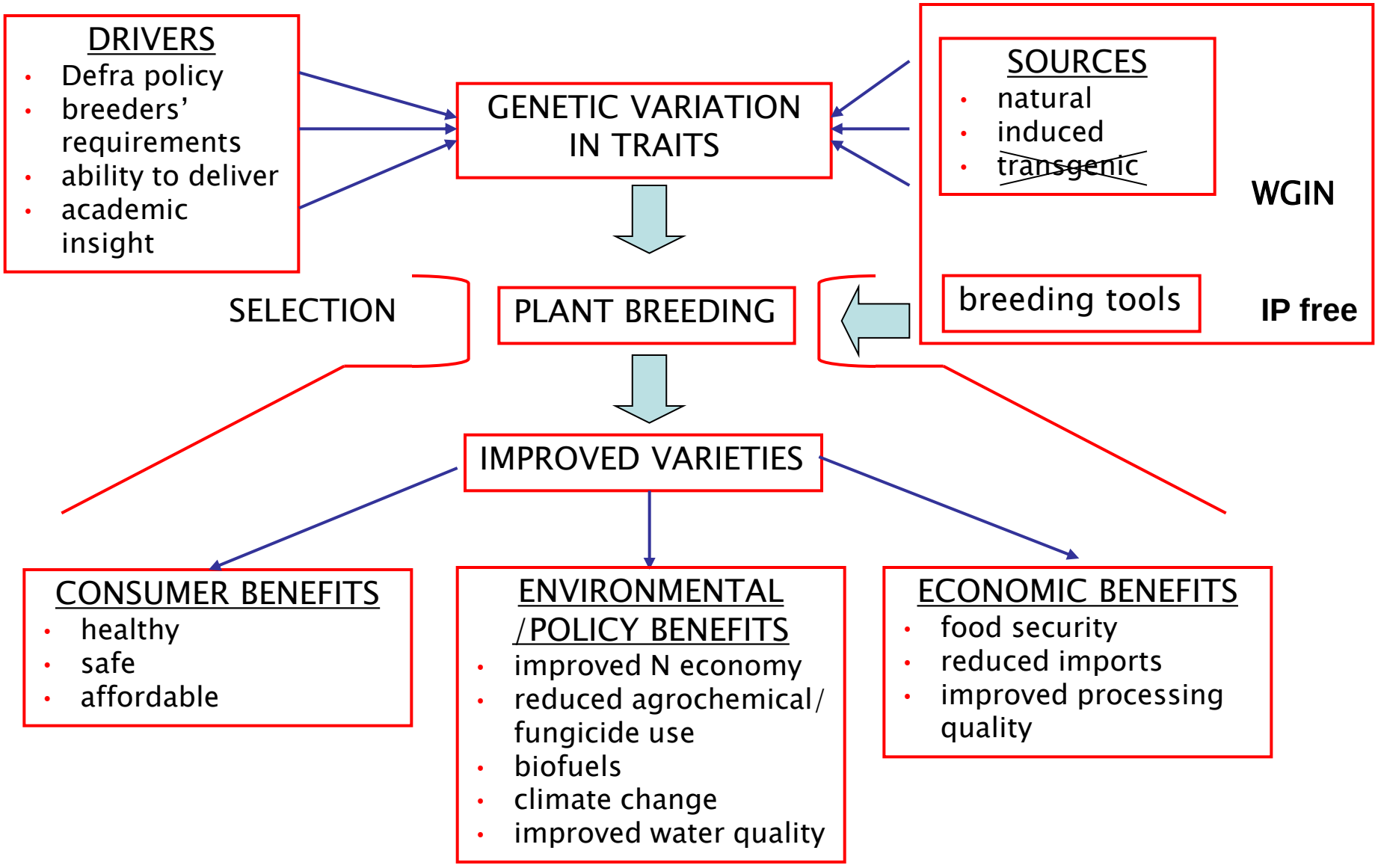
- **Several WGIN summer students have gone on to do PhDs in plant / crop sciences**

- **MSc Students, BSc final Year projects @ UoN, UoB**
- **Overseas 3-6 months internship @ RRes**

- **European Research Training Network - Bionut for PhD students (WGIN diversity trial) @RRes**
  Malcolm Hawkesford

A training workshop - "TILLING strategies and methods in polyploid species" - ~ 20 people Oct 2011 @JIC
Andy Phillips and Cristobal Uauy

WGIN in the wider context



Defra

Donal Murphy-Bokern, Bruno Viegas, Kath Bainbridge, Farhana Amin, Giulia Cuccato and David Cooper

WGIN (present)

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

JIC – Simon Griffiths
Susan Freeman
Cathy Mumford

UoN - John Foulkes
Jayalath DeSilva

WGIN (past)

RRes – Andy Phillips
Katie Tearall
Peter Barraclough
Hai-Chun Jing
Carlos Bayon
Sam Irving
Lesley Smart
Ruth Gordon-Weeks
Elke Anzinger
Richard Gutteridge
Suzanne Thrussell

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

The farm / trials staff at all the sites used

The Plant Breeders
The Management team

www.WGIN.org.UK

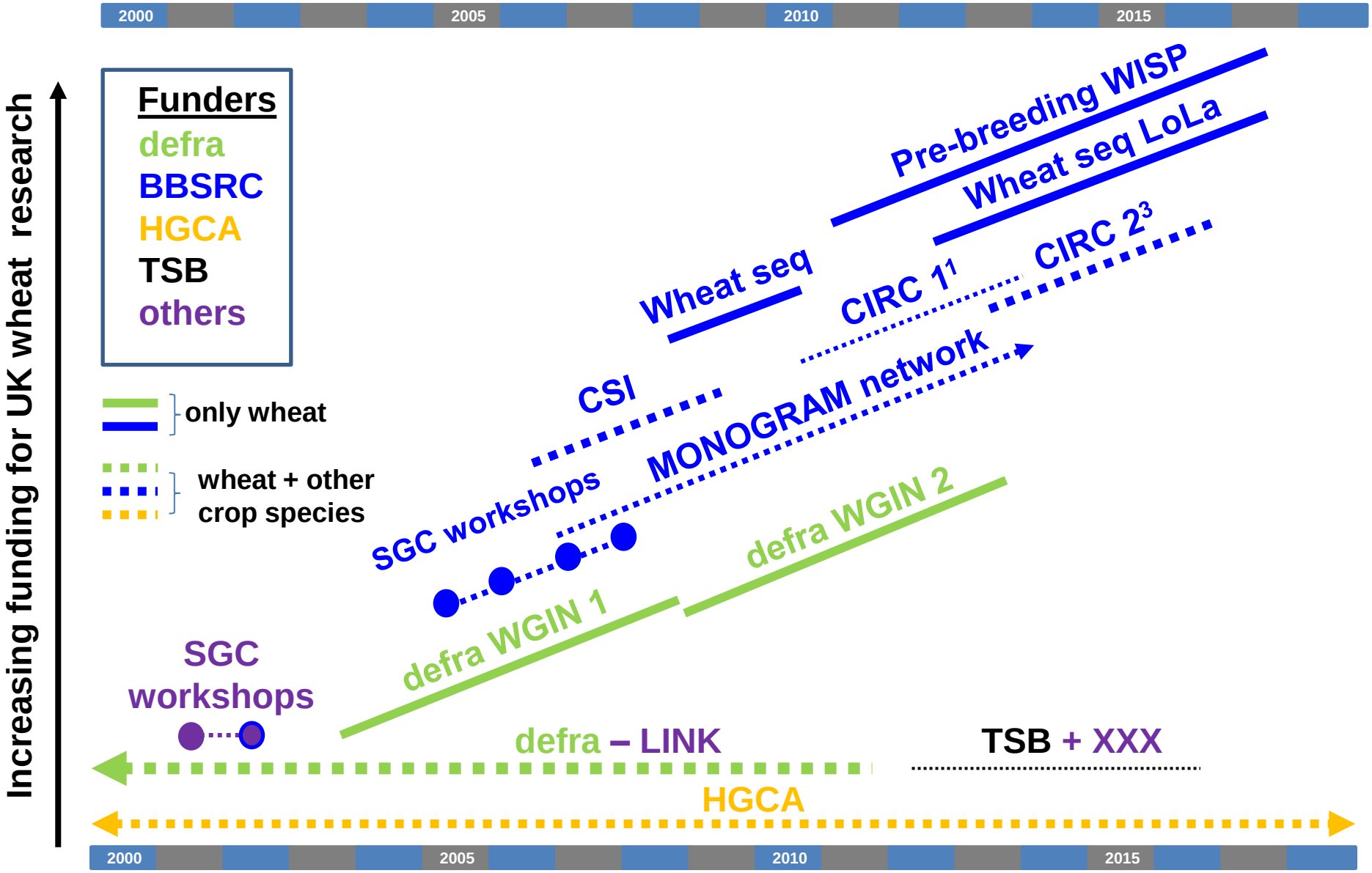

WHEAT BEER
hereward
18


CIMMYT
International Maize and Wheat Improvement Center
Spring
1
2A
2B
3A
3B
4A
4B
4C
5A
5B
6A
6B
Facultative
7
8
9
Winter
10
11
12


Ford
Wheat Straw Bio-Filled Polypropylene
Industry and World-First Usage in Quarter Trim Bins on 2010 Ford Flex
Extrusion Compounding
Injection Molding
Wheat Straw
Wheat Straw / Polypropylene Resin
Wheat Straw Bio-Filled Polypropylene Quarter Trim Bin
AgriPlas™

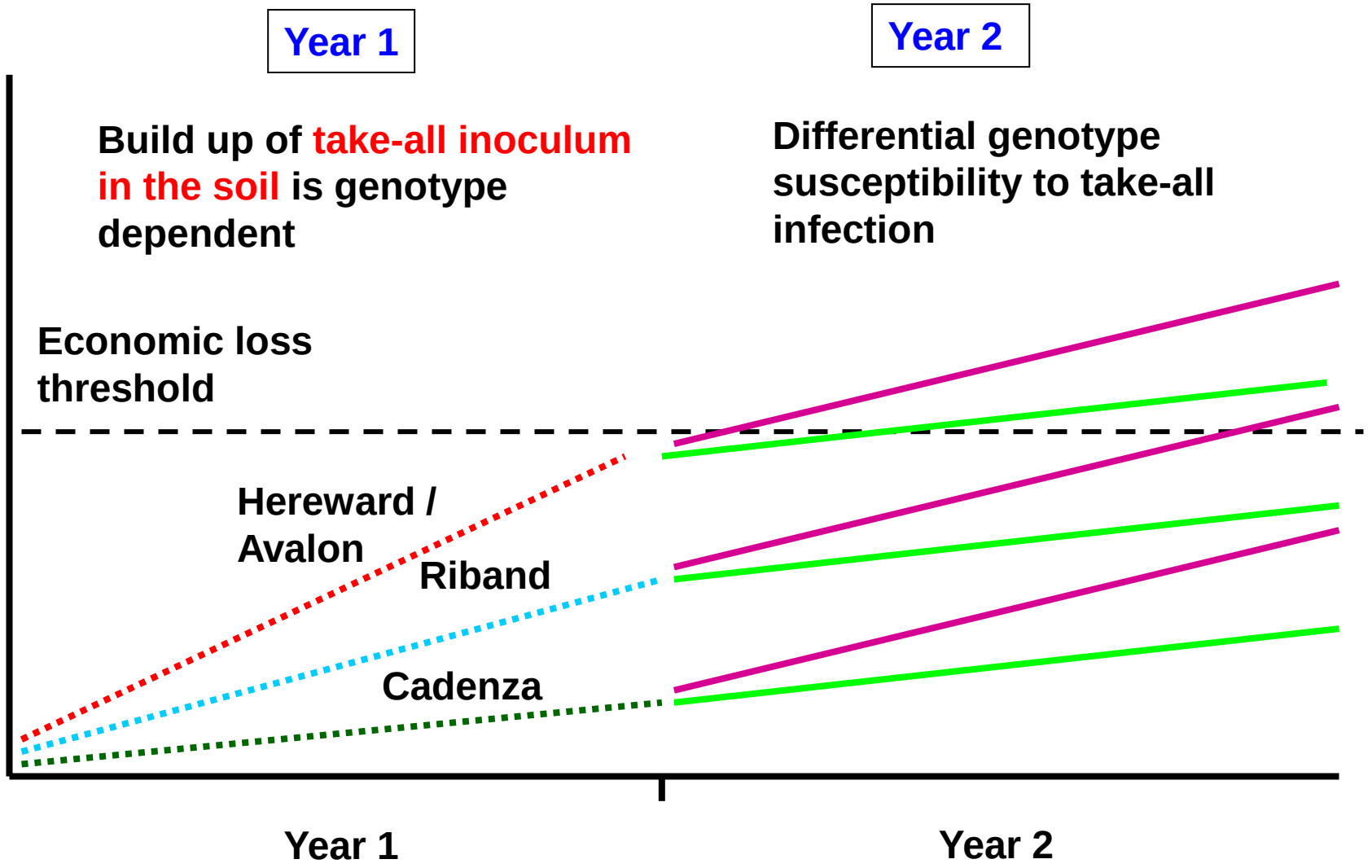

Camgrain

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



Cultivar rotation trials

Overall objective: **Explore the effect of sowing different sequences of cultivars on take-all disease pressure**



The WGIN disclaimer

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In grant applications as well as final publications

We developed in early 2010 : A generic statement on data and resource use by others

Please use this statement and inform us of all successful activities

Three Defra's current policy priorities addressed by WGIN

1. **Support and develop British farming and encourage sustainable food production**

   Help to enhance the competitiveness and resilience of the whole food chain, including farms and the fish industry, to help ensure a secure, environmentally sustainable and healthy supply of food with improved standards of animal welfare

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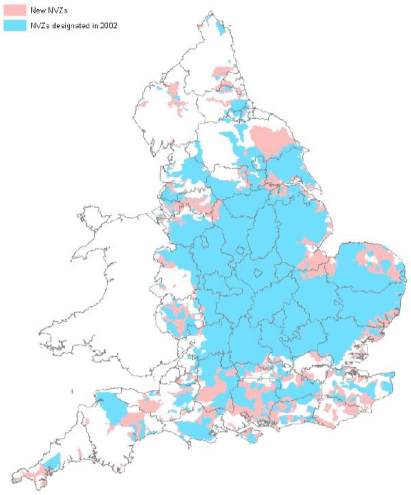
Three Defra's current policy priorities addressed by WGIN

2. Help to enhance the environment and biodiversity to improve quality of life

Enhance and protect the natural environment, including biodiversity and the marine environment, by reducing pollution, mitigating greenhouse gas emissions, and preventing habitat loss and degradation



Increase in England of Nitrate Vulnerable Zones (NVZ) due to arable activities 2002 (blue) to 2009 (pink)

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Three Defra's current policy priorities addressed by WGIN

3. Support a strong and sustainable green economy, resilient to climate change

Help to create the conditions in which businesses can innovate, invest and grow; encourage businesses, people and communities to manage and use natural resources sustainably and to reduce waste; work to ensure that the UK economy is resilient to climate change; and enhance rural communities

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Great Harpenden I - Full Avalon x Cadenza mapping population

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