

WGIN 2008 – 2013 An overview – concepts and aims

**Kim Hammond-Kosack
Rothamsted Research**



7th WGIN Stakeholders Meeting 25th November 2009

The Defra Crop Genetic Improvement Networks

Announced July 2002

Dr Donal Murphy-Bokern

**Arable Crop Sciences & Pesticide
Safety Unit**

Science Directorate

Defra



Overall Objectives

- **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**

To recreate the best of the past

Networks established

- **Wheat (WGIN)**
- **Oilseed rape (OREGIN)**
- **Short rotation coppice (BEGIN)**
- **Pulse crops**
- **Miscanthus**
- **Oats**

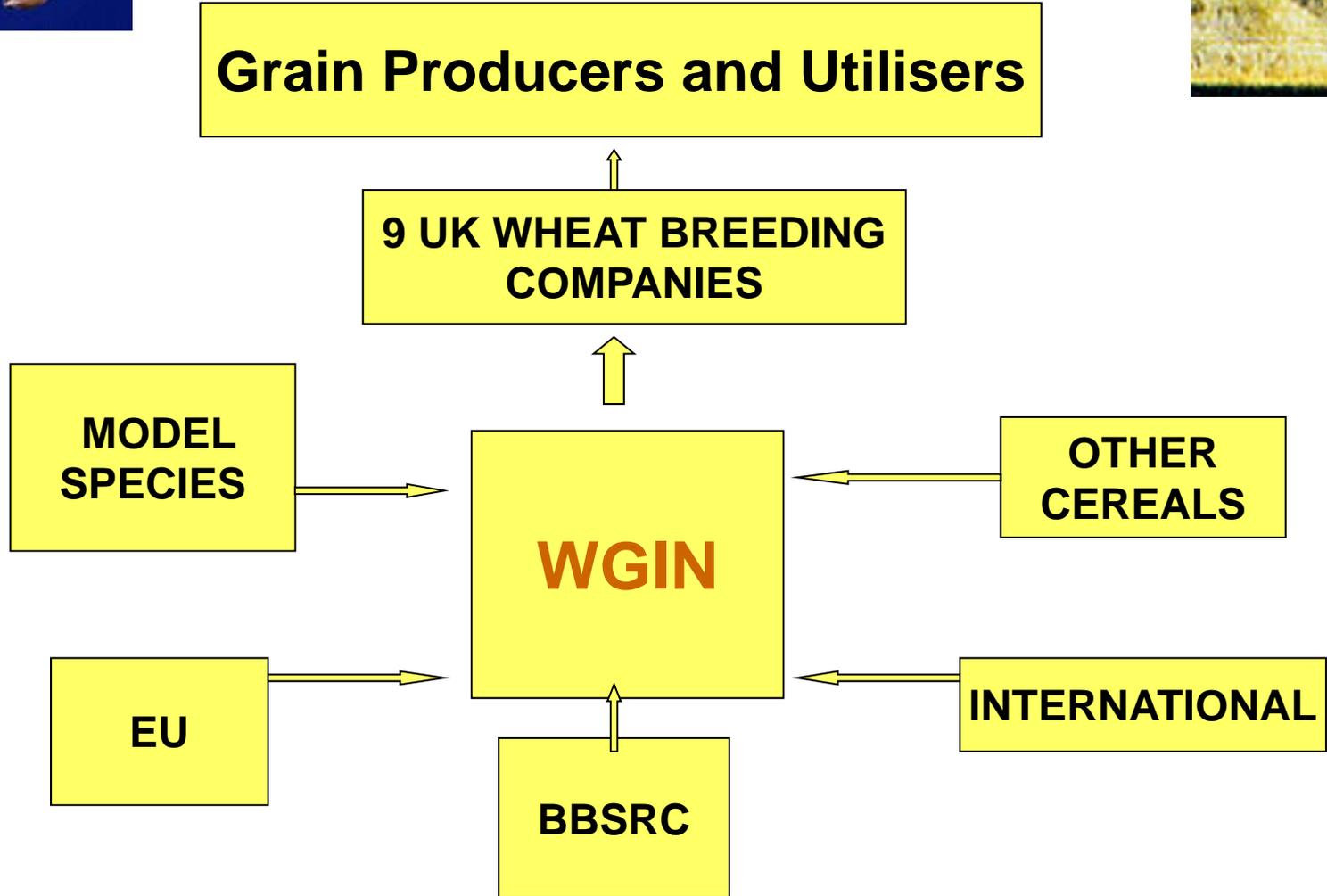
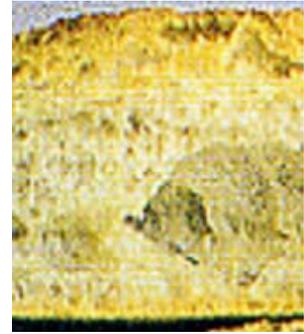


The longer-term vision

- 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



The Defra WGIN



The Defra WGIN 1 Core Project (2003-2008)

Aims:

To Underpin Wheat Improvement by Plant Breeders

Approaches:

- 1. Characterisation and provision of genetic resources**
- 2. Genetic mapping (A x C) and marker development**
- 3. Trait identification – Nitrogen use efficiency**
- 4. Identification and generation of novel variation in key traits : using non-GM approaches**
- 5. Central storage of grain from field trials**
- 6. Liaison and communication**

Funded research partners:

Rothamsted Research and John Innes Centre

some funds for one sub-contractor project

Characterisation and provision of genetic resources

March 2007 WGIN newsletter – special issue resources

Seed is available via the JIC Genetic Resource Unit

Two large EMS populations for hexaploid spring wheat

Paragon and Cadenza

Gamma irradiated Paragon population

Ion beam irradiated Cadenza populations

Many resources for the diploid wheat

Triticum monococcum

Central storage of grain from the field trials

5 years of field trials

The stored samples - 1 kg grain at - 20 C

Genotype diversity trial – for all years and all plots

Avalon x Cadenza - for some years, all plots

~ 4,500 samples with associated metadata

**A key biological resources for new projects
and / or pilot studies**

The WGIN 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**.**

In grant applications as well as final publications

Aim by early 2010 : To have developed a generic statement on data and resource use by others

The WGIN 2 project (2008 – 2013)

In April 2008 started discussions on future project resource development and trait targets

- Defra**
- UK wheat breeding community**
- Other UK research groups**
- Other stakeholders**

In March 2009 we completed the process

Total funding over 5 years - £1.95 million

Mission statement - WGIN 2008 to 2013

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

Wheat Genetic Improvement Network (WGIN) 2008-2013

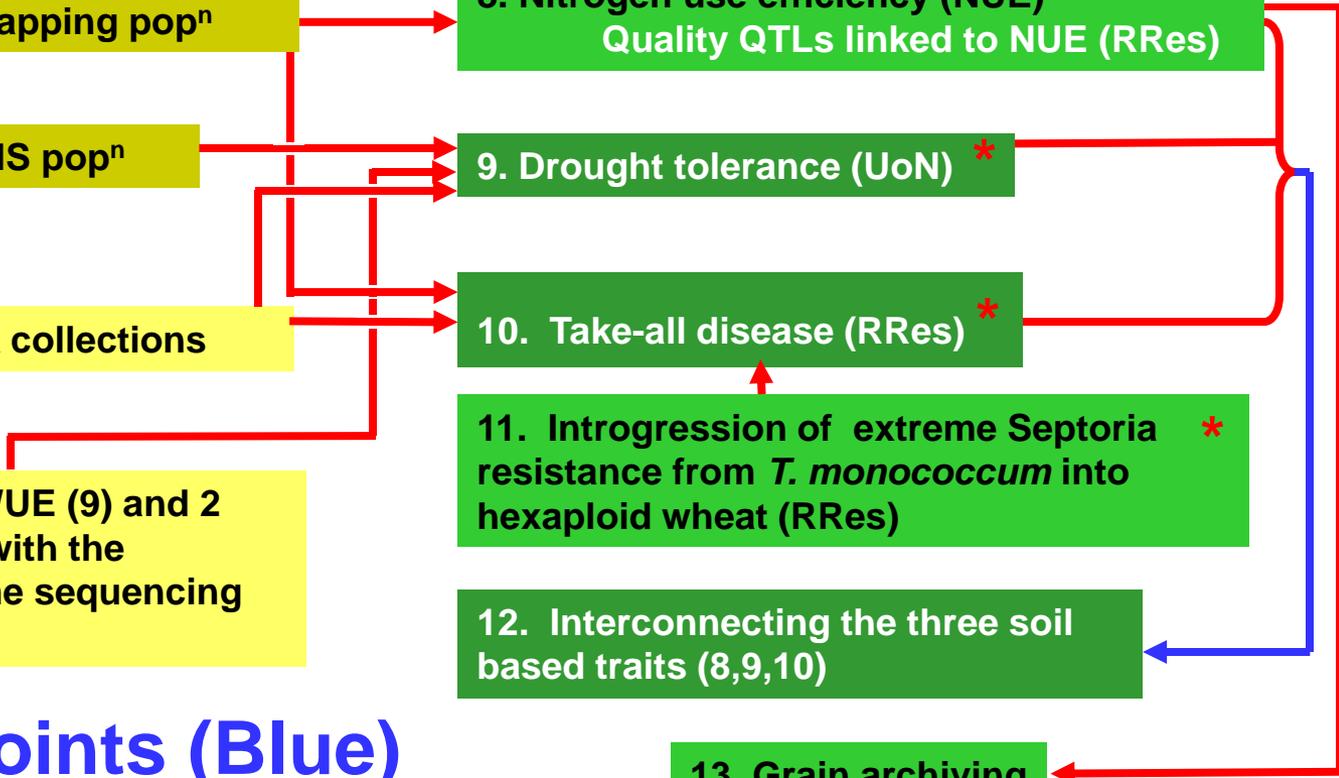
Tools and Resources

- 2. Near Isogenic lines (NILs) *
- 3. The Avalon x Cadenza Mapping popⁿ
- 4. Paragon gamma and EMS popⁿ
- 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)



Characterisation and provision of genetic resources

The **Watkins** winter wheat collection (JIC)

1930s collection from markets in 32 countries

Seed now available for 814 'purified' lines
- with more lines to come

**Represents germplasm never used in
UK wheat breeding programmes**

1st Watkins collection trial @ RRes 2007-2008



BLOCK 1 – Alpha design

Long Hoos Take-all trial

14th February 2008

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



Grain quality (QTLs) linked to NUE

Aim – To study the genes controlling grain functionality independently of protein content and known storage proteins

Development of NILs - 5 QTLs x 4NILs/QTL = 20 lines using MAS from the [Hereward x Malacca popⁿ](#)

**Replicated (x3) field trials for 2 years at 5 N levels (project years 4 / 5)
- 100, 150, 200, 250, 300kg/Ha**

Functionality analysis of selected samples

- lab scale predictive tests**
- SE-HPLC**
- spiral white bread-making**

Trait identification

2. Reducing pest and disease pressure

Aphids



***Septoria* leaf blotch**



Take-all fungus



Annually all crops at high risk

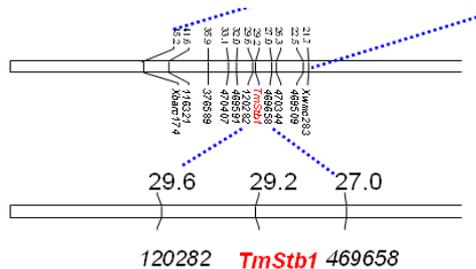
**A major problem
for 2nd / 3rd wheat
crops**

2nd wheat syndrome

Septoria resistance

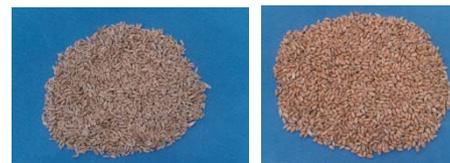


Field assessment over 5 years



Combined
DArT +SSR
marker map

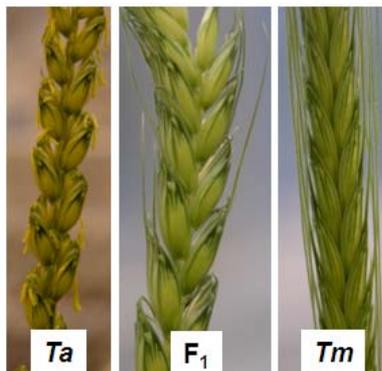
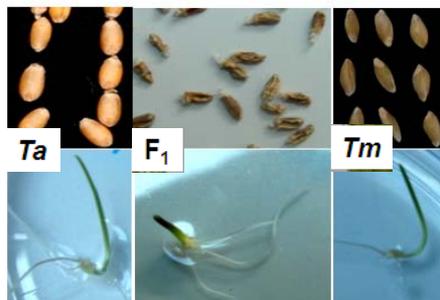
Take-all resistance in *T. monococcum*



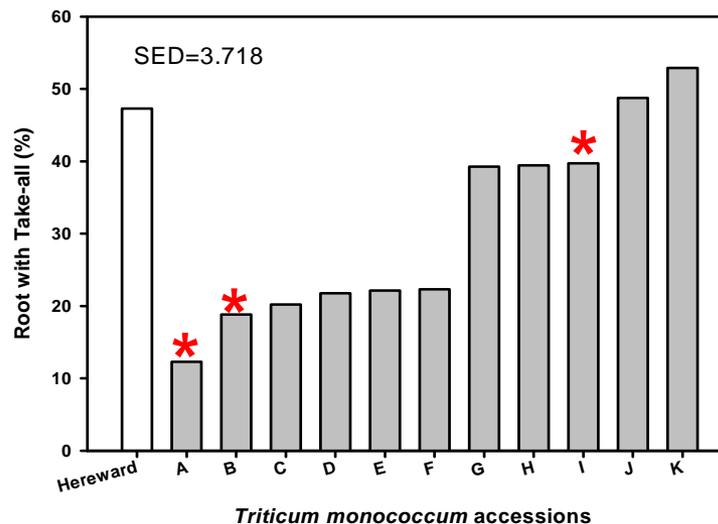
infected roots

Introgression breeding

Seed set

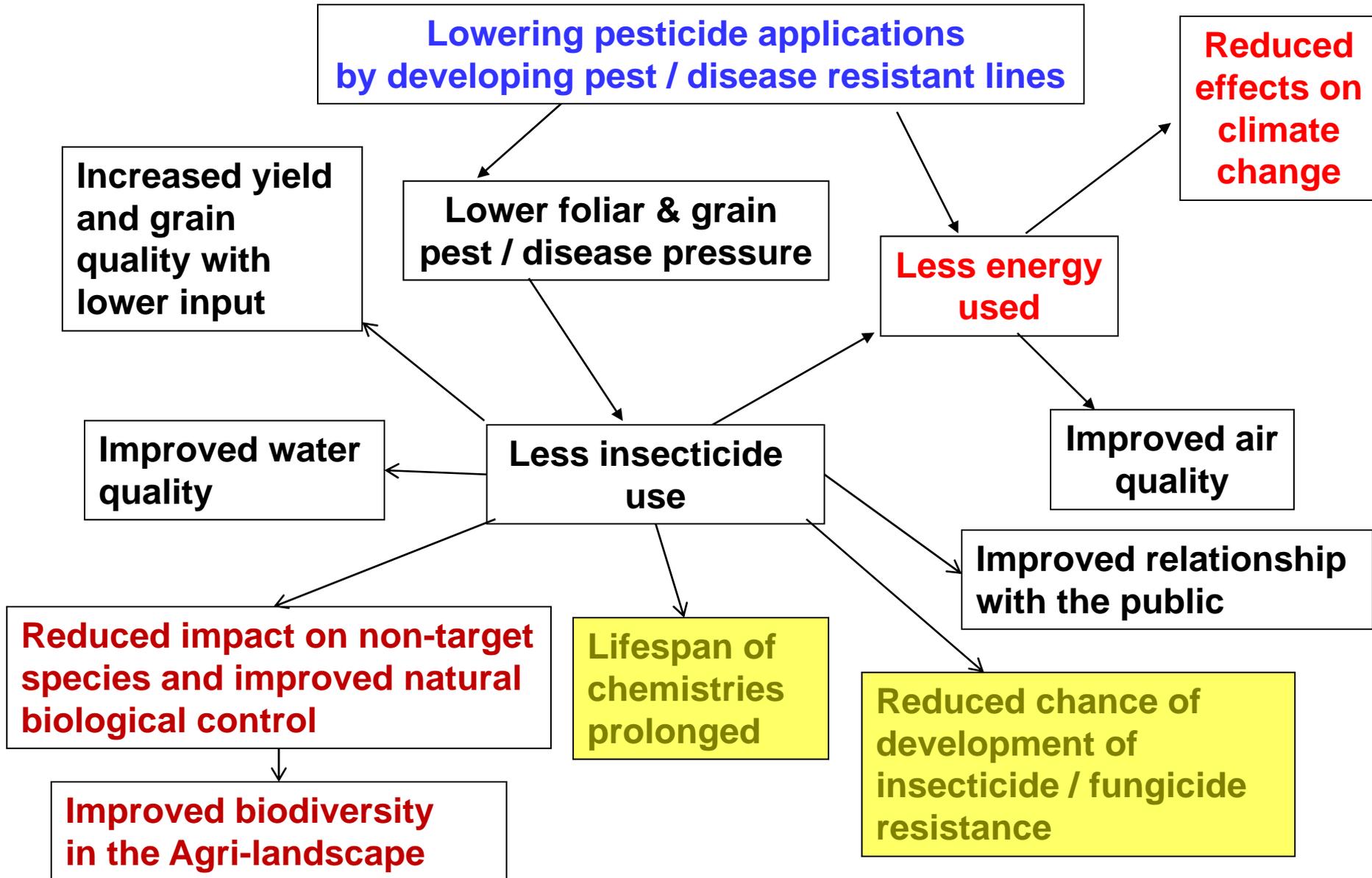


Embryo rescue

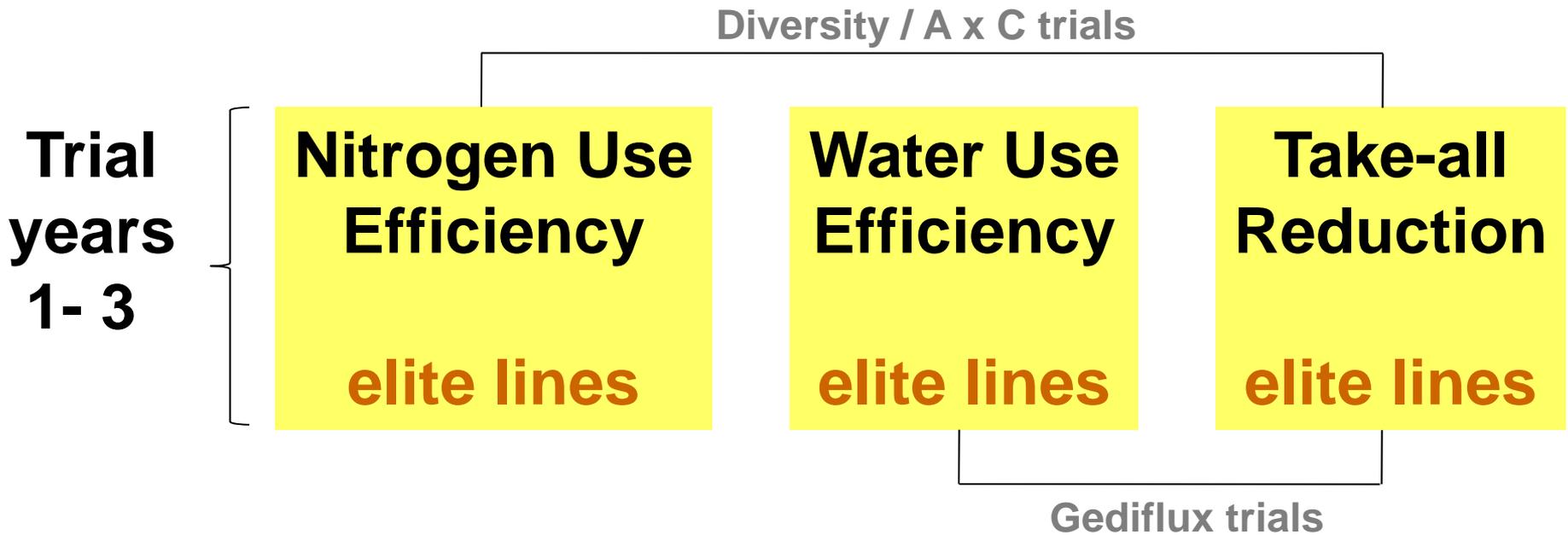


Three mapping populations produced and
F₄ generations to be screened in 2010

DEVELOPMENT OF IMPACT NETWORKS FOR EACH TRAIT - PEST / DISEASE RESISTANCE



Interconnecting the three soil based traits



Aim: To identify the lines with good tolerance to multiple stresses

What are the similarities / differences between the three traits ?

Interconnecting the three soil based traits WGIN trial years 4 and 5

The 24 genotype NUE diversity trial at 4 N rates to include

- 4 lines with high level of **drought tolerance**
- 4 lines with the highest level of **resistance to the take-all fungus**

If either stress type is abundant,
then the selected germplasm will be of **diverse parentage**

Various parameters measured

Accessing the WGIN germplasm

Two routes:

RRes – by E. mailing directly to WGIN
JIC - Genetic Resources Unit



Collections /
Databases

Genetic Resources Unit

What's New

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 °C and 10%RH with some 600m³ of storage capacity.

People

GRU
Publications

Links

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.

Return to
Genetic
Resources

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 40000 for
RRes WGIN
accessions**

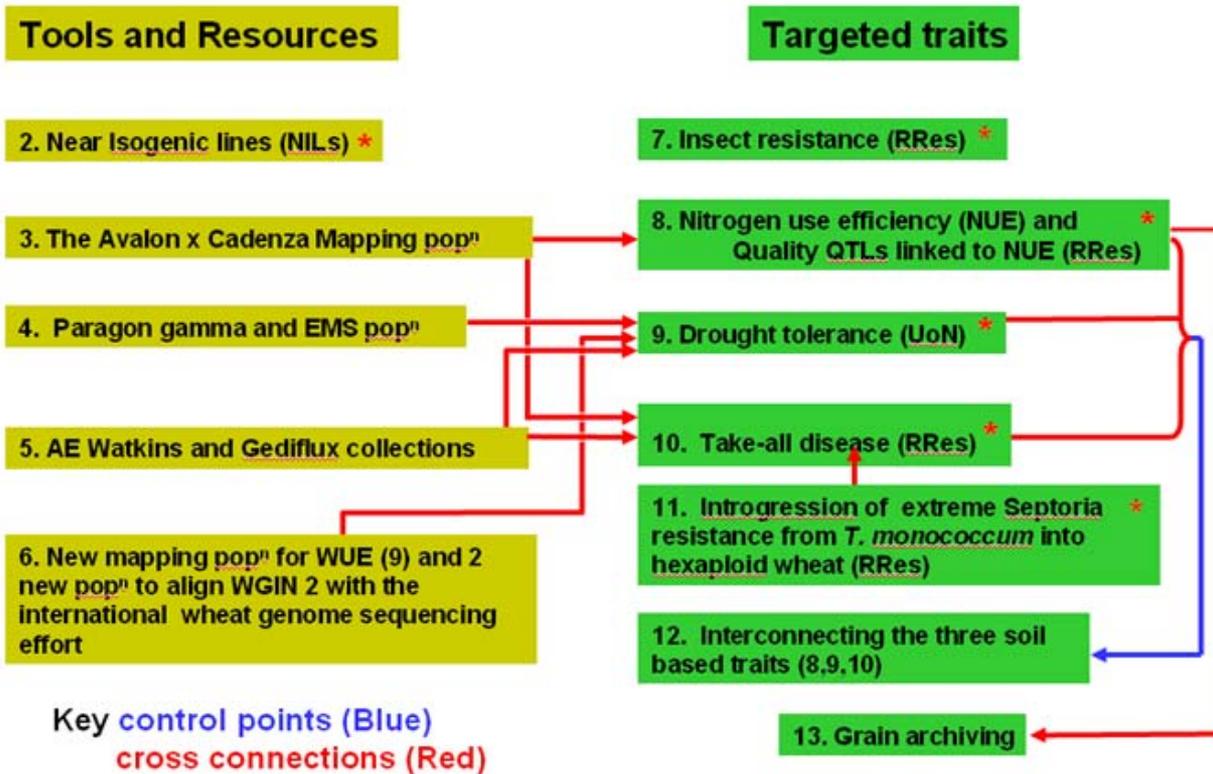
Mike Ambrose

The Networking objectives

8 of the 20 activities

Wheat Genetic Improvement Network (WGIN) 2008-2013

Act 1 Management meetings – The network



Act 14 Sub-contractor projects

- ### Improving the network and communication of results
- | | |
|-------------------------------------|------------------------------|
| Act 15 Website | Act 16 Electronic Newsletter |
| Act 17 Annual Stakeholders Forum | Act 18 Focussed workshops |
| Act 19 International collaborations | Act 20 Publicity |

Management of the Defra WGIN : The Management Team

Defra

Funded partners.

Rothamsted Research

John Innes Centre

University of Nottingham

Other Partners *

ADAS

NIAB

University of Bristol

BBSRC*

UK Wheat breeders*

HGCA*

(*Ex-Officio Members)

Three meetings per year – rotated the location

All meeting minutes and ppts in the public domain

Management of the Defra WGIN : The Stakeholders

Millers and Bakers

Brewers and Distillers

CCFRA

Livestock Feed Producers

Food processors

Agrochemical/Biotech Companies

Wheat Researchers

Field Trials Contractors

New interest groups – via **Next Generation Foods**, 1000 word article – launch Sept 2009 - 1,147 contacts / 21 countries



The **1st EPA REGISTERED** Antimicrobial Preservative to protect Food Grade Lubricants



Tuesday, November 24, 2009

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Built to last - Could a stronger focus on sustainability be critical in safeguarding our future food supplies?

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WGIN – Improving the environmental footprint of farming

WGIN | www.wgin.org.uk

This project regularly engages and has the support of the entire UK wheat breeding community. We are now seeking to reach out and interact with other stakeholder groups and industries in the UK and Europe who regularly use wheat.



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. The programme is managed by a team including representatives of the key UK research groups and breeders. They ensure the programme and its outputs are communicated to the wider scientific and end user communities, via a web site, a stakeholder forum, focused meetings and peer reviewed publications. WGIN liaises with equivalent operations overseas to ensure the programme is internationally competitive.

<http://www.nextgenerationfood.com/article/WGIN>

The Defra WGIN: Dissemination, Liaison and Communication

Annual “Stakeholders’ Forum” (Nov)

Focussed Workshop – 2009 ‘A x C mapping popⁿ’

2010 – DArT marker analysis

Workshops with overseas partner organisations:

CIMMYT, INRA, 2010 – Serbia / Eastern Europe

Web Site (www.WGIN.org.UK)

Six Monthly Electronic Newsletter

Scientific publications

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



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.



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.

Sponsored by: [Defra \(UK\)](#)
Hosted by: [Rothamsted Research](#)
Maintained by: [Elke Anzinger](#)
Edited by: [Kim Hammond-Kosack](#)
Designed by: [Pierre Carion](#)
Last updated:



The University of
Nottingham



John Innes Centre



ROTHAMSTED
RESEARCH

Maintained by
Elke Anzinger
project assistant

Recent Updates

June 2009: Launch of the new website.

02.11.2009: [Disclaimer for the use of WGIN data and germplasm resources](#)

02.11.2009: [Updated traits data on the Watkins collection](#)

02.11.2009: [BBC report on the WGIN diversity trial](#)

02.11.2009: [Programme for the WGIN stakeholder meeting](#)

02.11.2009: [WGIN stakeholder newsletter October 2009](#)

25.08.2009: [Provisional Programme for the WGIN stakeholder meeting 2009](#)

25.08.2009: [Avalon x Cadenza DH population Workshop](#)

13.08.2009: [Trait data from Avalon x Cadenza field trials at JIC, years 2005, 2007, 2008](#)

Finding what you want on the website

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WGIN



ABOUT	INFORMATION	RESOURCES	STAKEHOLDERS
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HOME >

Welcome to WGIN

Defra Wheat Genetic Improvement Network
footprint of farming through

Background

The UK government is committed to meeting the challenge of the 21st century. The UK food and drink industry is facing an ever expanding range of change challenges. Wheat is grown on more than any other arable crop in the UK. The Wheat Genetic Improvement Network (WGIN) arose in the 2000s that over the preceding two decades there had been a disconnection between commercial plant and crop research. The overall aim of WGIN is to generate 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.

Outline
Project Outline
Research Objectives ...
Management and Networking
Meetings
Collaborations
Subcontractor Projects
General Links
Publications
Publicity
Reports

Outline
2 - Near Isogenic Lines (JIC)
3 - Avalon x Cadenza Mapping Population (JIC)
4 - Paragon Gamma and EMS mutagenised Lines (JIC)
5 - AE Watkins and Gediflux Germplasm Collections (JIC)
6 - New Mapping Populations (JIC)
7 - Insect Resistance - Cereal Aphids (RRes)
8 - Nitrogen Use Efficiency Improvement and QTLs (RRes)
9 - Water Use Efficiency and drought tolerance (UNo and JIC)
10 - Take All disease (RRes)
11 - Introgression of Disease Resistance (RRes)
12 - Soil based Traits (UNo and RRes)

site guide



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Maintained by
Elke Anzinger
project assistant

Unlike LINK projects
the WGIN data goes
straight into the
public domain

Accessible via the
MONOGRAM
website

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John Innes Centre



ROTHAMSTED
RESEARCH

Many Additional Outreach Activities

Cereals 2007, 2008, 2009

RRes and JIC
demonstration plots



With assistance from RRA, NIAB and Velcourts

RRes open weekend 22 / 23rd May 2010

The GINs Marque : WGIN, OREGIN, BEGIN

The Bioscience behind:



secure harvests

Global food security depends ultimately on growing enough crops. Economic, political and social factors are important, but sufficiency and sustainability of harvests are the primary needs.

The world's population is growing inexorably and harvests worldwide are threatened by climate change. Grain stores must be sufficient to protect against price volatility and speculation – particularly in poor, developing countries. Within a lifetime, regions near the equator could face agricultural losses of up to one-third.

We need to focus on where production gains are most readily and sustainably achievable. This means identifying and selecting crop traits and production systems that can increase yields in particular soils and climatic conditions, and reducing losses to pests and diseases. To do this requires knowledge of how

January 2009

WGIN 2008

Septoria and Take-all *T. monococcum* trial

Increasing crop yields



Getting novel traits into wheat

Some of wheat's wild relatives have potentially useful traits such as drought-tolerance and disease-resistance. But these cannot be bred into commercial varieties because of a mechanism in wheat that prevents its chromosomes from swapping genes, except with other wheat plants.

Scientists at the JIC have found that a gene called *Ph1* senses when parental wheat chromosomes match and allows them to cross. They are identifying ways to block *Ph1* temporarily so that breeders can cross wheat varieties with wild relatives to obtain hybrids with new traits. Once a useful gene is incorporated, *Ph1* would be switched on again, fixing the new gene in subsequent generations of the crop.^[1]

August 2009

World | Perfect Storm: Science and food

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NEWS **LIVE** BBC NEWS CHANNEL

Page last updated at 10:08 GMT, Tuesday, 25 August 2009 11:08 UK

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Averting a perfect storm of shortages

[Overview](#) [Science's role](#) [Mega-cities](#) [Lifestyles](#)



01.13 / 01.14

How wheat can be adapted to survive varying environments

Faced with the threat of a booming population going hungry in a warming world, there is quiet confidence among many researchers that technology can provide solutions, reports the BBC's environment correspondent, David Shukman.

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WGIN NUE Diversity Trial 2009

Economic impact of WGIN

Special focus Newsletter May 2008

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

What was the return ?

Defra commission SAC in 2007 to find out

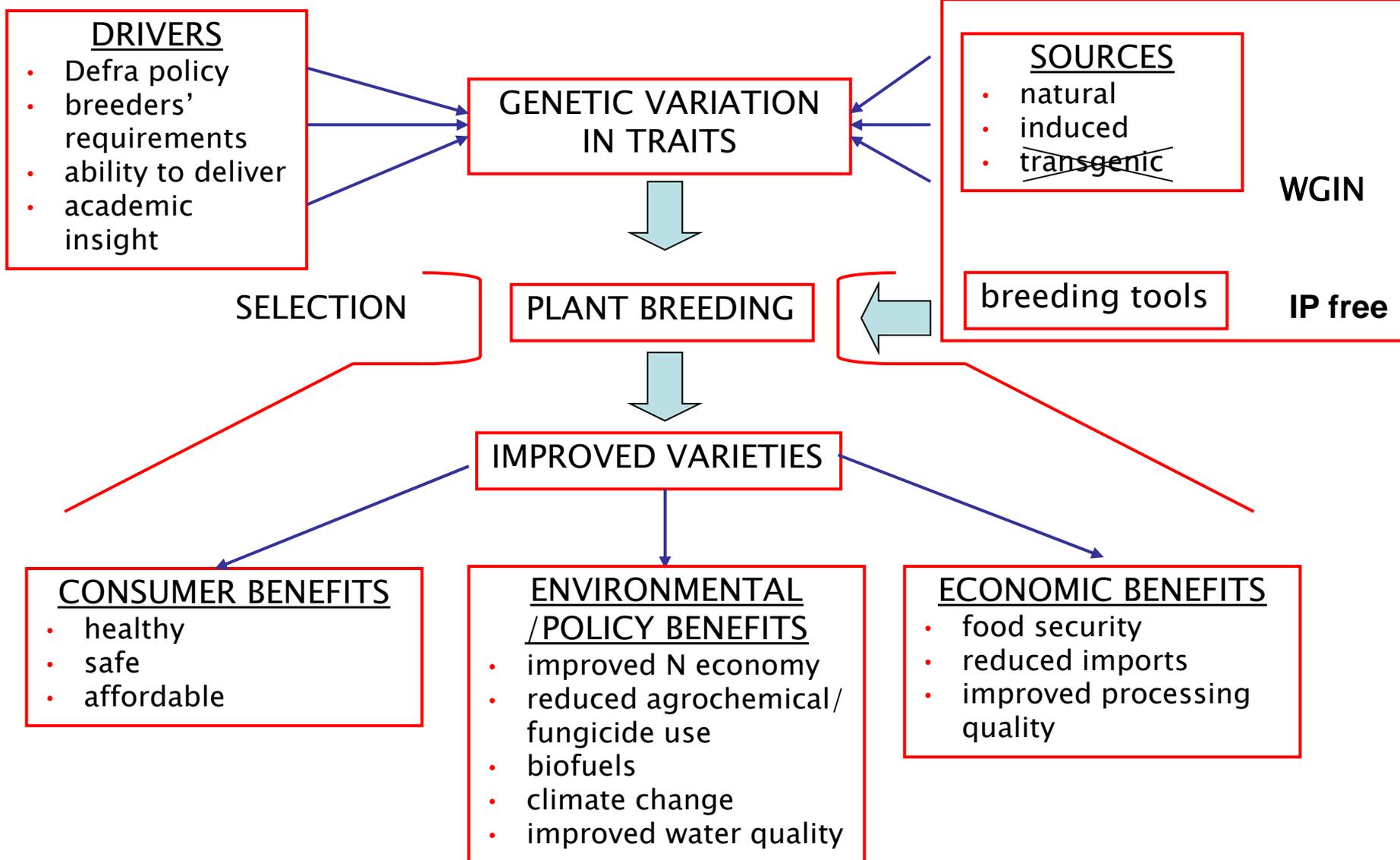
~ £16.7 M for all the GINs (after 4 years)

WGIN

1. Funded BBSRC projects using WGIN data and resources - £ 3.0M
2. Funded projects using WGIN data in the application - £ 4.3M
(BBSRC, EU-FP6, HGCA, LINK, RIF)

Another WGIN project impact audit due in late 2010

WGIN in the wider context





CIMMYT
International Maize and Wheat Improvement Center

Ford

Wheat Straw Bio-Filled Polypropylene
Industry and World-First Usage in Quarter Trim Bins on 2010 Ford Flex

Wheat Straw

Wheat Straw / Polypropylene Resin

Wheat Straw Bio-Filled Polypropylene Quarter Trim Bin

AgriPlas™



Camgrain

Defra

Donal Murphy-Bokern, Bruno Viegas and Kath Bainbridge

WGIN (present)

**RRes - Peter Shewry
Kim Hammond-Kosack
Malcolm Hawkesford
Richard Gutteridge
Lesley Smart
Ruth Gordon-Weeks**

Elke Anzinger

**JIC – John Snape
Simon Griffiths
Simon Orford
James Simmonds
Michelle Leverington**

UoN - John Foulkes

WGIN (past)

**RRes – Andy Phillips
Katie Tearall
Peter Barraclough
Hai-Chun Jing
Carlos Bayon
Sam Irving**

**JIC - Robert Koebner
Christian Rogers
Pauline Stephenson
Leodie Alibert**

The farm / trials staff at all the sites used

**The Plant Breeders
The Management team**

www.WGIN.org.UK



Wheat Straw Bio-Filled Polypropylene

Industry and World-First Usage in Quarter Trim Bins on 2010 Ford Flex



Mapping traits and trait introgression

Generation of interspecies hybrids



Seed-set

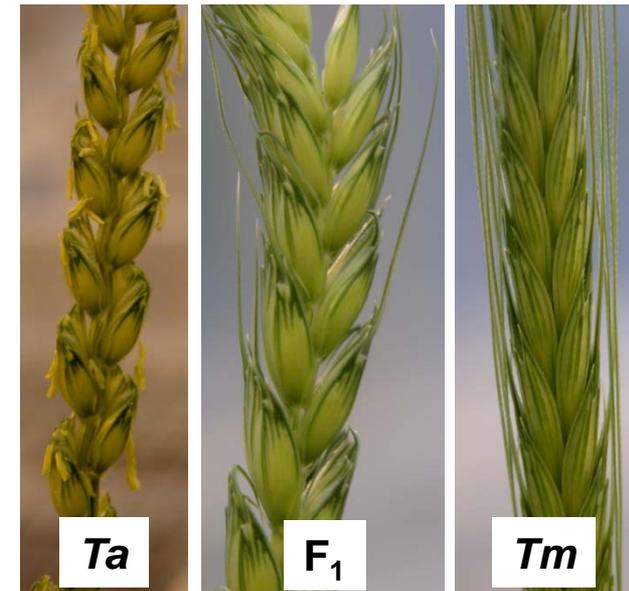


Embryo-rescue

Bread wheat
(Cadenza)

Hybrids *T. monococcum*
(MDR308)

Cross	Female	Male	F1 embryo rescued seedlings	F1 germinated seeds	F1 plants in soil survivors
1	Chinese spring	MDR308	1	9	4
2	Chinese spring	MDR002	1	36	14*
3	Cadenza	MDR308	1	1	1*
4	Cadenza	MDR002	1	-	
5	Riband	MDR308	4	-	2
6	Riband	MDR002	1	-	



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Averting a perfect storm of shortages

Overview

Science's role

Mega-cities

Lifestyles

PLAY THIS AGAIN!



Perfect Storm: Food

The BBC's David Shukman has been to a food technology centre in London to find out how food can be adapted to cope with environmental changes.



How wheat can be adapted to survive varying environments

Faced with the threat of a booming population going hungry in a warming world, there is quiet confidence among many researchers that technology can provide solutions, reports the BBC's environment correspondent, David Shukman.

The warning of a "perfect storm" is partly intended to focus attention on the positive role that science can play - and to galvanise politicians to support it.

There is a glimpse of that potential at the Rothamsted plant research centre in Hertfordshire, where 160 years of experiments have repeatedly boosted the key feature of crops - their yield.

During a visit to the centre's experimental plots and carefully managed greenhouses it is hard to

PERFECT STORM 2030

BBC correspondents explore the forecast by UK chief scientist John

PERFECT STORM 2030

THE PROBLEM



A grim forecast for 2030

There will be two billion more people, and not enough food



Cities drain resources

Migrants swell cities that suck in water, food and energy



China's energy hunger

China is investing in wind - but coal remains king



California's 'dust bowl'

Farms in California's Central Valley are steadily drying out



Leasing Ukraine

Foreigners are taking over tracts of the ex-breadbasket

SOLUTIONS



How to grow more food

Scientists say new crops can help - and GM would be useful



Will we change our ways?

Some will - but many remain climate-change sceptics



Viewpoint: EU 'not helping'

Advances in agriculture risk being 'hampered by regulators'