

# Defra's WGIN 2008 to 2013



# Defra's vision for the new WGIN

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## Overall Mission

**Improving the environmental footprint of farming**

## Approach

**To continue to increase the effectiveness of UK genetic science for crops by supporting integrated networks of research**

# Programme activities planned for the next 5 years

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## WGIN Project management

**Activity 1. The Network – mode of operation  
Management meetings – 3 per year**

**Activity 16. Website**

**Activity 17. Electronic Newsletter – 2 per year**

**Activity 18. Annual Stakeholders Forum - Nov**

**Activity 19. International collaborations**

**Activity 20. Publicity**

# WGIN Research

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## Two overarching topics

**Generating and improving specific resources and tools**

**Targeted traits**

*We have received numerous suggestions for research activities / topics over the past 18 months*

## The groups so far to receive funds

**John Innes Centre**

**Rothamsted Research**

**University of Nottingham**

**+ appointed sub-contractors**

# Targeted traits

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## Activity 7. Crop adaptation for climate proofing

Will crop vernalisation requirements be fulfilled in the future?

### Approach

Winter wheat's RL (10), Gediflux (15), Watkins (25)

4, 6 and 8 weeks vernalisation

*Vrn1* locus - allele variation

F<sub>2</sub> mapping population, map additional QTLs

Simon Griffiths and John Snape (JIC)

# Targeted traits

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## Activity 8. Nitrogen use efficiency (NUE) and Quality QTLs linked to NUE

### NUE

- canopy longevity
- rate of canopy N remobilisation
- explore variation in early (seedling) N uptake as a contributor to seedling establishment
- overall NUpE (uptake)

### Quality QTLs linked to NUE

- validation of QTLs for bread-making quality found to be independent of protein content in a Hereward x Malacca population (exLINK)
- explore NILs (5 QTLs x 4NILs/QTL = 20 lines)
- identification of close markers and / or genes to permit exploitation

Malcolm Hawkesford and Peter Shewry (RRes)

# Targeted traits

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## Activity 9. Drought tolerance

- 30% of UK wheat is grown on drought-prone land and drought losses are on average 1-2 t ha<sup>-1</sup>
- water supply to crop's less predictable
- increase water-use efficiency (WUE)  
biomass / crop evapotranspiration
- additional benefit of decreasing crop water consumption in non-drought years

# Targeted traits

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## Activity 9. Drought tolerance

Optimal plant ideotype for durable drought resistance will be based on a combination of traits

1. deeper rooting
2. high accumulation and remobilisation of stem soluble carbohydrate reserves to grains
3. delayed senescence with the stay-green trait
4. high water-use efficiency

## Approaches

- 2 years WUE field trials at Nottingham > 20 genotypes
- 2 years WUE QTL detection in a new elite DH population
- AE Watkins and the 'improved' Gediflux collections - screened for key visual traits (leaf green area and leaf rolling) then cycle into mapping population

# Targeted traits

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## Activity 10. Take-all disease

1. To identify wheat germplasm resistance to Take-all
2. Genetic analysis of resistance to take-all in hexaploid and non-hexaploid wheats.
3. Introgress resistance to take-all from different non-hexaploid wheats.
4. Identification and characterisation of hexaploid wheat germplasm which reduce in a 1<sup>st</sup> wheat situation take-all inoculum build up (TAB) in soil.
5. To explore the genetic basis of take-all inoculum build up.

TAB assessments helped by the new Predicta B test (HGCA)

**Already many leads from WGIN 1 and other projects**

Richard Gutteridge, Hai-Chun Jing, Kim Hammond-Kosack (RRes)

# Targeted traits

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## Activity 11. Introgression of extreme resistance to Septoria leaf blotch from *Triticum monococcum* into hexaploid wheat

Most RL cultivars only have a Septoria resistance rating of 4-6 which is inadequate.

The new EU directive 91/414 to reduce the diversity of pesticides available which has long term implications to durable Septoria control

Hai-Chun Jing, Kim Hammond-Kosack (RRes)

# Targeted traits

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## Activity 11. Introgression of extreme resistance to Septoria leaf blotch from *Triticum monococcum* into hexaploid wheat

1. To complete the introgression of the *TmStb1* locus into different elite hexaploid wheats.
2. To test the efficacy of this novel resistance source under both glasshouse (single isolate tests) and field conditions (natural inoculum).
3. To provide closer linked markers to *TmStb1* locus that can be used by the breeders in marker assisted selections.
4. To screen for other alleles of *TmStb1* locus in *Tm* germplasm using defined flanking molecular markers and compare their efficacy.
5. Introgression of Septoria resistance using hexaploid wheat-*T. monococcum* chromosomal substitution lines

# Targeted traits

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## Activity 12. Resistance to aphids

The grain aphid, *Sitobion avenae*  
the bird-cherry oat aphid, *Rhopalosiphum padi*  
are major pests of wheat,  
vectoring virulent strains of Barley Yellow Dwarf Virus (BYDV),  
one of the most damaging cereal viruses in the world

Currently no commercial wheat varieties resistant to UK  
resident aphid species, although resistance to  
*S. avenae* has been found in *T. monococcum* (Migui & Lamb 2004)

Lesley Smart and John Pickett (RRes)

# Targeted traits

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## Activity 12. Resistance to aphids

1. To explore whether the differential response of hexaploid wheats to two different cereal aphid species has a genetic basis.

### *A promising observation in a BBSRC funded project*

A very limited number of lines from the Spark x Rialto mapping population that show selective response to *D. noxia* and *S. graminum*, has demonstrated differential attraction for *R. padi* and *S. avenae*.

### Approach

Selected R and S DH lines to *D. noxia* and *S. graminum* will be tested against *R. padi* and *S. avenae* in lab bioassays.

QTL identification, UK germplasm assessment for QTL

Then seek Defra LINK funds to continue

# Targeted traits – the field experiments

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- Activity 7. Crop adaptation for climate proofing
- Activity 8. Nitrogen use efficiency (NUE) and Quality QTLs linked to NUE
- Activity 9. Drought tolerance
- Activity 10. Take-all disease
- Activity 11. Introgression of extreme resistance to Septoria leaf blotch from *Triticum monococcum* into hexaploid wheat
- Activity 12. Resistance to aphids
- Activity 13. Exploring the interconnections between the three soil based traits (8, 9 and 10)
- Activity 14. Grain archiving
- Activity 15. Sub-contractor projects

# WGIN Research

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## Two overarching topics

**Generating and improving specific resources and tools**

**Targeted traits**

# Generating and improving specific resources and tools

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## Overall aim

To develop resources that can be used to improve the identification and then manipulate genetic mechanisms involved in the control of

- resistance to biotic stress,
- resource use efficiency,
- yield stability

# **Generating and improving specific resources and tools**

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**The following types of resources will be improved**

- 1. germplasm that cannot be developed within the timeframes of most funded grants**
- 2. genomic resources where the cost could not be justified for the benefit of a single piece of research**
- 3. 'off-the-shelf' resources available immediately for spin-off projects that can be funded by schemes such as LINK**

# Generating and improving specific resources and tools (JIC)

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- Activity 2. Production of Near Isogenic Lines (NILs)**  
Multiple traits – 3 years to produce, 2 years field phenotypes
- Activity 3. The Avalon x Cadenza Mapping population and pop<sup>n</sup> expansion at RRes using other funds**
- Activity 4. Paragon gamma and EMS mutant lines**
- DArT analysis of the gamma 480 lines
  - increase the gamma popn 430 to 5,000
  - 20 EMS lines exhibiting mutant phenotypes relevant to key traits will be crossed to lines with the maximum level of polymorphism with Paragon (Defra project - BIRST)
- 30 F2 phenotyped, DArT analysis on BULKS

# Generating and improving specific resources and tools (JIC)

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## Activity 5. AE Watkins and Gediflux Germplasm Collections

- **DArT genotyping**
- More extensive **allele mining** for genes involved in sustainability traits such as yield stability, resource use efficiency, and drought tolerance emerges from the literature
- **Selected Population development**  
Watkins line x Paragon  
to develop up to ten single seed descent or doubled haploid populations of 94 lines

**Activity 6. New Mapping populations** will align WGIN 2 with the international wheat genome sequencing effort

- Paragon x Chinese Spring
- Paragon x JIC Synthetic

# The funding available over the 5 years

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## WGIN 1 short extension

**Oct and Nov 2008 – 25K per month –  
establish the field trials  
staff continuity JIC**

## The new project

**1<sup>st</sup> Dec 2008 – 31<sup>st</sup> March 2009 start WGIN 2 year 1  
£175K - 50K will be put aside for the  
future sub-contractor activities**

**1<sup>st</sup> April 2009 – 1<sup>st</sup> full year of WGIN 2  
- 375K**

**Months 17- 60 - 1060 K based on project activity needs**

**Many thanks to all those who have provided  
valuable input so far**

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**Pre-proposal and sid3 writers**

**Simon Griffiths, John Snape**

**Malcolm Hawkesford, Peter Shewry**

**John Foulkes**

**Richard Gutteridge, Hai-Chun Jing, Kim Hammond-Kosack**

**Lesley Smart**

**All of you for suggesting research activities / topics over  
the past 18 months**