

WGIN – renewal 2008 to 2013



Kim Hammond-Kosack

6th WGIN Stakeholders Meeting 14th November 2008

Defra's vision for the new WGIN

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

WGIN Project management

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

- Activity 16. Website – New info on LINK projects**

- Activity 17. Electronic Newsletter – 2 per year**
- Activity 18. Annual Stakeholders Forum - Nov**
- Activity 19. International collaborations**
- Activity 20. Publicity**

WGIN Research

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

+ various sub-contractor activities

Targeted traits

Activity 7. Crop adaptation for climate proofing

Will crop vernalisation requirements be fulfilled in the future?

A defra requested activity

Approach

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

4, 6 and 8 weeks vernalisation

***Vrn1* locus - allele variation**

F₂ mapping population, map additional QTLs

Targeted traits

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

Targeted traits

Activity 9. Drought tolerance

- 30% of UK wheat is grown on drought-prone land and drought losses are on average 1-2 t ha⁻¹
- 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

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

- **Ability of the crop to withstand drought conditions during key growth phases**

John Foulkes, University of Nottingham

Targeted traits

Activity 9. Drought tolerance

This is a complex trait

There is an existing defra LINK project on this topic (LK0986) lead by Eric Ober's at Brooms Barn

Approaches

- 2 years WUE field trials at Nottingham with 6 genotypes with contrasting drought performance based on the LINK data (detailed plant / crop physiology / trait assessments)
- 2 years WUE QTL detection using the most appropriate and already publically available DH popⁿ + generation of one new DH popⁿ within WGIN 2 based on the emerging LINK data

Targeted traits

Activity 9. Drought tolerance

Approaches

- Assemble a collection of diverse germplasm from worldwide breeding organisations with drought tolerance programmes (e.g. CIMMYT, Marton-vásár, Adelaide, CAS)

While seed stocks are being bulked up screen for key visual traits (leaf green area and leaf rolling)

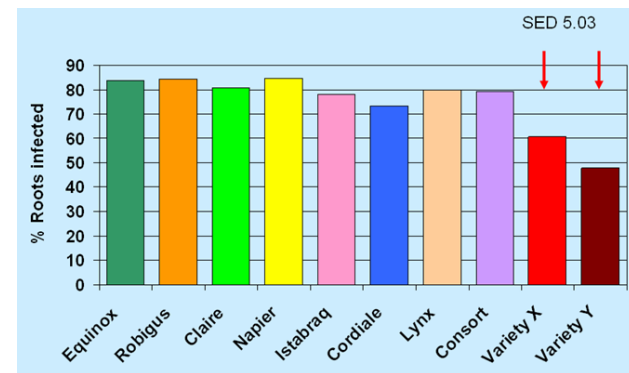
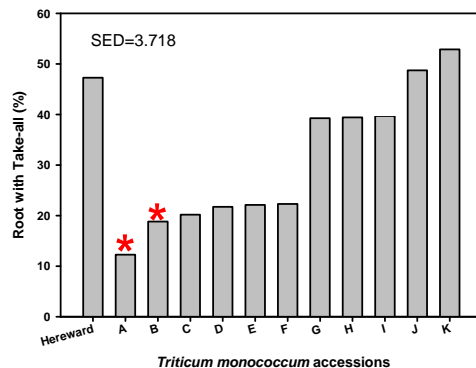
To become a resource for future work to explore the natural variation for specific traits and for association studies

Targeted traits

Activity 10. Take-all disease

Part 1 : Exploring tissue based resistance

Several leads from WGIN 1 and other non defra projects



1. To identify wheat germplasm resistance to take-all
focus - Watkin's collection, Vavilov collection, *T. monococcum* and other ploidys
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

Targeted traits

Activity 10. Take-all disease

Part 2 : Exploring take-all inoculum build up (TAB) in soil in a 1st wheat situation

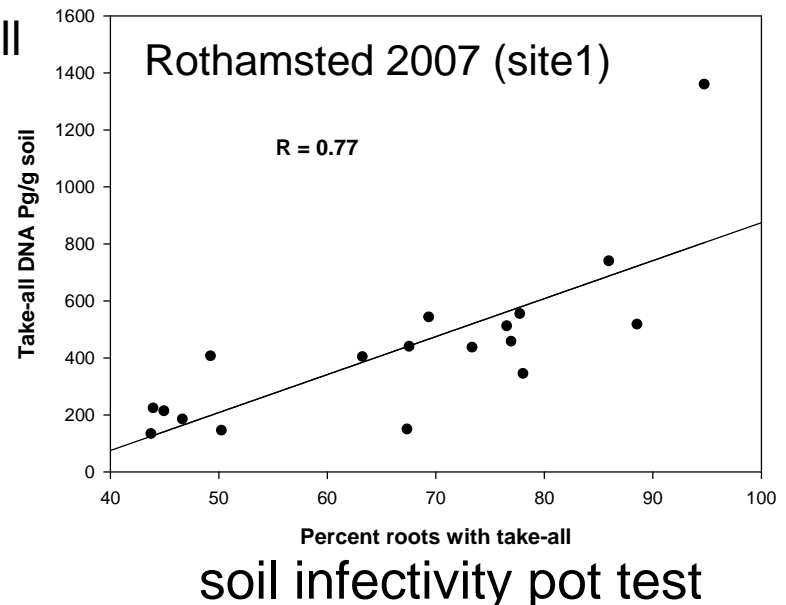
Already many leads from WGIN 1 and an HGCA project

4 years data from the NUE diversity trial (200kg / N)

TAB level	Cultivar
Low	Cadenza
Medium	Riband
High	Avalon
	Hereward

Predicta B tested at 3 sites

Take-all DNA levels in soil



Targeted traits

Activity 10. Take-all disease

Part 2 : Exploring take-all inoculum build up (TAB) in soil in a 1st wheat situation

1. Identification and characterisation of additional hexaploid wheat germplasm which reduce TAB in a 1st wheat situation
2. To explore the genetic basis of take-all inoculum build up using the Avalon x Cadenza DH population and the NUE trial

TAB assessments by the pot assay but may be helped by the new Predicta B test based on measure take-all DNA in the soil

Targeted traits

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

A defra requested activity

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

Disease rapidly increases during period of wet weather
- often difficult spraying conditions

Still heavy fungicide used to control this disease on most farms
- typically 2 – 4 sprays each season = £50 million per annum

Leaking of unused N can lead to diffuse pollution in surrounding water-course

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

Remains the No1 disease of UK wheat

Targeted traits

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.

Overall aim – To provide back cross generation 2 material to the breeders in 2009 / 2010 for pyramiding with existing *Stb* resistance genes and resistance QTLs

RRes

Targeted traits – the field experiments

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. Exploring the interconnections between the
three soil based traits (8, 9 and 10)**

- the best drought and / or take-all resistant
germplasm will be put into the NUE diversity
trial (years 4 and 5)

Activity 13. Grain archiving

Activity 14. Sub-contractor projects

Two types

- 1. Completely new traits** – selected following open traits discussion meetings
- 2. Additional specific assessments for existing WGIN 2 traits**
 - to bring in specialist skills to improve the depth of knowledge and inter-linked data sets obtained

Modest size funds available for each project (£10 - 20K)

Approach

Project applications during years 1 – 3

Approved by a specific sub-set of the management team

WGIN Research

Two overarching topics

Generating and improving specific resources and tools

Targeted traits

Generating and improving specific resources and tools

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

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

- 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**
- 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

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

WGIN 1 short extension

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

The new project

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

**1st April 2009 – 1st full year of WGIN 2
- 375K**

Months 17- 60 - 1060 K based on need

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

Pre-proposal and sid3 writers

Simon Griffiths, John Snape

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Project assistant – Elke Anzinger

defra - Kath Bainbridge and David Cooper

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

All who attended the regular WGIN management meetings

**The wheat breeders who provided comprehensive
feedback on the October version**

defra's overall mission

Improving the environmental footprint of farming



Targeted traits

- 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
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- Activity 14. Sub-contractor projects