

# Wheat Genetic Improvement Network WGIN

**Kim Hammond-Kosack**  
**Andy Phillips**



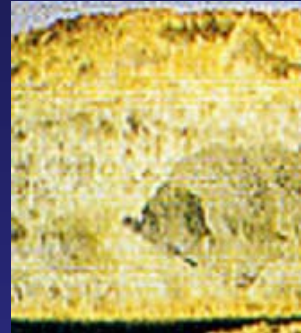
<http://www.wgin.org.uk>

16<sup>th</sup> February 2006

# The Defra WGIN



**Grain Producers and Utilisers**



**UK WHEAT BREEDING COMPANIES**

**MODEL SPECIES**

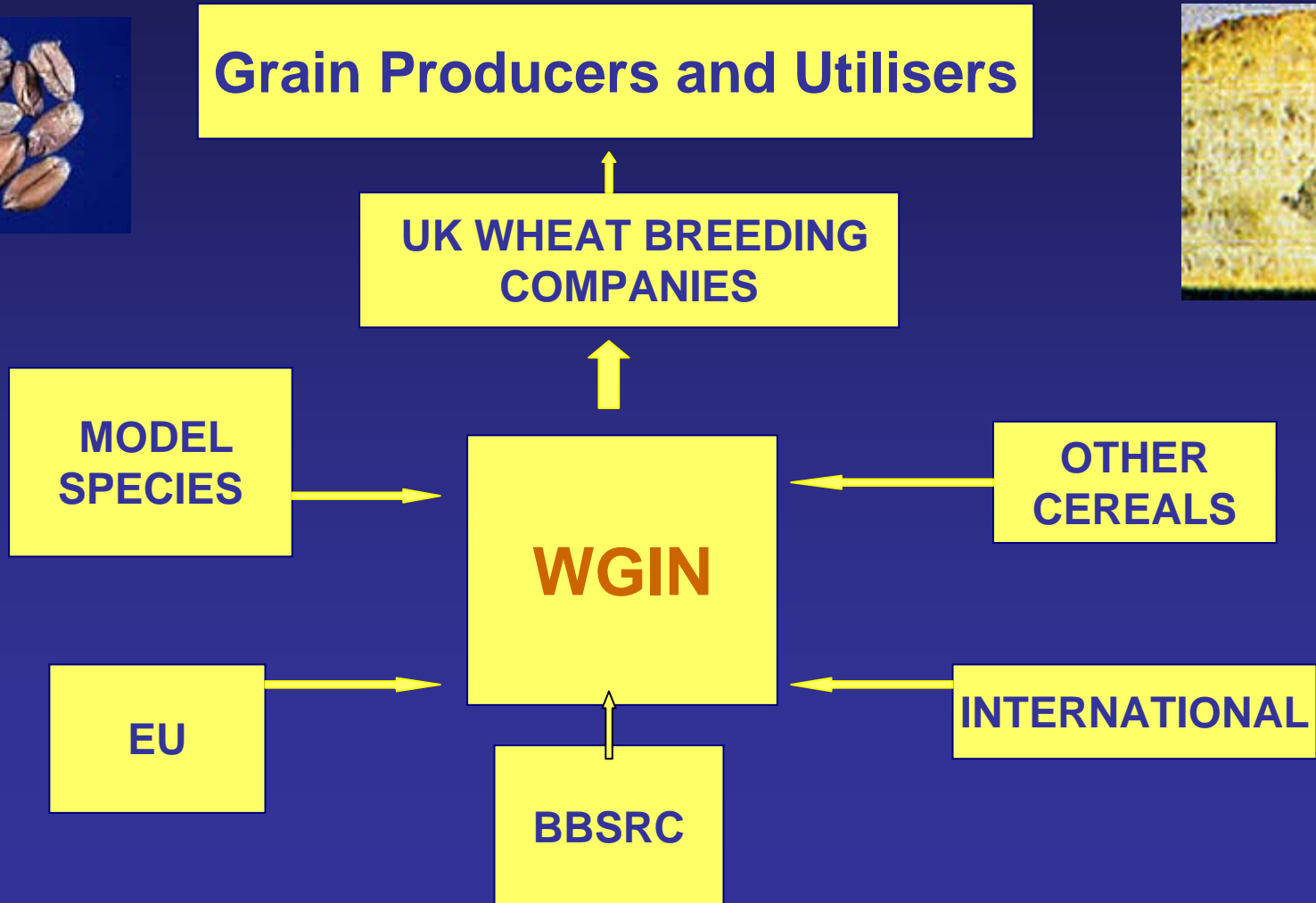
**OTHER CEREALS**

**WGIN**

**EU**

**INTERNATIONAL**

**BBSRC**



# THE Defra WGIN CORE PROJECT

## **Aim:**

**To Underpin Wheat Improvement by Plant Breeders**

## **Approaches:**

- 1. Characterisation and provision of genetic resources**
- 2. Genetic mapping and marker development**
- 3. Trait identification**
- 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**

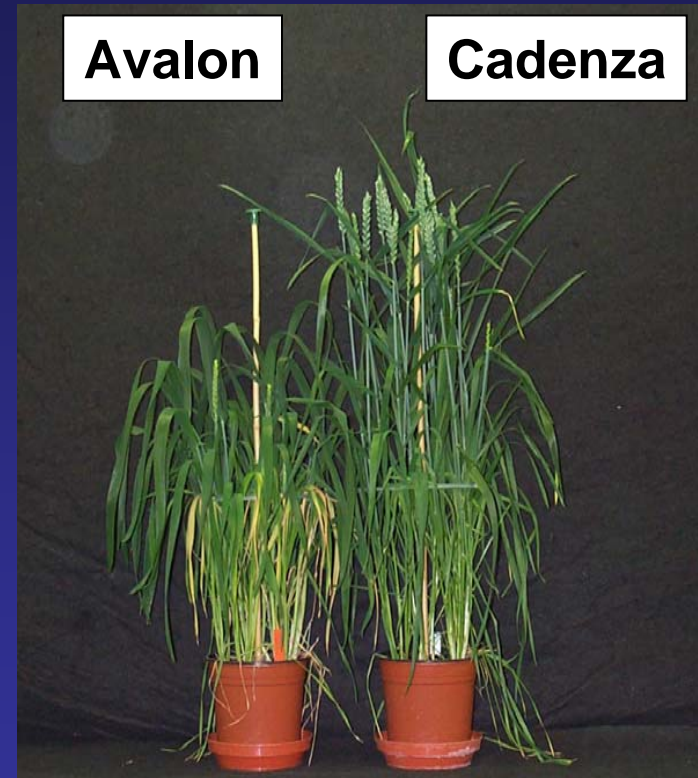
**Funded research partners:**

**Rothamsted Research and John Innes Centre**

# GENETIC MAPPING AND MARKER DEVELOPMENT

- **Establish a reference UK mapping population**

**Avalon x Cadenza -  
203 double haploid lines**



- **Switch to 'within the gene' molecular markers**  
**> 500,000 wheat ESTs available**

# TRAITS 1. Nitrogen Use Efficiency

## 2003/04 Field Trial

- 31 cultivars : 20 UK, 5 French, 5 German, 1 Polish
- 4 N levels : 0, 50, 200, 350 kg/ha
- measured N uptake efficiency (NupE), N utilisation efficiency (NutE) and N use efficiency (NUE)

## 2004/05 Field Trial

- 20 cultivars
- 2 N levels

## 2005/06 Field trial

- 24 cultivars / 3 N levels

Preliminary results show significant variation between cultivars in NUE at low N application, eg. Beaver (good) and Soissons (poor)

## TRAITS 2. Plant Architecture and Disease Resistance

***Septoria* leaf blotch**



***Fusarium* ear blight**



**+ Take-all disease**

# IDENTIFICATION AND GENERATION OF NOVEL VARIATION IN KEY TRAITS

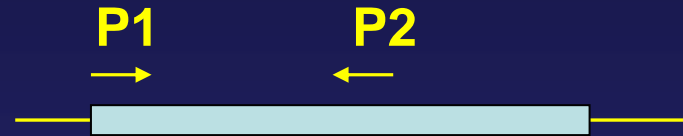
- 1. Establish TILLING technique on diploid and hexaploid wheats**
  - EMS mutagenised populations
  - Diverse germplasm collections
- 2. Provide a “cost recovery” service for the UK research community**



The Vavilov  
Institute,  
St. Petersburg  
Russia

# THE USE OF MUTAGENESIS AND TILLING TO IDENTIFY GENE VARIANTS

Gene of interest



Pool of PCR products (500 bp)

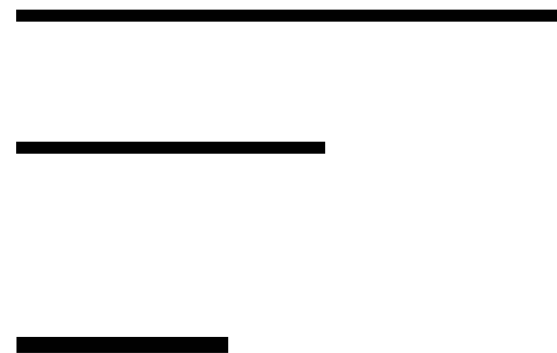


PCR product lines 1- 9

PCR product line 10

Single bp mis-matches cut in heteroduplex DNA by Cel1 enzyme

denaturing electrophoresis



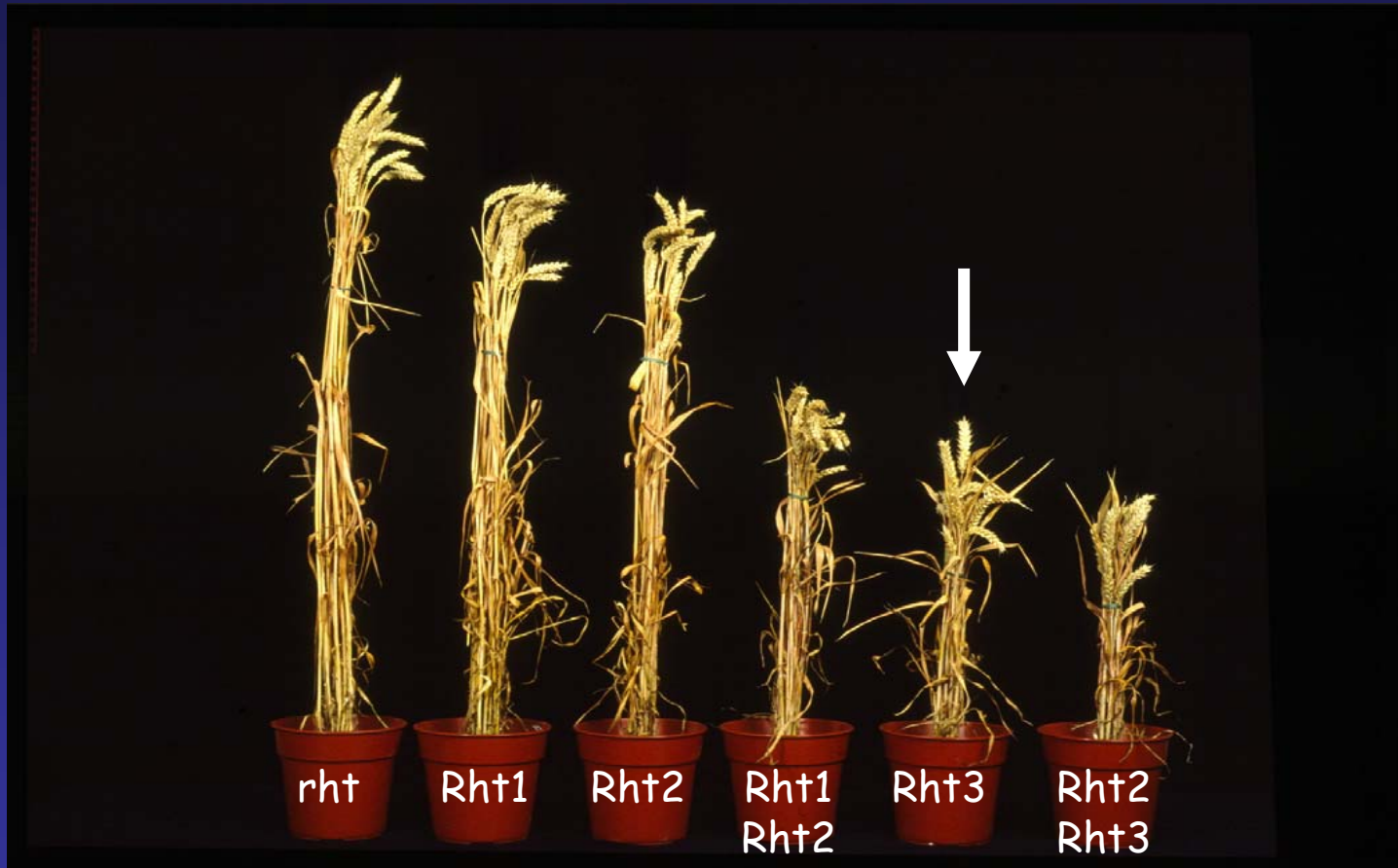
Wild-type allele

Variant allele

Assess lines carrying variant allele for novel phenotypes

# TILLING DEMONSTRATION PROJECT - 1

*Rht3* gene variants - wild-type phenotype extreme dwarf



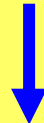
EMS mutagenised - Mercia *Rht3* line

# TILLING DEMONSTRATION PROJECT - 2

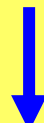
Global plant defence signalling regulators  
in **both** cereal and non-cereal species

## 3 COMPONENTS TO INDUCIBLE PLANT DEFENCE

PATHOGEN RECOGNITION

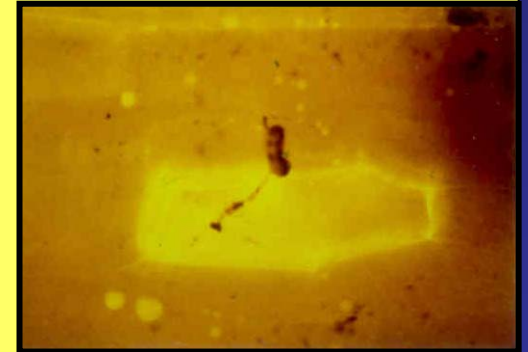


PLANT CELL SIGNALLING



*rar1, sgt1,  
npr1*

A MULTI-COMPONENT  
RESISTANCE RESPONSE



# THE WGIN MANAGEMENT TEAM

**DEFRA**

**Funded partners**

Rothamsted Research  
John Innes Centre

**Other Partners\***

ADAS  
University of Nottingham  
NIAB  
University of Bristol

**BBSRC\***

**UK Wheat breeders\***

**HGCA\***

( \*Ex-Officio Members)

# THE WGIN STAKEHOLDERS

Millers and Bakers

Brewers and Distillers

CCFRA

Livestock Feed Producers

Food processors

Agrochemical/Biotech Companies

Wheat Researchers

Field Trials Contractors

# THE DEFRA WGIN:DISSEMINATION, LIAISON AND COMMUNICATION

- Annual “Stakeholders’ Forum” (Nov)
- Annual “Small Grain Cereals Workshop” (with BBSRC) (March/April)
- “ Traits Workshops” (June 2004)
- Workshops with overseas partner organisations  
CIMMYT (Dec 2004), INRA (May 2005) etc
- Web Site ([www.WGIN.org.UK](http://www.WGIN.org.UK) )
- Six Monthly Electronic Newsletter
- E. mail address ([WGIN.defra@bbsrc.ac.uk](mailto:WGIN.defra@bbsrc.ac.uk))

# THE WIDER ACTIVITIES OF WGIN

- 1. Liaison with other Defra programmes on wheat**
- 2. Liaison with other UK bodies supporting wheat research:**
  - BBSRC, HGCA, FSA
- 3. Liaison with overseas organisations:**
  - CIMMYT/ICARDA (International)
  - USDA/Agriculture Canada (N.America)
  - CSIRO/Waite Institute, Adelaide (Australia)
  - DSIR Crop and Food (New Zealand)
  - CSIR (South Africa)
  - EU (FP6/7)

<http://www.wgin.org.uk>



## **RRes**

**Peter Shewry**  
**Andy Phillips**  
**Kim Hammond-Kosack**  
**Katie Tearall**  
**Hai-Chun Jing**  
**Elke Anzinger**

## **JIC**

**John Snape**  
**Robert Koebner**  
**Leodie Albert**  
**Simon Orford**

[WGIN.defra@bbsrc.ac.uk](mailto:WGIN.defra@bbsrc.ac.uk)

# WGIN Traits Meeting

## June 10<sup>th</sup>, 2004 at RRes

### Breeders' target traits

(in order of priority):

Hagberg Falling Number

Septoria resistance

Second wheat syndrome

Orange blossom midge

Ergot

Lodging resistance

Barley Yellow Dwarf Virus

Other insect pests

Nitrogen use efficiency

### Progress (Feb 2006)

- LINK project funded £2.2M (2006)
- LINK project renewed
- LINK concept note accepted (2006)
- LINK project running
- LINK project running
- Some activity within core project (Rht)

- Defra target but no breeder support

**Sustainability and resource use efficiency**

# Population resources for TILLING

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## HEXAPLOID

### Headrows

- Cadenza population ~ 4,000 lines at M3
- Single M2 ear of each line will be sent to Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvasar, Hungary - HEALTHGRAIN
- Sowing in March
- Plants will be field phenotyped and seed bulked
- All lines also to be fixed by SSD in Hungary

Paragon population (JIC)

SSD ~4,000 lines to M4

# Population resources for TILLING

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## DIPLOID

### EMS populations :

- 1,200 M2 lines of MDR050 (JIC; 0.3% EMS?)
- 1,800 M1 lines of MDR308 (RRes; 0.3-0.5% EMS)

### Low-energy ion beam irradiation :

- ~ 5,000 seeds treated with three dosages

# Population resources for TILLING

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## Accessions for EcoTILLING

- UK (NIAB AND NUE) - elite varieties
- GEDIFLUX
  - 600 accessions
  - UK elite varieties
- HEALTHGRAIN
  - 150 accessions
  - major European bread grains

Compiled varieties list available

- DIPLOID: - 263 accessions (Vavilov)

# TILLING status

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TILLING now operational

TILLING service offered from  
April 2006

- RRes staff
- FEC cost recovery

Primer design service through  
Wheat EST Tool - alignment  
and sorting utility from Rowan  
Mitchell (RRes)

