General enquiries on this form should be made to:
Defra, Procurements and Contracts Division (Science R&D Team)
Telephone No. 0207 238 5734
E-mail: research.competitions@defra.gsi.gov.uk

defra
Department for Environment Food and Rural Affairs

SID 4 Annual/Interim Project Report for Period 2012

- **ACCESS TO INFORMATION**
  The information collected on this form will be stored electronically and will be required mainly for research monitoring purposes. However, the contents may be used for the purpose of notifying other bodies or the general public of progress on the project. Defra may also disclose the information to any outside organisation acting as an agent authorised by Defra to process research reports on its behalf.
  Defra may be required to release information, including personal data and commercial information, on request under the Environmental Information Regulations or the Freedom of Information Act 2000. However, Defra will not permit any unwarranted breach of confidentiality or act in contravention of its obligations under the Data Protection Act 1998. Defra or its appointed agents may use the name, address or other details on your form to contact you in connection with occasional customer research aimed at improving the processes through which Defra works with its contractors.
- This form is in Word format and boxes may be expanded or reduced, as appropriate.

Project details

1. Defra Project code: IF0146
2. Project title: Defra - Wheat Genetic Improvement Network - WGIN
3. Defra Project Manager: Katherine Bainbridge
4. Name and address of contractor: Rothamsted Research, Harpenden, Herts
   Postcode AL5 2JQ
5. Contractor's Project Manager: Prof Kim E Hammond-Kosack
6. Project: start date 01/12//2008
   end date 31/11/2013

Scientific objectives

7. Please list the scientific objectives as set out in the contract. If necessary these can be expressed in an abbreviated form. Indicate where amendments have been agreed with the Defra Project Manager, giving the date of amendment.

01 Project management (RRes); 02 Production of Near Isogenic lines (JIC); 03 The Avalon x Cadenza Mapping population (JIC); 04 Paragon gamma and EMS mutagenised populations (JIC); 05 AE Watkins and Gediflux collections (JIC); 06 New mapping populations to align WGIN 2 with the International wheat genome sequencing (JIC); 07 Insect Resistance (RRes); 08. Nitrogen use efficiency (NUE) and Quality QTLs linked to NUE (RRes); 09 Drought tolerance (University of Nottingham); 10 Take-all disease (RRes); 11 Introgression of extreme resistance to Septoria leaf blotch from Triticum monococcum into hexaploid wheat (RRes);12 Exploring the Interconnections between the three soil based traits; 13 Grain archiving; 14. Sub-contractor projects (To be determined during the project) 15. Website; 16 Electronic Newsletter; 17 Annual Stakeholders Forum; 18 Focussed workshops; 19 International collaborations; 20 Publicity

Summary of Progress

8. Please summarise, in layperson's terms, scientific progress since the last report/start of the project and how this relates to the objectives. Please provide information on actual results where possible rather than merely a description of activities.

Objective 1. Three management meetings were held during the year (1) 21st February 2012 at RRes, Harpenden (2) 28th June 2012 at JIC, Norwich and (3) 6th November 2012 at University of Nottingham. All minutes and ppts have been posted on the WGIN website.

The progress on the 11 wheat research **objectives (2 through 13)** is summarised in an accompanying word document.

Objective 14 Subcontractor projects: One subcontractor project has already been completed and the final report is available from the WGIN website. This subcontractor has gave a final a summary presentation at the Feb 2012 management meeting. The 2nd subcontractor, is now in the 2nd and final year of the project. An interim report for the year 2 activities has already been received and approved

Objectives 15, 16 and 17. Website, newsletter, stakeholder meeting. The website has been updated on several occasions. One electronic Newsletter was produced and distributed. This Newsletter describes how the WGIN project still fits very well into the wider UK funded wheat research community. The rest of the Newsletter describes the breath and depth of unencumbered resources and tools generated throughout WGIN that are available for use by the UK and international wheat research community. The annual Stakeholder meeting was held in November. Approximately 80 people attended from industry and academia. This topic of this year's panel discussion was switch in June, following discussions and concerns raised by the UKs commercial wheat breeders arising from the unseasonal prolonged wet weather. The discussion on the new topic "Emerging Disease Patterns"– was well received by all. The originally intended topics of drought and /or nutrient use efficiency have been deferred until,2013

Objective 19. International workshop. No international workshop was organised during 2012. Instead plans are developing for a visit to the Vavilov Institute in St Petersburg in Russia in July 2013.

Objective 20. Scientific outreach activities
See list below in section 11

Amendments to project

9. Are the current scientific objectives appropriate for the remainder of the project? ..... **YES** ☒ **NO** ☐

If **NO**, explain the reasons for any change giving the financial, staff and time implications.

Contractors cannot alter scientific objectives without the agreement of the Defra Project Manager.

Mr Richard Gutteridge head of the Take-all research at RRes took early retirement at the beginning of WGIN project year 4. Richard has been replaced on the RREs staff by his finishing and highly respected and well known PhD student Ms Vanessa McMillan. Throughout her Take-all PhD studies , Vanessa helped Richard, prepare, sample and harvest all the WGIN take all trials. Since completing her PhD thesis in Sept 2013, Vanessa is already up to speed with all the WGIN trials and WGIN data.

Progress in relation to targets

10. (a) List the agreed milestones for the year/period under report as set out in the contract or any agreed contract variation.

It is the responsibility of the contractor to **check fully that all milestones have been met** and to provide a detailed explanation when they have not been achieved.

Milestone		Target date	Milestones met	
Number	Title		In full	On time
01	Project management	30/11/2013		✓
02	Production of Near Isogenic Lines	01/03/2013		✓
03	The Avalon x Cadenza mapping population	30/11/2013		✓
04	Paragon gamma and EMS mutagenised populations	01/01/2011	✓	
05	AE Watkins and Gediflux collections	01/07/2011	✓	
06	New mapping populations	01/03/2013		✓

07	Insect Resistance	01/04/2010	✓	
08	Nitrogen use efficiency (NUE) and Quality QTLs linked to NUE	30/11/2013		✓
09.1	Drought tolerance: Complete phenotyping and data analysis for drought tolerance traits in elite winter wheat varieties in 2009/10 &10/11	30/11/2011	✓	✓
O9.2	Drought tolerance: QTL analysis to identify genome locations associated with WUE and drought tolerance traits completed.	30/11/2012		✓
O9.3	Drought tolerance: Complete development of one new DH population in an elite modern background segregating for drought-tolerance traits.	31/03.2012		✓
O9.4	Drought tolerance: Association genetics analysis of drought tolerance traits using AE Watkins & Gediflux collections completed.	28/02.2013		✓
O9.5	Drought tolerance: Collation of diverse germplasm collection (cultivars, advanced lines) from worldwide drought-tolerance wheat breeding programmes completed.	28/02/2013		✓
10	Take-all disease	30/11/2013		✓
11	Introgression of extreme resistance to Septoria leaf blotch from Triticum monococcum into hexaploid wheat	30/11/2012		✓
12	Exploring the Interconnections between the three soil based traits	30/11/2013		✓
13	Grain archiving	30/11/2013		✓
14	Sub-contractor projects	30/11/2013		✓
15	Website	30/11/2013		✓
16	Electronic Newsletter	30/11/2013		✓
17	Annual Stakeholders Forum	30/11/2013		✓
18	Focused workshops	30/11/2009	✓	
19	International collaborations	30/11/2013		✓
20	Publicity	30/11/2013		✓

(b) Do the remaining milestones look realistic?..... **YES** ☒ **NO** ☒
If you have answered **NO**, please provide an explanation.

Objective 09.2 The QTL analysis has been delayed to 30/11/2013 since it is necessary to repeat the Rialto x Savannah DH population irrigation experiment at Nottingham in 2012-13 due to the above-average rainfall in 2011-12 and the lack of a significant drought in the unirrigated treatment at the experimental site at Nottingham in 2012

Objective 11. Introgression of extreme resistance to Septoria leaf blotch from Triticum monococcum into hexaploid wheat. Although this activity is running late the new introgression strategy (described in the year 3 sid4) is now well underway.

Publications and other outputs

11. (a) Please give details of any outputs, e.g. published papers/presentations, meetings attended during this reporting period.

Peer Reviewed:

Parry MAJP, Hawkesford MJ (2012) An integrated approach to crop genetic improvement. J Integr Plant Biol. 54, 250-259. [50:50:50]

Hawkesford MJ (2012) Improving nutrient use efficiency in crops. eLS (electronic encyclopedia of life science. Wiley. www.els.net

WGIN resources used in:

Gasperini, D., A. Greenland, P. Hedden, R. Dreos, W. Harwood & S. Griffiths (2012) Genetic and physiological analysis of Rht8 in bread wheat: an alternative source of semi-dwarfism with a reducedmodified sensitivity to brassinosteroids. Journal of Experimental Botany.

COS markers

Griffiths, S., J. Simmonds, M. Leverington, Y. Wang, L. Fish, L. Sayers, L. Alibert, S. Orford, L. Wingen & J. Snape (2012) Meta-QTL analysis of the genetic control of crop height in elite European winter wheat germplasm. Molecular Breeding, 29, 159-171.

Avalon x Cadenza

Lukac, M., M. J. Gooding, S. Griffiths & H. E. Jones (2012) Asynchronous flowering and within-plant flowering diversity in wheat and the implications for crop resilience to heat. Annals of Botany, 109, 843-850.

Avalon x Cadenza NILs

Non-Peer reviewed:

Hawkesford MJ (2012) Nitrogen use efficiency and long and longer term experiments at Rothamsted. Manuscript for XIV Congreso Internacional en Ciencias Agrícolas, Mexicali, Mexico, October 2011.

PBI 100 Celebration. Poster including WGIN follow on to PBI outputs (20th June JIC)

Foulkes MJ, Gaju O, Allard V, Martre P, Snape J, Le Gouis J ,Griffiths S, Sylvester-Bradley R (2012) Increasing the efficiency of water and nutrient use of crops by exploitation of novel germplasm, traits and technologies Proceedings of12th Congress of the European Society for Agronomy University of Helsinki, Finland 20-24 August 2012

Popular press articles:
Hawkesford MJ (2012) The diversity of nitrogen use efficiency for wheat varieties and the potential for crop improvement. Better Crops, 12, number 3. pp. 7-9. http://www.ipni.net/publication/bettercrops.nsf

Oral Scientific Presentations:

MJH Invited plenary speaker at Indian biotechnology conference, Gudjarat, India (March)
MJH Invited lecturer, Yangling, China (Sept)
MJH Phenotyping Network meeting, presentation (Oct)

Simon Griffiths invited speaker describing WGIN at:
Eucarpia General Congress (Budapest, 23rd May)
Association of Applied Biologists (Dec 5th and 6th University of East Anglia)
OptiChina workshop (University of Barcelona, 18th September)

Cathy Mumford and Simon Orford spoke at numerous WGIN field walks.

Foulkes et al. (see above) Invited talk at Proceedings of12th Congress of the European Society for Agronomy University of Helsinki, Finland 20-24 August 2012

Foulkes et al. Invited talk on “High throughput phenotyping for drought tolerance traits in wheat” at The China - EU Workshop on Phenotypic Profiling and Technology Transfer on Crop Breeding, University Barcelona, 17-19 September 2012

Scientific Discussions:

MJH Visit and presentations at Nofirma, Oslo (July)
MJH Invited participant Wheat Yield workshop, Hennan Seeds, Kaifeng, China (June)
MJH Nitrogen Ideas Lab (Dec)

Simon Griffiths represented WGIN a NIAB 'map your breeder' event 2nd July.
Sarah Hendry and Judicaelle Hammond visit to JIC 7th August

Scientific Outreach activities/articles
MJH Parliamentary reception (BBSRC and the bioeconomy) networking (March)
MJH Discussion with farmer/industry at Cereals 2012 (June)
MJH Visiting Indian delegation (May)
MJH Tour of WGIN experiments with local farms group
MJH Foresight Workshop on Nitrogen (Sept)
MJH NABIM Research Day, presentation of WGIN and other projects,

Simon Langton school GROW project.

KHK described the overall WGIN project to 30 University of Nottingham Plant Sciences MSc students in Feb 2012.

WGIN Drought tolerance poster at Nottingham stand at annual Cereals event 13-14 June 2012

WGIN Take-all disease, funding wheat germplasm with either root resistance or Low inoculum build-up was described in 3 posters and a10 mini-plot display at the Rothamsted Research stand at the Cereals 13-14 June 2012. This display was geneated by Kim Hammond-Kosack and Vanessa Mcmillan and delivered / discussed with farmers, farm advisors and the AgIndustry over both days by Richard Gutteridge.

Rothamsted Resaerch Day (October 2012). Vanessa McMillan gave an oral presenation on the WGIN Take-all inoculum project and reported the successful 4 years of wheat cultivar rotation trial designed to reduce Take-all disease

(b) Have opportunities for exploiting Intellectual Property arising out of this work been identified? ..... **YES** ☐ **NO** ☐

If **YES**, please give details.

This project is entirely IP free.

(c) Has any other action been taken to initiate Knowledge Transfer?..... **YES** ☒ **NO** ☐

If **YES**, please give details.

See above section 11, Scientific outreach activities

Future work

12. Please comment briefly on any new scientific opportunities which may arise from the project.

These projects have begun (or approved) in this reporting period, include JIC, and make extensive use of WGIN resources:

BBSRC Crop Club 'Development and validation of a flexible genotyping platform for wheat' - 3 years duration

FP7 ADAPTAWHEAT-Genetics and physiology of wheat development to flowering: tools to breed for improved adaptation and yield potential

BBSRC LINK Genetic improvement of wheat to reduce the potential for acrylamide formation during processing

FSOV G "Reducing height without increasing diseases"

Marie Curie Fellowship: FTPUQ— Flowering Time Pathways Underlying Quantitative variation in heading date of
Wheat

These projects have begun (or approved) in this reporting period, include RRes, and make extensive use of WGIN resources:

A new PhD project will commence in 2013 involving combining the use of plant breeding and chemistry to further reduce take-all inoculum build-up in 1st wheat crops and therefore secure a better yield for 2nd wheats. Funded solely by industry. A pre-trial has been funded and sown for the 2012-2013 season to provide additional information ahead of the start of this project.

Many of the genotyping projects now ongoing with the BBSRC funded pre-breeding Lola at The University of Bristol (Edwards lab), John Innes Centre (Griffiths lab) are taking advantage of WGIN identified genotypes. In addition further wheat phenotyping within the Lola project , by the Hawkesford, Hammond-Kosack, Foulkes and Pickett Lab is using phenotyping assays originally developed within WGIN.

On 9th Jan 2013, the UK wheat breeders will collectively be discussing and reassessing their current priority traits list at PSPB headquarters. This this will then be circulated to the entire WGIN management team and discussed in detail at the next WGIN MM in March 2013. This exercise was last done 2 years ago and should reveal which new and difficult targets are emerging for the wheat industry.

In March 2013, WGIN is organising a 2nd Avalon x Cadenza double haploid mapping population workshop at the JIC. This will bring together all the academic and industry based researchers and PhD students using the original mapping population and now the extended mapping population for phenotyping specific new traits of interest as well as fine mapping traits previously discovered to be segregating in this population. Each researcher / student will be given the opportunity to present /discuss their project. In addition, the group at Bristol (Edwards lab) will explain the marker density now available for both populations. We anticipate between 30 and 50 attendees.

Declaration

13. I declare that the information I have given is correct to the best of my knowledge and belief.

Name	Prrofessor Kim Hammond -Kosack	Date	31st December 2012
Position held	Programme Leader Wheat Pathogenomics , Rothamsted Research PI on WGIN project		