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## 16<sup>th</sup> WGIN Stakeholders' Meeting

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16<sup>th</sup> November 2018

@ Fowden Hall, Rothamsted Conference Centre, Harpenden, AL5 2JQ

### Programme

10:00 **Arrival, Tea and Coffee**

10:15 Welcome – **Peter Shewry** *RRes*

10:20 Wheat Market Update – **Daniel Rooney** *AHDB*

A snapshot of the current state of global and domestic wheat markets. Looking back at key events shaping the current picture and looking forward to key watch points for the year ahead.

### The Wheat Genetic Improvement Network

10:40 WGIN3 Legacy and Overview of the WGIN4 Core Project – **Kim Hammond-Kosack** *RRes*

For the past 14 years, WGIN has provided a research platform for the delivery of tools, resources, bioinformatics information and expertise for the identification of naturally occurring (useful) genetic variation in new traits. While industry breeding programmes tend to have a broad focus on crop varieties with greater yields and improved quality, characteristics that might improve the resilience and sustainability (e.g. abiotic/biotic stress, nutrient use efficiency, canopy architecture) do not receive as much attention as commercial breeding targets. WGIN focusses on these traits, but also acts as a catalyst giving rise to multiple and diverse areas of research which are taken up by breeders and other funding agencies. Importantly, WGIN is also helping to train the next generation of crop scientists. Defra has now funded WGIN for a further 5 years. In this talk, I will provide some highlights from the WGIN3 legacy so far and give an overview of the new WGIN4 project.

11:00 Germplasm Development Highlights and Plans for WGIN 4 – **Simon Griffiths** *JIC*

UK wheat breeding leads the world in fine tuning the performance so that new varieties achieve new highs in grain yield, stability, end use quality, and disease resistance. However, some wheat breeding challenges are always present. They limit the potential gains that might otherwise be achieved. This includes problems like susceptibility to lodging. In addition, the target environment of our breeding industry is changing. The UK climate is increasingly volatile. Traits like drought resistance could increase UK wheat yield stability and help farmers cope with one 'exceptional' season after another. WGIN is developing special resources which allow new genetic variation controlling these traits to be identified and then to precisely map the genes responsible, and even the DNA differences which make one version of a gene better than another. In this presentation we will provide an overview of progress in this area describing plans for new lodging screens, gene combinations for better UK drought tolerance, and common resources that allow any researcher to do the same for their trait of interest at the click of a button. New variation screened is from global elite germplasm collections and wild wheat relatives. This work benefits greatly from links to the wider UK wheat network, most notably Designing Future Wheat. The use of the DFW pipeline for the deployment of WGIN discoveries will be described.

11:20 The Evolving WGIN Nitrogen Variety Trial – **Malcolm Hawkesford** *RRes*

The WGIN sponsored Nitrogen Variety trial was first harvested in 2004 and now comprises 15 years of data covering 71 varieties to date, including a core set of 15 varieties grown in most years. Four rates of N application have been applied (0, 100, 200 and 350 kg N ha<sup>-1</sup>), deliberately chosen to stretch the responses of the varieties in terms of yield, grain nitrogen and nitrogen use efficiency parameters. The long-term nature of the trial has also provided an indication of stability of all of these traits with very contrasting annual weather conditions. In addition, the trial has enabled many spin-out projects targeting quality, micronutrient interactions, remote (drone) sensing. In 2019 the trial will include standard and reduced crop protection

treatments (fungicide, insecticide) to allow interaction between variety, N and diseases to be evaluated. In addition, the trials will be used to develop drone-based disease detection.

11:40 **Tea, Coffee**

12:00 **Disease Resistant Wheat – Vanessa McMillan RRes**

Fungal diseases are a major constraint on wheat production in the UK and worldwide. Within the WGIN project, phenotyping of diverse germplasm collections and mapping population experiments are in progress to identify and characterise novel sources of resistance against three problematic root and foliar diseases of wheat crops, namely take-all root disease, Septoria leaf blotch and yellow rust. The overall aim is to improve the resilience of the wheat crop against biotic stresses and protect yield potential.

## Designing Future Wheat

12:20 **An Introduction to DFW – Simon Griffiths JIC**

BBSRC has funded an integrated programme bringing together wheat research at RRes, Earlham Institute, Quadram Institute, NIAB, EBI, JIC and the Universities of Nottingham and Bristol around four work packages. I will provide a brief overview of this programme, and the research being carried out.

12:30 **The Wheat-Rust Conflict: Shifty Enemies and the Long Reach of Genomics – Diane Saunders JIC**

Wheat rusts have been associated with crop failures and famine throughout history. Recent outbreaks of stem and yellow (stripe) rust in Europe have been linked to expansions in pathogen geographic distribution, exotic incursions and increased virulence. For example, in the past two decades wheat yellow rust, caused by *Puccinia striiformis* f. sp. *tritici* (PST), has seen the emergence of new races that are adapted to warmer temperatures, have expanded virulence profiles, and are more aggressive than previous races, leading to wide-scale epidemics. Our rapid “field pathogenomics” strategy, that uses gene sequencing of infected wheat leaves taken directly from the field, has enabled us to gain insight into the population structure of PST over successive seasons. For instance, our analysis uncovered a dramatic shift in the PST population in the UK and supports the hypothesis that a recent introduction of a diverse set of exotic PST lineages may have displaced the previous populations. In addition, we uncovered potential seasonal and varietal specificity for certain genotypes of PST and the first evidence of mutations in the demethylation inhibitor (DMI) fungicide target gene, *cyp51*. Furthermore, by expanding our technique to wheat stem rust, we have also gained new insight into the recent emergent outbreaks of this disease in Europe. Developing and applying a genomics-driven approach to pathogen surveillance, we have generated valuable new knowledge that could be extremely useful for various aspects of disease management.

## New UK Wheat Research Activities

12:50 **Trehalose 6-phosphate, a Sugar for All Seasons in Yield Improvement – Matthew Paul RRes**

Since the discovery in our lab that the sucrose signal, trehalose 6-phosphate (T6P), is an inhibitor of the feast / famine protein kinase, SnRK1 in *Arabidopsis* (Zhang et al. 2009) there have been a growing number of opportunities to use this finding in crop improvement. Significantly, T6P regulates metabolic pathways and sucrose utilisation processes that have been modified as part of the crop domestication process. It looks likely that further perturbation of T6P may be possible in yield improvement in a range of environments. Genetic modification (GM) of the pathway has provided one of very few examples of yield improvement in a major food security crop in the field under contrasting water availabilities (Nuccio et al. 2005; Oszvald et al. 2018). Work at IRRI has shown that selection of a trehalose phosphate phosphatase gene in rice confers better germination under flooding enabling the development of rice that can be seeded directly instead of the current need to transplant plantlets to flooded paddies. We are currently using newly available genome sequence availability plus T6P chemical intervention tools (Griffiths et al. 2016) to progress opportunities for wheat yield improvements by modifying T6P through genetics and chemistry.

13:10 **Lunch**

14:10 **IWYP Root<sup>y</sup>: a Root Ideotype Toolbox to Support Improved Wheat Yields – Eric Ober NIAB**

The goal of this new IWYP project is to support increases in wheat yield potential by optimising wheat root system architecture. Roots must efficiently supply a greater demand for water and nutrients in higher yielding crops without draining any more carbon away from grain formation than is necessary to provide this function. The project utilises wheat genomics, germplasm resources, ‘speed breeding’, physiological and genetic understanding of root growth/development, high-throughput root phenotyping methods and the creation of novel genetic variation ready for exploitation. We will establish a pipeline to validate the impact of root ideotype on yield, based on the use of: (1) recently cloned genes, (2) known QTL, and (3) *de novo* natural and artificial allele discovery. This pipeline provides staggered delivery of validated root ideotypes that

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will feed the breeding activities carried out by the IWYP Hub, participating breeding companies, and wider wheat breeding networks. By focusing on roots, this approach complements IWYP work on above-ground traits, ultimately providing the knowledge and resources to allow above and below ground approaches to be combined in the future to maximise genetic gains for yield.

14:30 Long Term Wheat Experiments at Rothamsted: the Next 175 Years! – **Jon Storkey** RRes

In the tradition of long term field experimentation, for which Rothamsted is famous, a new largescale experiment has been set up at two sites (Brooms Barn in Suffolk and Harpenden) supported by the Lawes Agricultural Trust. The experiment has large main plots in either a three, five or seven course rotation with two years of wheat in each rotation. Every phase of each rotation is present every year either as a ploughed plot or minimum tillage (sown with a Weaving direct drill). Finally, the main plots are split and green compost added to half of the plots at strategic points in the rotation. There is also the flexibility within the design for testing contrasting crop protection strategies. The experiment is intended to serve as a platform for integrating different disciplines into a systems approach to improving the sustainability of arable cropping. The wheat plots are currently sown with KWS Zyatt but there is the opportunity to use the experiment to study the interaction of genetics with contrasting cropping systems.

### Loss of Chemistry: Implications for the wheat crop

14:50 European Legislation and Fungicide Resistance – is this a Perfect Storm for Wheat Disease Control? – **Rosie Bryson**, *BASF SE, Senior Principal Scientist, Fungicide Development Europe*

Innovation should lie at the heart of the development of new solutions for the control of cereal pathogens in Europe. However, agricultural solution providers must balance the risks against the rewards. In other words, they need to work within the existing regulatory framework of EC 1107/2009 in order to defend actives that are already on the market whilst at the same time develop new solutions to replace those that may be lost due to obsolescence or regulatory restrictions. In addition, particularly in Western Europe, the intensive use of fungicides has led to pathogen resistance to some key modes of action with others currently under threat. This balance of risk versus reward not just in relation to economic business performance but also effective disease control comes at a cost in terms of budget and resource. The logical way forward is a truly integrated approach where all relevant technologies can be utilised to reduce the impact of plant pathogens and to maintain high levels of yield and quality in the European wheat crop.

15:10 **Panel discussion** with **Alan Dewar** (*Independent Crop Protection Consultant*), **Neil Paveley** (*Director - Crop Protection, ADAS*), **David Feuerhelm** (*Wheat Breeder, Syngenta*), **Keith Norman** (*Independent Consultant, former Technical Director of Velcourt*), **Russell McKenzie** (*Farmer, Member of AHDB Monitoring Farms Programme*), **Rosie Bryson** *BASF* & **Peter Shewry** (*chair*) RRes

Please submit questions for the panel in advance to [peter.shewry@rothamsted.ac.uk](mailto:peter.shewry@rothamsted.ac.uk)

16:10 General discussion on the day and future WGIN panel discussion topics

16:30 **Tea and coffee**

17:15 Depart

**Please note:**

- You can still register for this event here <https://www.eventbrite.com/e/16th-wgin-stakeholders-meeting-tickets-51143795469>

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