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University of Bristol



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Sometimes occupying the space between two disciplines can be a lonely place, with each side seemingly so near - yet in practice, so far. So thanks are due to GARNet, who are helping me and others to walk the bridge between the familiar ground of Arabidopsis and the cereal crops which are the primary focus of the Monogram conference.

I am a Postdoctoral Research Associate at the Sainsbury Lab, University of Cambridge. This is my first postdoc, which I've been working on for nine months. Prior to that, I did my PhD in Nottingham looking at root architecture in *Arabidopsis thaliana*. So why, you might ask, am I now doing a project concerning nitrate use efficiency and shoot branching in the model grass *Brachypodium distachyon*?

Making the jump from working with dicots to monocot grasses was a learning curve; there are whole new anatomies, physiologies, developmental differences, layers of complexities, differences in timescales and general little quirks that one does not appreciate when immersed solely in the Arabidopsis world. But like a recent born-again convert who instantly seeks to convert others, I was impressed by the many benefits of working with Brachypodium, and hoped to convince some cereal skeptics that Brachypodium really can be a useful model for

them - and conversely, some Arabidopsis researchers that Brachypodium really is a great candidate for bridging the gap in translation between Arabidopsis and cereals. What better pulpit for me to preach from than Monogram?



The Wills Memorial Building
Photo: Stephanie Smith

The venue for Monogram was the stunning Wills Memorial Building, an imposing piece of Gothic architecture standing 65 metres tall (which was a real stroke of luck for a Bristol novice like me with a questionable sense of direction – there were no problems finding the venue!). The Monogram conference itself was divided into six broad sessions: Quality & Nutrition, Genomic Technology, New Projects and Areas, Phenotyping Technology and Applications, Crop-pathogen interactions, and the GARNet session: From Arabidopsis to Cereals and Back Again. There was also an optional Cereal Bioinformatics workshop chaired by Cristobal Uauy. The delegates came from far and wide across Europe and beyond: the usual suspects of Rothamsted, John Innes Centre and NIAB were joined by speakers and attendees from Norway, Ireland, Germany and even Australia, the USA and Mexico.

After the welcome address by Prof. Keith Edwards we kicked off the 'Quality & Nutrition' session with a well-rounded talk from keynote speaker Odd-Arne Olsen demonstrating how molecular biology, cell biology, genomics and

transcriptomics have shaped our understanding of the cereal endosperm. The presentation neatly showed how different cell types within the endosperm (endosperm, aleurone and transfer cells) are the result of different developmental programs: endosperm is the default developmental program and is 'locked in' either immediately before or at point of fertilisation, with sucrose providing a crucial developmental trigger. Maternal signalling is required to specify the transfer cell fate, whilst aleurone cell fate is specified by surface cell position and the calpain protease DEK1.

Six more talks followed, featuring research in combatting pre-harvest sprouting (Oluwaseyi Shorinola), trade-offs between grain yield and grain quantity in wheat senescence (Sophie Harrington) and some very, very important research in how we can improve whiskey and beer production and quality (reducing viscosity of grain extract; Till Pellny and improving malting quality of UK winter barley – Bill Thomas).

After some surprisingly entertaining flash presentations and looking around the many posters (all of very good quality) it was time to sample some local ciders and cheeses (well, when in Rome...) - and to take a walk up to the top of the Wills Memorial Tower. After what felt like endless stairs (which went some way to alleviate the cheese-calorie guilt) we were treated to stunning views of the sun setting over Bristol.

Fast forward to day two, and it was time for the GARNet session. Thanks to the GARNet travel award I was able to talk about my work with CINTRIN, the Cambridge-India Network for Translational Research in Nitrogen. CINTRIN's



The author delivering her talk at Monogram17 with GARNet committee member Zoe Wilson as session chair. Photo: Alison Bentley

aim is to reduce the dual issues of over-application of nitrate fertiliser in India (which currently is causing extensive environmental damage), whilst still meeting pressure to keep yield high enough to feed India's 1.2bn and growing population. Thus, there are six work packages ranging from the fundamental research I am involved with with a developmental focus (work package 1) - going through each stage of the translational pipeline to genomics led pre-breeding (work package 3) and applied agronomic management strategies (work package 6). My research follows on from observations previously made in Arabidopsis - different accessions respond in two contrasting ways to nitrate limitation: a 'live fast, die young' strategy of prioritising reproduction, or a 'wait in hope strategy' of remaining in a vegetative state for longer, gambling on an increase in

nitrate availability and capitalising on this more effectively if it does happen. I was glad that the pictures of James Dean vs George Clooney to illustrate these contrasting strategies raised a few laughs!

I went on to explain how I'm trying to establish the basis of this nitrate sensitivity and corresponding developmental response in *Brachypodium* with various genetic methods (and of course, had to include a slide explaining the benefits of my new favourite model). Luckily I was not alone in my optimism about research in models – other talks in this session included some fascinating work from Ian Henderson about using *Arabidopsis* and wheat to study the relationship between chromatin, recombination and transposable elements – the latter of which are in no short supply in wheat! Candida Nibau also used *Arabidopsis* as a model for investigating recombination and chromosome pairing - looking at the function of Ph1-like kinases in these processes. Syabira Yusoff joined me in extolling the virtues of *Brachypodium* as a model for her work investigating grain morphology and evolution, whilst Alastair Hetherington gave an enlightening talk on how transpiration and seed iron and zinc concentration are related – and how he is trying to manipulate the signalling pathways involved in order to combat the surprisingly common nutritional deficiencies of these nutrients in humans.

Several more presentations followed, including an enjoyable talk from MECEA PhD student award winner Jemima Brinton about her work in grain size and grain yield relationships in wheat, and keynote speaker for the genomics



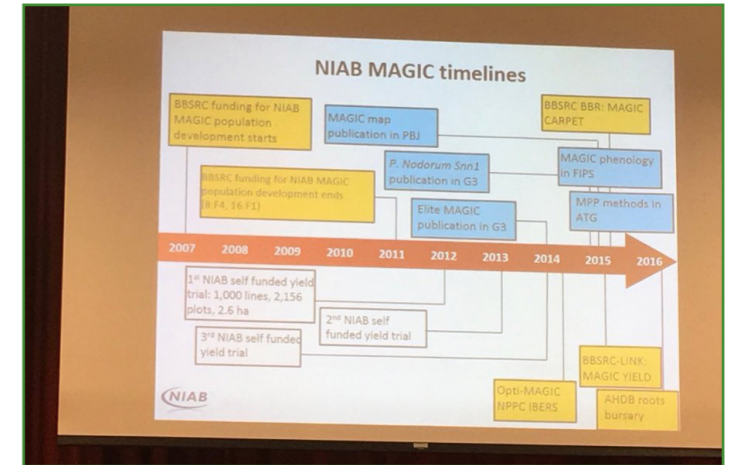
MECEA award winner Jemima Brinton with her supervisor Cristobal Uauy. Photo: Alison Bentley

session, Susanne Dreisigacker, showing how CIMMYT are using genetic marker collections and other genomic technologies to speed their genomics-assisted breeding programme for wheat. In the 'New Projects and Areas' session, invited speaker Keith Edwards gave a talk sure to be of interest to many – his progress in effectively using the CRISPR/Cas9 gene editing system in the notoriously recalcitrant hexaploid wheat, using modified wheat codon-optimised constructs.

I cannot write this review without including the highlight of the conference – the conference meal aboard the SS Great Britain, Isambard Kingdom Brunel's triumphant ship which first sailed in 1845. The food was divine and the wine flowing...a little too much perhaps! The next Monogram – to be held at the John Innes Centre in Norwich – certainly will be challenged to beat that venue!

On the final day of the conference, we opened with the Phenotyping session – with keynote speaker Tobias Wurschum showing a new strategy to integrate phenotyping with genomics in cereal breeding, using the precision phenotyping platform 'BreedVision' in concert with genetic mapping in a Triticale model. Other interesting advances in phenotyping techniques followed, including biomedical approaches such as X-ray CT to study grain morphology (John Doonan) and how the recombinant inbred 'MAGIC' population developed by NIAB has been a useful resource in linking phenotypical traits with genotype (Anyela Camargo, Yeorgia Argirou).

After heads were soothed with plenty of fluids and strong coffee over lunch, we came to the final session: crop-pathogen interactions. This was the session topic I was least acquainted with, so invited speaker Darren Soanes did a great job in delivering an accessible and illuminating talk about the spread of wheat blast fungus from South America to Bangladesh - and how comparative genomics can be used to track this pathogen in relation to viable host populations, facilitating attempts to stem the devastating yield losses caused. Other highlights included a genome-wide association study of 1000 spring wheat accessions to find sources of resistance to wheat stripe rust (Josh Hegarty) and some very comprehensive work by Emma Wallington concerning how to engineer wheat for resistance to take-all fungus – an especially challenging issue as neither wheat nor any of its relatives have resistance to this fungus, so the answer has to come from gene transfer from oat, and the antimicrobial avenacin A-1 it produces.



A timeline of the NIAB Magic lines
Photo: Geraint Parry

The four-hour drive back home gave me plenty of time to digest all I had heard and seen at Monogram. I came away from the conference feeling inspired and motivated, and it also renewed my respect for the challenges of working with cereals - especially wheat. I am enthused about the new contacts I've made and the interesting conversations I've had – which even persuaded me to finally join twitter! I was also heartened by the thought that despite past pessimism for translational approaches, the mood seems to be slowly shifting, and there are really promising examples of work in this area. Importantly, examples of two-way approaches from either side of the divide also seem to be becoming more common.

I am grateful to GARNet for awarding me the travel award that allowed my attendance at this conference, and for all they do to promote translational work and relationships generally.

Apologies to all the delegates whose work I was not able to highlight for space reasons.