RICE RESEARCH

The BBSRC has recently announced a total of 13 projects funded through the Newton Fund's Sustainable Rice Programme. These projects were awarded to partnerships with research organisations in SE Asia led by UK researchers. This investment makes rice the third most important crop within the BBSRC portfolio in which NIAB makes one of the largest contributions from the UK's organisations leading in two projects. This success follows from a number of long-term collaboration with international partners working in rice genetics and genomics as well as from the NIAB's unique expertise in crop breeding and bioinformatics.

Wild rice MAGIC

Ian Mackay – collaborations with University of Cambridge and IRRI.

SCPRID funded PhD student

This project is led by Prof. Julian Hibberd of Dept. Plant Sci, Cambridge. The main objective is to identify useful novel alleles in wild *Oryza* species that were lost during evolution, domestication and subsequent targeted breeding, and introgress these traits or alleles into an agronomically useful genetic background. The wild species of the genus *Oryza* serve as a virtually untapped reservoir of genetic diversity. A MAGIC population is being developed from crosses between wild varieties using eight A-genome *Oryza* species: *O. rufipogon, O. nivara, O. meridionalis, O. glumaepatula, O. barthii, O. glaberrima, O. longstaminata and O. sativa.* The anticipated transgressive variation could be used for breaking the yield barrier, developing climate smart materials with multiple abiotic and biotic stress tolerances and breeding for nutrient and water use efficiency. NIAB's role has been to provide advice on crossing schemes and to study practical and theoretical aspects of multi-founder populations through computer simulation, validated by experimental data as it becomes available. The PhD student, Funmi Ladejobi recently visited IRRI to familiarise herself themselves with rice breeding and the development of the populations.

NutrientRice: Molecular characterisation of Philippines Pigmented Rice

Lesley Boyd – Collaboration with PhilRice and IRRI.

Newton Fund: £644,834.

The aim of this study is to identify rice accessions with high nutrient and antioxidant traits and good grain quality to integrate into rice breeding programmes. Pigmented rice, such as black and red rice, contains high levels of phytochemicals such as anthocyanin, flavonoids and vitamin E. Since the price of pigmented rice is more than twice that of white rice and the potential for pigmented rice in international market is large, growing pigmented rice will result in higher incomes for Philippines farmers.

We will assess a collection of indigenous rice accessions held at PhilRice, measuring agro-morphological traits, grain quality, nutrient content and nutritionally valuable secondary metabolites to determine their genetic value to rice breeding. The rice 6K Infinium SNP array has been used to screen over 600 accessions. In general the accessions appear unique and divide into four distinct clusters. These accessions will be compared to the 3k sequenced rice varieties to place the PhilRice collection into context within the global 3k pool.

Resequencing Native Vietnamese Rice Lines
PI: Mario Caccamo – Collaboration with AGI (Vietnam) and Earlham Institute (UK). Newton Fund: £431,747.
We are developing a comprehensive genomics and bioinformatics platform to capture the unique genetic diversity of Vietnam's native rice varieties. We focus on economically important traits that are relevant to addressing some of the challenges emerging from climate change in Vietnam (e.g. salt tolerance, diseases resistance and drought resilience). We will also develop capabilities to support the long-term adoption by breeders and rice researchers in Vietnam of molecular breeding technologies. We will sequence around 10% of the rice lines in Vietnam National Genebank with the purpose to characterise the diversity and use phenotyping data to perform genome-wide association studies for key agronomical traits.

Spatial regulation of rice D14L for pre-symbiotic perception of beneficial fungi
Emma Wallington
BBSRC: £196,755
This project is also led by Dr Uta Paszkowski of Dept. Plant Sci, Cambridge. Colonization of plant roots by arbuscular mycorrhizal (AM) fungi requires the reciprocal exchange of diffusible molecules before fungal attachment to the root surface. DWARF 14 LIKE (D14L) is crucial for fungal perception by rice. The recognition of the fungus by the root and the subsequent establishment of primary contact involves distinct root tissue and cell types. The precise coordination of the signaling response is thus essential for the successful development of AM symbioses. In this project we will determine where in the root tissue (relative to the approaching fungus) the protein needs to be present, and by magnifying onto the subcellular level, where within the cell the protein functions in initiating signal transduction.

Rice transformation
Rice transformation was added to the NIAB crop transformation portfolio four years ago. We have undertaken collaboration with groups in several UK universities, and now have two BBSRC funded projects underway plus ongoing contributions to PhD projects focussed on rice. A University of Cambridge targeted DTP PhD studentship will start October 2017 transferring the knowledge gained in these areas into wheat at NIAB.

Rice Data and Bioinformatics
NIAB is member of the **International Rice Informatics Consortium (IRIC)** at IRRI. Mario Caccamo has been a member of IRIC's steering committee since the launch of the consortium in 2013. IRIC has grown to become the prime site for rice genomics and bioinformatics resources. We will contribute to IRIC with novel genomic and genetic generated by the Newton-funded project to ensure compliance with adopted standard and the integration with pre-existent resources (e.g. 3000 genomes). Following a meeting held at IRRI early in January with the Rice Newton Consortium we have proposed to submit a project to the BBSRC to support the submission of the data generated by the consortium as a whole.

Root type contribution to phosphate nutrition of rice during asymbiosis and interaction with symbiotic fungi
Emma Wallington
BBSRC: £103,813
This project is led by Dr Uta Paszkowski of Dept. Plant Sci, Cambridge. Plants acquire phosphate either directly or in association with naturally prevalent arbuscular mycorrhizal (AM) fungi. The main objective of this project is to determine the contribution of individual root types to rice phosphate nutrition in asymbiosis or during interaction with AM fungi. The project includes analytics, imaging and molecular genetics to deliver an insight into in-situ phosphorus fluxes across individual root-types of the rice root system quantitatively and spatially to determine phosphate uptake and partitioning into tissue and cellular pools in adult rice root types.