



Heat and Drought Resilience in Wheat

Background

Wheat production in northern India occurs as part of a two-cycle rotation (primarily with rice). This restricts the length of the growing season and exacerbates the effects of late season heat or drought stress, and limits the grain-filling period. Although major genes controlling photoperiod and vernalisation responses are known,

processes modulating phenology require identification and manipulation. This has practical implications for the date of planting (impacting on crop rotation options and timings), the application of nutrients and pest control chemistry (avoiding stress periods), and the effects of heat and drought stress.

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Outline of Programme Activities:

- Screen advanced wheat germplasm (generated through ongoing partnership collaborations) across a range of planting dates in the Punjab (led by A Bentley; see cv refs);
- Additional precision management trials undertaken controlling allocation of water and nutrients to the developing crop across different phenology classes (with S Heuer (see cv for refs).
- Candidate QTL identified in the germplasm screening will be investigated bioinformatically (C Uauy, see cv refs) and alternative haplotypes will be identified for future phenotypic evaluation.
- Additional up-scaling across environments will be undertaken in Pakistan to demonstrate the value of parallel hypothesis testing to deliver value to Subcontinent breeding



Practical Description of Research and Allocation of Responsibilities to Staff in UK and India

The work will use existing panels of wheat germplasm, developed through existing collaborations within the partnership in India and Pakistan. Elite near-market lines will be split into phenology classes based on major genes and pre-project data. Field assessments will occur over two growing seasons to test a range of planting dates, stress responses, water supply and agronomy. Genotyping of the panels will support QTL detection and these will be

further investigated bioinformatically. Co-Is Bentley and Uauy will co-lead the activities and jointly supervise the PDRA. The work in India will be locally co-ordinated by Co-I Sharma who will also supervise 2 PDRAs (1 co-supervised by Co-I Sidhu). Co-Is Heuer, Sidhu and Maqbool (allocated 1 PDRA) will all contribute to the design and analysis of field experiments.

Engagement with Stakeholders

Members of the FP3 team already work collaboratively.

- Bentley with Co-Is Sharma and Sidhu on a Newton Fund (INEW), and others at PAU as part Newton Fund project (CINTRIN); Uauy participates in a BBSRC-DBT project with PAU.
- Bentley is advisor for a MSc and a PhD student in Co-I Sharma's group. Both Co-I Bentley and Uauy already contribute to training activities (via workshops) at PAU.

- The FP3 up-scaling in Pakistan adds regional scientific value and promotes the early-career female Pakistani wheat breeder Co-I Maqbool.
- State government officials in the Punjab will be invited to workshops to learn of project findings, particularly in relation to aspects of variety improvement and recommendations.
- Engagement with farmers will occur via annual Kisan Melas (farmers' fairs).

Outcomes, Deliverables and Impact

Robust information on variety and phenology will:

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| <p>Inform farmers on optimal variety selection to suit rotations and cropping systems.</p> | <p>Support the key objective to optimise phenology window: the ratio of the length of the vegetative to reproductive phase.</p> | <p>Improve support for ideotype breeding in wheat-producing regions of India and Pakistan.</p> | <p>Genetic characterization of key drivers will support long term programmes of efficient targeted breeding and selection.</p> | <p>Engage female early career researchers via UK workshops and soft-skills training in India and Pakistan, and promote collaborations/consolidate research within UK.</p> |
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Lead:

Alison Bentley (NIAB)/Cristobal Uauy (JIC); Co-I S. Heuer (Rothamsted); Co-I Achla Sharma, Parveen Chhuneja (Punjab Agricultural University: PAU); Co-I HS Sidhu (Borlaug Institute for South Asia); Co-I Rizwana Maqbool (University of Agriculture Faisalabad, Pakistan)

HR Career Stage Requirements:

Employment in UK: 1 PDRA; India: 3 PDRA at key Institutions

Capacity Building India-UK and UK-India Exchanges:

3 Senior Investigator; 3 PDRA/PhD extended exchanges; techniques, soft skills and bioinformatics workshops.

