iCase Project / AY 2024 -2025

Optimising Diversity Capture and Maximising Genetic Gain for Breeding 'Future-Proof' Wheat

Project Code: ICS-NIAB-TW

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Industrial Partner: KWS UK Ltd

Research area: Quantitative Genetics; Crop Science; Plant breeding

BBSRC DTP main strategic theme: Bioscience for sustainable agriculture and food

BBSRC DTP secondary strategic theme: N/A

Project outline:

Wheat is a paramount crop for ensuring future food security. Incorporating novel genetic diversity into wheat breeding pools is a necessary step for breeding for improved climate resilience, sustainability and higher grain yield. Current breeding approaches for capturing new diversity are resource intensive and requires generation of large quantities of material. Cutting edge advancements in genotyping and computer simulation have facilitated genomic and cross prediction that could be explored to improve diversity capture.

The project will explore these areas of genetics:

(1) Combining ability: form wheat backcross populations using modern elite wheat and wild/exotic accessions. Identify elite varieties with a high general combining ability for important adaptability traits. In parallel, through genomic prediction and simulation, generate populations in silico; simulations will then be validated with in vivo comparisons.

(2) Diversity capture: use further in silico simulation, actual validation crosses, and adaption traits (plant height, flowering time, and disease resistance), to explore how segregation patterns can be optimised in initial crossing generations.

(3) Haplotype exploration: Explore recombination patterns of exotic introgressions and novel haplotypes during backcrossing and generation advancement in elite backgrounds. Explore different methods for incorporating pre-breeding diversity into elite backgrounds while minimising linkage-drag.

Based at NIAB in Cambridge, and working closely with KWS and the Department of Plant Sciences (University supervisor: Professor Ian Henderson), the PhD candidate will use traditional Quantitative Genetic approaches coupled with the latest methods in computer simulation and prediction, to maximise the speed of genetic diversity capture to aid breeding for 'future-proof' crops.