Investigating resistance to Barley yellow dwarf virus in wheat

Supervisory team:

Rothamsted supervisor: Prof Kim Hammond-Kosack (Rothamsted Research)

Academic supervisor: Prof Gary Foster (University of Bristol)

Non-academic CASE Supervisor: Dr Chris Burt (RAGT Seeds UK)

Other partners: Dr Kostya Kanyuka (Rothamsted Research), Dr Gary Barker (University of Bristol), Dr Lawrence Bramham (Rothamsted Research), Ruth Bryant (RAGT Seeds)

Host institution: Rothamsted Research

CASE Partner: RAGT Seeds UK

Project description:

Barley yellow dwarf virus (BYDV) threatens sustainable UK wheat production. Control of BYDV has historically relied upon vector-targeted mitigation strategies underpinned by pesticides, removing aphid species which acquire and spread the virus during feeding. Prior to late 2018 when a ban came into force, neonicotinoid seed treatments were widely used to protect winter wheat. Growers retain the option of alternative insecticide use, such as pyrethroids, but these require foliar sprays which are neither always possible in autumnal conditions nor specific, killing beneficial insects. Increasing levels of pyrethroid resistance by key aphid species are also being recorded. Combined with the demand for pyrethroids, a markedly high risk for rapid spread of insecticide resistance exists, further reducing the chemical arsenal available for controlling BYDV. Sources of genetic resistance are consequently of value and have become a renewed focus by the wheat breeders. This includes RAGT Seeds who have recently developed the BYDV resistant cultivar RGT Wolverine.

This PhD project would involve screening the Wolverine source of BYDV resistance (and/or tolerance) against informative BYDV isolates, qualifying the level of resistance to different virus strains and determining whether strain complementation could overcome resistance. Through a series of experiments including antibody-based whole plant tissue printing combined with western blotting, the spatial and temporal movement of BYDV within resistant and susceptible plant lines will also be explored. Using the 'MutChromSeq' approach, or transcriptomics combined with bulk segregant analysis, the causal genomic loci underpinning the BYDV resistance will be elucidated.

In concert to this work, an additional focus will be the development of a mid/high-throughput RT-qPCR assay for BYDV, as well as new approaches and technologies to help identify and/or validate other resistances. Limited reliable in-field BYDV resistance screening methodologies currently exist with most testing relying upon natural BYDV presence. During this PhD, prevalent strains of BYDV will be identified (via the Rothamsted UK insect suction trap network) and used to develop infectious clones (ICs). The use of these ICs with biolistic inoculation strategies will be explored and an IC 'toolkit' for screening wheat germplasm potentially developed. This would allow simplified maintenance of pure BYDV strains in bacterial cultures, rapid generation of a desired inoculum and robust investigations into BYDV strain complementation.

This PhD represents an opportunity to generate valuable applied outputs with training provided (where required) on molecular biology/virology techniques, bioinformatics, entomology, critical thinking and conceptualising, data interpretation, and glasshouse and field work.