2023_59_DoLS_Turnbull: Climate change and biotic impacts on success of aphid populations

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Background and impact. In both natural and agricultural ecosystems, fitness and populations of parasitic insects such as aphids are subject to multiple environmental and genetic influences that present complex challenges in prediction of climate change impacts. Here, we seek to simplify to a model system, building on our recent discoveries about factors that suppress host plant immunity against aphid infestations. We have learned that, paradoxically, a very strongly resistant plant genotype (that results in aphid death within 2-3 days) exhibits almost complete immune suppression following introduction of secondary factors such as drought (the climate change variable that we will study), leaf detachment or prior presence of a second, virulent aphid race. We hypothesise that the abiotic and biotic influences likely converge on the same host plant mechanisms. In this PhD, you will seek to discover the pivotal elements of physiology and genetics, providing a challenging basic science component. But the loss of plant immunity under climate change scenarios presents a serious global threat to crops: it is likely that what we have discovered is not restricted to our particular system (pea aphid on the model legume *Medicago truncatula*) and will be problematic for many crops infested by a wide range of pests and pathogens. There is therefore a strong food security angle.

The project has a strong fit to SSCP and NERC remit/priorities: To understand and quantify complex biological, physical and human systems, and the interactions between them, in sufficient detail to predict and manage future change. Climate Change. Plant & crop science/Environmental physiology

Outline of proposed research strategy. You will refine microcosm approaches using defined climate change environments, defined genetics and our extensive prior knowledge to rigorously test our hypotheses on the dynamics of aphid population success and host plant immunity. For example, tight control of both aphids and plants enables behavioural studies such as video tracking of settling and gregariousness of colour-coded aphid races on plants carrying or lacking innate immunity genes, under simulated normal and climate change (drought etc) scenarios. You may choose to explore the mechanism(s) of immune suppression at the physiological (bioactive plant metabolites) and genomic (transcriptomics) levels, drawing contrasts between the three key factors: aphid genotype, plant genotype and climate change severity. You will have opportunities to pursue a wide range of different approaches, for example focussing on data-driven questions (genomics), modelling (spatially and temporally resolved designs) and translation to other pest-crop plant combinations.

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