Grower Summary

Selection and improvement of insect pathogenic fungi for the control of multi-resistant aphids

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Title: Selection and improvement of insect pathogenic fungi for the control of multi-resistant aphids

Short title: Selection and improvement of entomopathogenic fungi

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1. Industry Summary

1.1 Background

The entomopathogenic fungus (EPF) *Akanthomyces muscarius* has been used as a biocontrol agent for the management of insect pests in agriculture. Nevertheless the licensing and commercial success of aphid biocontrol agents has been a challenge. This project had three main aims: test if this fungus could be used as a management tool for the control of insecticide resistant aphids (*Myzus persicae*); to test whether we could apply evolutionary theory to improve the properties of this species as a biocontrol agents and finally to produce a high quality genome of this fungus as a resource for future use.

1.2 Summary

While we expected that pesticide resistant insects might have a fitness cost that would increase susceptibility to fungus, this proved not to be the case. In contrast, some susceptible clones, particularly those subject to decades of laboratory rearing, showed enhanced susceptibility to a fungal pathogen, but not reduced reproductive fitness, an observation consistent with down-regulation of costly immune functions in culture. Nevertheless, changes in susceptibility were small and overall, fungal pathogen control is compatible with insecticides and should not increase the selection pressure for resistance of *M. persicae* to chemical insecticides.

Experimental passage has been used to successfully increase virulence of insect pathogens. Passage experiments with EPF are relatively unexplored. Here we adopted a theory based approach and selected for speed of kill, pathogen yield and infectivity at different scales of competition in *M. persicae*. The selection experiment resulted in small but significant increases in virulence when compared to the ancestor which also resulted in increased virulence against another aphid host, *Brevicoryne brassicae.* In addition we also observed increases in spore production on solid media and changes in timing of sporulation in some treatments. Changes in sporulation were unrelated to virulence showing that it is possible to produce more virulent mutants with improved sporulation characteristics.

We also present a new population genomic resource for *A. muscarius* comprising a high-quality genome assembly together with resequenced genomes of 13 experimentally selected lineages of this fungi.

1.3 Benefits to industry

The work presented here benefits industrial partners and stakeholders by providing novel methodologies for strain improvement of EPF and efficacy data of EPF on aphid genotypes resistant to synthetic insecticide. Increased use of biopesticides containing EPF can lead to a

reduction in the use of chemical pesticides, increased biodiversity and reduced impacts on pollinators and other beneficial insects and could facilitate integrated biocontrol of difficult to manage aphid pests.