Grower Summary

CP 176

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

Annual report, 2/2021

Project title:	Selection and improvement of insect pathogenic fungi for the control of multi-resistant aphids
Project number:	CP 176
Project leader:	Dr. Ben Raymond, University of Exeter
Report:	Annual report, 2/2021
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Key staff:	
Location of project:	University of Exeter, Penryn TR10 9FE
Industry Representative:	Will Illife
Date project commenced:	23/09/2018

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[The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.]

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Dr. Ben Raymond

Associate Professor

University of Exeter

Signature _____ Date 15/2/2020, Penryn

GROWER SUMMARY

1. Headline

Fitness cost of resistance under pathogen challenge

Biological control can be an effective tool and could play a key role in managing the evolution of insecticide resistance. The fitness cost of resistance can be increased under exposure to natural enemies or pathogens, and can therefore increase the value of integrating biological control into pest management. In this study of the aphid *Myzus persicae* we aimed to identify whether insecticide resistance affected fitness and vulnerability of clones to the entomopathogenic fungus *Akanthomyces muscarius*.

Targeted selection for improved fungal virulence against *M. persicae*

A better understanding of virulence evolution in different host-parasite systems can play a critical role in human health, animal welfare and modern agriculture.[1] Strain improvement in biocontrol pathogens is a key research area in improving efficacy of biopesticides. Selectively passaging *A. muscarius* in its host *M. persicae,* we aim to improve fungal virulence towards aphids by artifically selecting for strains that result in higher % mortality, and faster speed of kill.

2. Summary

Fitness cost of resistance under pathogen challenge

The loss in effectiveness of chemicals due to the development of resistance and the growing concern about their negative effect on human health and the environment provides a strong incentive for stakeholders to work on finding alternatives as well as improving existing ones.[2] Furthermore, recent regulatory bans and restrictions has led to few active substances being available for use to control aphids.[3-5] Heavily relying on the few insecticides currently used for control can lead to an increase in selection pressure for resistance to evolve.[6] The ever-increasing costs, more stringent regulatory restrictions, time and complexity of developing new insecticides[7-9] means that an effective insecticide resistance management (IRM) system is critical to preserve the utility and investment in present and future arthropod pest control.[10] Biological solutions can play an important part in IRM especially if pathogens such as fungi, can enhance the fitness discrepancies between resistant and susceptible insects.[11]

In this study, we test whether resistance mechanisms evolved in response to insecticide use in *M. persicae* carry a fitness cost in terms of increased susceptibility to EPF.

We found no fitness cost associated with chemical resistance in reproductive rate or pathogen susceptibility. 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. Overall, fungal pathogen control is compatible with insecticides and should not increase the selection pressure for resistance of *M. persicae* to chemical insecticides.

Targeted selection for improved fungal virulence against *M. persicae*

Preliminary results show that our serial passage protocol can improve fungal virulence towards aphids. All treatments resulted in increased virulence towards its host, causing 2-2.5 fold changes in cumulative mortality at a single dose assay. Further work needs to be carried out to confirm these results.

3. Financial Benefits

The project aims at developing entomopathogenic fungi strains with higher virulence towards aphid pests that could be used for successful control. Novel control methods used in an IPM programme for aphids would benefit growers facing severe shortage of effective tools for managing aphids on crops. The development of insecticide resistance in field populations of aphids calls for fewer applications of insecticides. A more targeted pest management including biological control can lead to a lower number of insecticide sprays that is favoured by both consumers and retailers.