Project title: Pests,Plants and Parasitoids: how does climatic variability affect tritrophic interactions in apple orchards

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CTP_FCR_2017_5

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Location of project: University of Reading	
Industry Representative:	National Association of Cider Makers
	Worldwide Fruits
	AHDB
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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.

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GROWER SUMMARY

Headline

Climate change threatens species interactions in economically important crops leading to potential pest outbreaks. Understanding the decoupling of these interactions will be crucial in developing successful IPM practices.

Background

Ecological interactions present one of the greatest challenges to ecological forecasting under climate change, with consequences for economically important ecosystem services such as biological control. Differences in responses among trophic levels (the position an organism occupies in the food web) can give rise to asynchronous dynamics and instability that can yield qualitatively different outcomes to those predicted by single species models. Functional trait databases provide an essential resource to help disentangle the mechanistic basis underpinning this complexity and ultimately scale-up predictions to the community level. We demonstrate this concept using the established Rosenzweig-MacArthur population model and incorporate temperature-dependence of important behavioural and physiological traits including functional response parameters from the Uiterwaal et al. (2018) database. Using pests and parasitoids as a model system, we explore the consequences of differences in temperature dependence between traits and between species.

Summary

Our study reveals that the thermal response of host intrinsic rate of increase primarily governs overall pest abundance through a growing season. When parasitoids share the same thermal optima of their hosts, the addition of parasitoid temperature-dependent parameters do not significantly influence quantitative or qualitative outcomes compared to models only containing the aphid response.

When there is a warm adapted parasitoid you can get qualitatively different projections depending on which temperature-dependent trait you add to the model.

When a parasitoid is cool-adapted, the addition of temperature-dependent parasitoid traits to a model introduces quantitative noise to model predictions based on the hosts thermal response.

Our study reveals how an understanding of the differences in the relative thermal performance among species can explain responses at the population level. Whilst also providing further considerations for future empirical and theoretical work.

Financial Benefits

This project is not yet at a stage to deduce potential financial impacts to horticultural producers however using ecological theory and mathematical models we have deduced further empirical work which would bring us closer to achieving this. Coupling these models with the consequential economic influence of population dynamics between asynchronous species would also provide a fruitful area of research to encourage the uptake of IPM systems.

Action Points

There are no grower action points at this stage of research