Project title:	Developing a 'push-pull' strategy for the management of *Drosophila suzukii*
Project number:	CTP_FCR_2017_1
Project leader:	David Hall, Daniel Bray (University of Greenwich), Charles Whitfield, Michelle Fountain (NIAB EMR)
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Location of project:	Greenwich University, Medway Campus and NIAB EMR.
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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

- Fourteen putative *D. suzukii* repellent compounds have been screened in the laboratory and four were taken forward to semi-field trials.
- Three chemicals demonstrated *D. suzukii* repellence to the summer and winter morphs.
- Low dose sachets (129/08) caused a repellent behavioural response to *D. suzukii* summer morphs.

Background

Drosophila suzukii, also known as spotted wing drosophila, is the major insect pest threatening European fruit production (Asplen *et al.*, 2015; Cini *et al.*, 2012). This invasive fruit fly was first found in the UK in 2012 and has quickly spread (Harris and Shaw, 2014). *Drosophila suzukii* lay their eggs in ripening fruit (Goodhue *et al.*, 2011). The eggs hatch and the larvae cause the fruit to collapse through feeding. Secondary damage is caused by pathogens which enter the fruit through the oviposition hole in the fruit skin (Calabria *et al.*, 2012). Currently, the pest is controlled through a combination of monitoring, crop hygiene, and mesh barriers, but there is still a reliance on conventional insecticides.

There are two distinct forms of *D. suzukii*: a summer morph, and an overwintering winter morph. The larvae develop into the winter morph in response to lower temperatures and reduced exposure to light (Toxopeus *et al.*, 2016). The winter morphs are adapted to survive these conditions and are the primary source of fruit crop infestation at the start of the growing season as they move from their winter habitat to the fruit crops in spring (Panel *et al.*, 2018). To date, most research has focused on control of the summer morph. However, preventing the winter morph from entering a crop from early in the fruit growing season may prevent escalations in population growth and fruit damage.

In this project, we are developing a push-pull strategy for year-round control of *D. suzukii.* Push-pull employs repellents to ‘push’ pest insects from the crop and attractants to ‘pull’ them into a trap or onto a non-target plant, away from the crop (Cook *et al.*, 2007). In year one, we conducted electrophysiological assays to identify chemicals that are detected by the antenna of *D. suzukii*. In year two, laboratory bioassays conducted at three chemical concentrations and semi-field experiments conducted at two concentrations were conducted to identify chemicals that function as repellents against both the summer and the winter morphs. In year three, successful repellents were trialled in the presence of a strawberry crop and the distance the repellents were behaviourally active were measured. As the two morphs have different behaviours, and ecologies, it was hypothesised they may respond differently to chemical stimuli (Kirkpatrick *et al.*, 2018). Putative chemical repellents were tested against both morphs.

Summary

In the first year of this project electroantennography (EAG) was undertaken to establish which of the 14 chemicals were detected by *D. suzukii* antenna. The 14 chemicals were puffed over the antenna of ten summer or winter morphs and the antennal response was recorded. Three chemicals elicited a different magnitude of response in the summer and winter morphs. In the second year of this PhD behavioural bioassays were undertaken to establish which of the 14 chemicals were able to repel *D. suzukii* from a fruit and yeast bait. The bioassay was composed of a two-way choice test and replicated ten times. Each chemical was trialled against the summer and winter morphs at three concentrations. Overall, four repellents significantly reduced the number of *D. suzukii* summer and winter morphs entering a gated trap containing a repellent. The four most effective repellents were then tested in small outdoor polytunnels.

One red Drosotrap (Biobest), was positioned at each end of 12 meshed, 12 m long, flight tunnels. The traps contained fresh raspberries as an attractant and egg-laying substrate. One of the traps in each tunnel was surrounded by five repellents; the other was an untreated control. Laboratory reared *D. suzukii* were released into the centre of the tunnels. After 48 hours the traps were removed, adult flies were counted, and fruit was incubated to assess *D. suzukii* adult emergence (a proxy for egg-laying). The trial showed that three of the chemicals reduced numbers of *D. suzukii* attracted into traps and subsequent egg laying in raspberry fruits.

In the third year of this project, a strawberry crop was grown along the centre of each tunnel. Successful repellents from year 2 were placed 1 m from one end of each tunnel and *D. suzukii* were released in the centre of each tunnel. After one week, seven fruit samples (1 m, 2 m, 4 m, 6 m, 8 m, 10 m, 12 m from the polytunnel end containing the repellents) were taken, and *D. suzukii* emergence recorded. Statistical analysis is currently being undertaken.

Main Conclusions

- Using EAG 14 putative repellent compounds were detected by summer and winter morph *D. suzukii*; three chemicals elicited a different level of response in the winter morphs compared to the summer morphs.

- In the laboratory, seven putative repellents were effective on *D. suzukii;* four of these were repellent to both the summer and winter morphs.
- In a semi-field experiment, three of these chemicals reduced numbers of *D. suzukii* and subsequent oviposition in raspberry fruits.
- Field experiments in crops have been completed with at least two chemicals repellent to *D. suzukii* oviposition (data to be analysed).

Financial Benefits

This project will help meet a need within the soft and stone fruit industry to reduce crop damage by *D. suzukii* using an approach that can be used in integrated pest management.

Action Points

There are no grower action points at this stage of the project.

