Grower Summary

Developing a ‘push-pull’ strategy

for the management of *Drosophila suzukii*

SF/TF 170

CTP_FCR_2017 1

Final report 2021

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)
Report:	Final report, October 2021
Previous report:	October 2020
Key staff:	Christina Conroy (formally Faulder)
Location of project:	Greenwich University, Medway Campus and NIAB EMR.
Industry Representative:	Harriet Duncalfe
Date project commenced:	October 2017

DISCLAIMER

While the Agriculture and Horticulture Development Board seeks to ensure that the information contained within this document is accurate at the time of printing, no warranty is given in respect thereof and, to the maximum extent permitted by law the Agriculture and Horticulture Development Board accepts no liability for loss, damage or injury howsoever caused (including that caused by negligence) or suffered directly or indirectly in relation to information and opinions contained in or omitted from this document.

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.

Christina Conroy

PhD Student

University of Greenwich, NRI

Signature .... Cconroy ..... Date.....21 Oct 2021.....

Michelle Fountain

Deputy Head of Pest and Pathogen Ecology

NIAB EMR

Signature *MT Fountain* Date .....21.Oct 2021.....

GROWER SUMMARY

Headline

- Through a series of laboratory experiments, the *D. suzukii* summer morphs were repelled by seven chemicals, and the winter morphs were repelled by five repellents. Both morphs were repelled by four chemicals.
- When these coded chemicals were tested in a semi-field strawberry crop, two chemicals (129/04, 129/13) were identified that reduced the overall number of emerging *D. suzukii*, and two chemicals pushed egg-laying away from the chemical dispensers (129/08, 129/13).
- The questionnaire results indicated that training opportunities should be given to early adopters of novel IPM strategies, with a secondary focus on how the strategy works.

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 (Harris and Shaw, 2014) and within three years had established. *Drosophila suzukii* lay their eggs in ripening fruit (Goodhue *et al.*, 2011), and damage is caused by larvae feeding inside the fruit and where pathogens enter the egg insertion hole (Walsh *et al.*, 2011; Calabria *et al.*, 2012). Currently, the pest is controlled through a combination of plant protection products (PPPs), monitoring, crop hygiene, integrated pest management (IPM), and exclusion netting (Cotes *et al.*, 2018; HSE, 2020; AHDB, 2021).

There are two distinct forms of *D. suzukii.* Summer morphs are primarily situated in the crop, and the winter morphs are generally located in woodland and hedgerows (Tochen *et al.*, 2016; Pelton *et al.*, 2016). Larvae develop into the winter morph in response to lower temperatures and reduced exposure to light (Toxopeus *et al.*, 2016). *Drosophila suzukii* winter morphs are adapted to survive these conditions and were identified as the primary source of fruit crop infestation at the start of the growing season (Panel *et al.*, 2018). To date, most research has focused on the control of *D. suzukii* summer morphs. However, preventing the winter morph from entering a crop early in the fruit growing season may help to prevent escalations in population growth and fruit damage.

The aim of the project was to develop a commercial repellent that could be used as part of a push-pull control strategy. Here, repellents are used to ‘push’ an insect pest from the crop,

and attractants are employed to ‘pull’ an insect into a trap or onto a non-target crop (Cook *et al.*, 2007; Fountain *et al.*, 2021). Electrophysiological assays (EAG) were conducted in year one to identify chemicals detected by the antenna of *D. suzukii* summer and winter morphs. In year two, laboratory bioassays were undertaken at three chemical concentrations to identify chemicals that function as repellents against *D. suzukii* morphs. Successful chemicals were placed in outdoor polytunnels to determine if they could reduce the numbers of *D. suzukii* caught in traps and eggs laid in sentinel fruit. Then the experiment was reproduced using high and low-dose sachets. In year three, repellents were trialled in the presence of a strawberry crop, and the distance the repellents reduced oviposition was measured. It was hypothesised that living in contrasting environmental niches may cause *D. suzukii* summer and winter morphs to respond differently to chemical stimuli (Cini *et al.*, 2012; Kirkpatrick *et al.*, 2018; Panel *et al.*, 2018). Finally, novel controls are frequently not implemented despite technological advancements. Therefore, a questionnaire was undertaken to determine the barriers to adopting new strategies.

Summary

EAG was undertaken to identify chemicals that were detected by the antenna of *D. suzukii*. The chemicals were puffed over the adult summer and winter morphs antenna, and the antennal response was recorded. Fourteen chemicals were detected by the antenna of both morphs, and a difference in antennal response was detected between *D. suzukii* summer and winter morphs in response to three of these chemicals. Behavioural bioassays were conducted to establish which of the 14 chemicals repelled *D. suzukii* summer and winter morphs from a fruit and yeast bait. The bioassays were composed of a two-way choice test at three chemical concentrations and replicated ten times. Overall, the number of *D. suzukii* summer and winter morphs entering gated traps containing a repellent was reduced when four chemicals were presented individually. The four most effective repellents were tested in small outdoor polytunnels.

Semi-field experiments were undertaken to determine the repellents able to reduce the numbers of *D. suzukii* caught in traps and eggs laid in sentinel fruit. One red Drosotrap was placed at either end of 12 netted polytunnels (12 m in length). Fresh raspberries were placed into the traps to act as an attractive odour and egg-laying substrate. One of the traps in each tunnel was surrounded by five repellent dispensers, and the second trap was encircled with untreated control dispensers. Laboratory reared *D. suzukii* were released into the centre of the tunnels. The traps were removed after 48 hours, and adult flies were counted. The fruit

was incubated for 14 days to assess *D. suzukii* emergence. Three chemicals reduced the number of *D. suzukii* attracted into traps and subsequent egg-laying in raspberry fruits. High-dose sachets (used in previous experiments) were compared to low dose sachets. The experiment used the same methodology as above. One chemical was effective when using a low-dose sachet (129/08). A final experiment was undertaken in a crop to determine 1) repellents effective at reducing overall *D. suzukii* emergence and 2) estimate the distance the repellents were effective over. Successful repellents from year two were placed 1 m from one end of each tunnel, and *D. suzukii* were released in the centre of each tunnel. Fruit samples (0, 1, 3, 5, 7, 9, and 11 m from the chemical dispensers) were taken after one week, and *D. suzukii* emergence was recorded. Two chemicals (129/04, 129/13) were identified that reduced the overall number of emerging *D. suzukii*, and two chemicals pushed egg-laying away from the chemical dispensers (129/08, 129/13).

A questionnaire was conducted to determine barriers to adopting novel IPM strategies. A pilot study was conducted with the help of three growers and two academics. These results were fed back into the final questionnaire and distributed by the Knowledge Exchange Manager at the AHDB. The questionnaire results indicated that training opportunities should be given to early adopters of novel IPM strategies, with a secondary focus on how the strategy works. In addition, grower-led training and workshops should be used once the strategy has become established on other farms.

Main Conclusions

- Fourteen chemicals were detected by the antenna of *D. suzukii* summer and winter morphs when using EAG.
- In the laboratory, summer morph *D. suzukii* were repelled by seven repellents, and winter morphs were repelled by five repellents. Both *D. suzukii* morphs were repelled by four chemicals.
- In semi-field experiments, three chemicals reduced the numbers of *D. suzukii* caught in traps and eggs laid in sentinel fruit, and one chemical 129/08 was effective when a low-dose chemical dispenser was used.
- In a strawberry crop, two chemicals were observed that reduced the overall number of emerging *D. suzukii*, and two chemicals were identified that pushed egg-laying away from chemical dispensers.
- In the questionnaire, it was ascertained that training opportunities should be given to early adopters of novel IPM strategies, and how the strategy works should be focused upon.

- Grower-led training should occur once novel IPM strategies have been established on a small number of farms.
- The education of individuals in the horticultural industry was determined to reduce the time between strategy design and application.

Financial Benefits

This project will help meet a need within the soft and stone fruit industry to reduce *D. suzukii* crop damage using a novel push-pull approach that can be used in Integrated Pest Management (IPM).

Action Points

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

