Grower Summary

CP 171

The use of highly attractive yeast strains for controlling *Drosophila suzukii* (spotted wing drosophila).

Annual report 2020

Project title:	**The use of highly attractive yeast strains for controlling *Drosophila suzukii* (spotted wing drosophila).**
Project number:	CP 171
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Report:	Annual report, October 2020
Previous report:	October 2019
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Date project commenced:	02 10 2017

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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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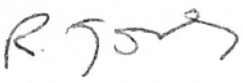
Signature  Date: 16.11.20

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GROWER SUMMARY

Headline

Four combinations of yeast have been found to be attractive to *D. suzukii* in laboratory choice tests; three of which are also attractive in the field. Additionally, three single yeasts previously shown to be attractive in the laboratory, in this project, also proved to be attractive in the field. Fruit type and fruit ripening stage have an impact on fungal community diversity on the surface of fruit.

Background

Since being identified in the UK, in 2012, *Drosophila suzukii* has caused considerable damage to commercial fruit, resulting in yield loss, and increasing expenditure on control methods. Currently *D. suzukii* is controlled with plant protection products, crop hygiene measures, and insect exclusion mesh. With more stringent measures being increasingly implemented on plant protection products (PPP) use, often resulting in the withdrawal of particular products; combined with the threat of insecticide resistance from a limited number of active ingredients, new control methods need to be developed and optimised.

There are complex interactions between fruit, microbes, and *Drosophila* species, and understanding these is important for the control of *D. suzukii*. Yeasts are an essential source of nutrients for *Drosophila*; they are important for oviposition and larval development. Some yeast species, most notably *Hanseniaspora uvarum,* are attractive to *D. suzukii* and have the potential to produce highly attractive and selective baits. There are two potential approaches for *D. suzukii* control using yeast: Firstly, precision monitoring, where numerous traps capture adult *D. suzukii.* This is widely available and easily to implement although it is labour-intensive. To date, this method has not yet been demonstrated to reduce crop damage. Trapping is recommended for the monitoring and detection of *D. suzukii* and lure-and-kill strategies could be used in integrated pest management of *D. suzukii*. However, more attractive, and selective baits are needed to reduce the capture rates of non-target species. This would also make detecting *D. suzukii* females easier as they can be mistakenly identified for other *Drosophila* species without the aid of a microscope. Secondly, another attract-and-kill strategy, which combines a phagostimulant with a PPP can be employed. The pest is attracted to the feeding bait upon which it feeds, thus killing the pest on ingestion. This method can enable a reduction in the amount of PPP applied whilst simultaneously increasing the targeted exposure of *D. suzukii.* This could also reduce the number of non-target species

which come into contact to PPPs and reduce residues on fruit and in the environment. A study of the literature and AHDB project SF 145 have both shown that combining plant protection products with the yeast species *H. uvarum* increases mortality and reduces egg laying.

Yeast has been used to trap *Drosophila* for many years; typically, dried baker's yeast has been used in fermentation-based baits. More recently *H. uvarum* has been investigated as it is associated with *D. suzukii*. Although, *H. uvarum* is known to be attractive to *D. suzukii* few other yeast species have been tested for attractiveness. This project will not only test the attractiveness of yeasts from an existing culture collection but also characterise fungal communities on ripening fruit (blueberries, cherries, raspberries, and strawberries), and will additionally provide a resources of microbes from relevant host fruit species that could be exploited in future projects in the control of this pest. Unlike most *Drosophila* species, *D. suzukii* oviposit in ripening fruit, therefore yeast from ripening fruit may be selectively attractive to *D. suzukii.* In nature, microbes on the surface of fruit are in complex communities and, currently, only single yeasts have been tested for attractiveness. This project will also test the attractiveness of combinations of yeasts.

The main aim of this project is to identify highly attractive yeast species alone and in combination, and then utilise these in the control of *D. suzukii.* Additionally, this project will aim to characterise microbial communities on ripening fruit and investigate identified yeast for attraction to *D. suzukii* and use in control strategies.

Summary

Yeasts vary in their attraction to *Drosophila* species and previous work in 2017/18 identified four candidate yeast species attractive to *D. suzukii*: *H. uvarum*, yeast coded 218, 164, and 190. *D. simulans* was indifferent to all four but *D. melanogaster* was attracted to all four. Both are common non-target species often captured in *D. suzukii* monitoring traps; highlighting the potential for yeast to produce attractive and selective baits for *D. suzukii.* Additionally, multiple strains of *H. uvarum* were attractive to *D. suzukii*. This yeast, in the context of *D. suzukii,* has received the most attention in the literature and is known to be attractive to *D. suzukii*, both in the literature and project SF 145. Building on this work, we tested the attractiveness of ferments of these yeasts in the field using standard commercially available traps. Three yeasts were attractive in the field; yeast coded 190, and two strains of *H. uvarum*. In addition, combinations of yeasts were screened, both in the laboratory and the field. Of the combinations tested, four proved to be significantly attractive in the laboratory; 201+164, 190+201, 190+218+201, and 190+218, but in the field only the latter three combinations attracted *D. suzukii*. Currently, none of the yeast-based attractants tested in the field proved

significantly more attractive than a commercial wine/vinegar liquid bait, Gasser. It is worth noting that these field-based trials were conducted between late October and early December when winter morph *D. suzukii* were more abundant than the summer form.

Microbial communities on ripening fruit are also currently being investigated. Fruit samples were collected in 2018 from four ripening stages of blueberries, cherries, strawberries, and raspberries. Fruits were surface-washed to collect microbes; DNA was extracted and ITS regions (conserved across fungal species) were amplified and sequenced. It was apparent that both fruit type and ripening stage have a significant impact on fungal community diversity; in terms absolute species richness (numbers of fungal phylotypes (taxon designation of 97% similarity)), relative species richness (types of fungal phylotypes) and community composition (abundances of fungal phylotypes). Additionally, fungal abundance (both relative and absolute) increases with ripening stage. Although, for absolute abundance we only present data for cherry, as this was the only fruit species that the quantitative analysis of fugal communities was successful for, andadditionally, when adjusted to cells per mm^2 this trend did not hold true. Cherry harboured significantly more fungal phylotypes than blueberry, raspberry, and strawberry, and with blueberry, raspberry and strawberry not differing significantly from one another. Ripening stage 1 had significantly fewer fungal phylotypes than 2 and 3 but not 4. Additionally, stage 2 and 4 were also not significantly different. For yeast phylotypes from the order *Saccharomycetales* fruit type but not ripening stage had a significant effect on species richness with raspberry harbouring significantly more yeast phylotypes than strawberry, cherry, and blueberry. Strawberry harboured significantly more than cherry and blueberry, and cherry harboured significantly more than blueberry.

Attractive yeasts, both single species and combinations (both single fermented then combined and co-fermented yeasts), are being assessed by exposing *D. suzukii* to a choice of baits in Drosophila Activity Monitoring (DAM) equipment. The baits have been presented in in SSJ (sterile strawberry juice) and YPD (yeast extract 1%, peptone 2%, dextrose 2%). YPD is a standard culture media and is a more realistic growth media for phagostimulant bait commercially (SF 145a). This data is currently being statistically analysed. Laboratory jar-bioassays experiments testing the efficacy of yeast /PPP combinations as control for *D. suzukii* have just finished and are also currently being statistically analysed (data will be included in final report). In addition, I have received training on the odour collection from yeast ferments at the Natural Resources Institute, University of Greenwich. This data is also being analysed and will be reported next year.

Financial Benefits

D. suzukii is an economically damaging pest that causes loss to soft and stone fruit yields. This project has the potential to improve *D. suzukii* control and reduce residues in fruits. The attractive yeast species and strains identified by this project could potentially be exploited in monitoring and control of *D. suzukii* in IPM strategies to combat this pest more effectively.

Action Points

Currently, a commercial product Combi-protec is available for growers to use as a feeding bait. This product should be used according to manufacturer recommendations and following the label specifications.