Hort Innovation

Final Report

Developing IPM compatible controls for spotted wing drosophila *(Drosophila suzukii)*

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MT18010

Project:

Developing IPM compatible controls for spotted wing drosophila (Drosophila suzukii) (MT18010)

Disclaimer:

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Summary

This project aimed to develop IPM compatible control measures for Spotted winged Drosophila (*Drosophila suzukii*) so that the Australian berry industries will be prepared should this pest arrive in Australia. The Australian berry industries currently have excellent IPM strategies that use minimal chemical insecticides or miticides. However, if this pest arrives and insecticides are the main method of control, then control of key pests such as two-spotted mite and western flower thrips will be disrupted and the industries will face a crisis in pest management.

This project consisted of two parts, each of which depended on the collaboration of advisors in the UK and Denmark. The first part was to visit the UK and Denmark and look at current methods of control and see if we could suggest possible IPM compatible methods to trial. We have had great collaboration from some of the key advisors to berry producers in these countries to co-operate with IPM Technologies. IPM Technologies entomologists Dr Paul Horne and Jessica Page visited farms in the UK with FASTs advisors (Graham Moore and Rosemary Houston) and in Denmark and Sweden with Nina Jorgensen. The visits took place in June 2019 (Monday 10th to Friday 21st). Included in the schedule were meetings with researchers at East Malling Research Station and with Bioplanet.

The second part of the project was to test our suggested alternative cultural control options on-farm. Pressure from SWD is higher in the UK than in Denmark but growers in the UK can use multiple insecticide applications. In Denmark there is not the same option to use insecticides, but the pest pressure is lower. In both situations there is a desire to develop IPM compatible control options.

Following our visit, small trials were carried out by FASTs advisors in a commercial crop to see if SWD adults could be attracted to a certain area of the crop. These trials were successful in demonstrating that higher numbers of infested fruit were found in areas that were managed differently, suggesting that an “attract and kill” approach is possible by drawing adult female SWD flies away from the main crop and into “sacrificial” plantings. However further trials were not possible in the last season but are still likely after the life of this project.

An estimate of the costs of dealing with SWD has been included as being prepared also means having some information about what additional costs are likely to be incurred. The estimate uses current $ values and this could be expected to change in absolute terms but would give growers some relative costs to consider. This could also be reproduced as an updated advisory note when required if SWD arrives in Australia.

Keywords

IPM, Spotted winged Drosophila, *Drosophila suzukii*, cultural controls.

Introduction

Spotted Winged Drosophila (SWD) is a species of fly that can cause high crop losses in berries and other soft fruit by laying eggs into ripening fruit. Losses of up to 100% have been reported in certain crops. Originating in south-east Asia it has spread rapidly in the last few years through large areas of the USA and Europe. Spotted Winged Drosophila has a wide plant host range, is highly adaptable to climatic conditions and is particularly invasive.

SWD is a pest that threatens several horticultural industries, including berry crops, cherries and other soft fruits. Large sectors of some of these industries are using very successful IPM strategies which rely mostly on beneficial insects and mites for the control of key pests. The approach to dealing with SWD in many countries has been with regular application of insecticides which is highly disruptive to the beneficial insects and mites that are critical in IPM programs. If this approach is followed in Australia, insecticide resistant pests such as western flower thrips and two-spotted mite would once again thrive and the current IPM strategies would be unworkable. This would be a disaster for the Australian fruit industry in terms of the costs of dealing with the full range of pests as well as potential crop losses. An IPM compatible method (or methods) of combating SWD should it arrive in Australia is essential.

The arrival of SWD sometime in the coming decade is almost inevitable. With proper preparations, the Australian fruit industry can be prepared and resilient. In May 2017 Dr Paul Horne and Jessica Page travelled to Europe (Denmark, Sweden and Switzerland) to prepare for the arrival of SWD by working with interested researchers and advisors to find an IPM compatible means of dealing with the pest. (Victorian Strawberry Industry Development Committee provided funding to support travel for this work). These countries have laws that prohibit farmers using the sort of insecticide-based approach that is being applied in the USA and the UK. IPM Technologies visited consultants, researchers and berry growers in Denmark, Sweden and Switzerland and discussed potential IPM compatible methods for controlling SWD.

Following all the farm visits and discussions with farmers, researchers and consultants, IPM Technologies formulated a potential strategy to control SWD that is based on cultural methods. This strategy was aimed to be trialed in the 2017 summer in Denmark. However, an unusually cold summer meant that pest pressure was too low to test the approach. Therefore, the project described here was proposed to be conducted in the UK where pest pressure from SWD is much higher. This was then implemented when the project commenced but contact with the Denmark entomologist was maintained.

Methodology

The first part of this project was to visit large berry producers in the UK who had to deal with significant pressure from SWD and some smaller farms in Denmark and Sweden to see how they were dealing with this (and other) pests. This was achieved with the assistance of advisors in the UK (FASTS) (Graham Moore and Rosie Houston), and entomologist Nina Jorgensen in Denmark. Paul Horne and Jessica Page visited farmers, advisors and researchers as per the schedule below.

Schedule of visits, UK, Denmark and Sweden 10 – 19th June 2019

Monday 10th June 2019

2 large berry producers, Faversham, Kent, UK

Tuesday 11th June

2 Large berry producers, Herefordshire, UK

Thursday 13th June

Bioplant (Biological control suppliers to berry growers), Copenhagen, Denmark

Friday 14th June

1 strawberry and raspberry grower, Trelleborg, Sweden

1 organic berry grower, Roskilde, Denmark

Monday 17th June

Visited Danish government research station

Tuesday 18th June

Visited berry researcher at East Malling Research Station, Kent, UK

Visited Bioplanet and FASTS (berry advisors), Kent, UK

Wednesday 19th June

Visited a large berry producer, Warwickshire, UK

Thursday 20th June

Visited a large berry producer, Berkshire, UK.

Discussion with FASTS advisors on possible trials based on our suggestions for cultural control.

At each location we discussed how growers currently deal with SWD and also changes that they have had to make in order to adequately control this pest and how they deal with other pests. These discussions allowed us to make a summary of current control methods, cultural and chemical. At the conclusion of these visits, we discussed an additional cultural control option with FASTS advisors and whether this could be trialed in a commercial crop. The proposed trial and rationale for it are described here.

Proposed Cultural Control trial

This proposal assumes that at some point in the season SWD adults will have broken through the barriers and be inside the crop typically in July/August. At this point growers start regular applications of pesticides because the cultural controls are not providing adequate control, in part because of the labour needed.

What we have learned about SWD from talking to growers, advisors and researchers is that SWD prefers the berries to the traps, so the traps have little effect on the population during the peak pressure period.

The adults seek shelter and humidity which is why canopy management or reducing the areas for them to shelter is an important cultural control option.

We propose to try and use a small portion of the crop as a “trap and kill” method by providing SWD with exactly

what they want. The aim is to draw as many adults as possible to one small part of a tunnel to reduce the pressure in the rest of the tunnel. For example, this could be a 1m strip of plants with a leafier and more humid canopy at the end of each row where the picking interval is longer than in the rest of the crop so more red berries. This would provide an ideal habitat in which to trap flies. Large monitoring traps could be placed here as well.

The adult SWD flies can then be killed by insecticides in the trap crop and larvae removed simply by picking at a 4 - 5 day interval. This has the potential to reduce the need for as many pesticide applications over the whole crop that may interfere with biological control.

Provided that the trap crop is actively managed to prevent the flies from breeding and infesting the rest of the crop it is low risk. The assumption is that at this stage SWD is already established in the crop and not moving in from outside. So the trap crop will not be drawing them in. The trap crop is simply a way of managing the population breeding within each tunnel.

Possible Options:

Instead of strawberries, the trap could be a few pots of raspberries.

The trap area could be on the edge, and also in the centre of the tunnel.

If effective this approach would (i) reduce the costs to growers by reducing the commercial traps and (ii) potentially reduce the frequency of insecticide applications.

Such a trial, as described above, was carried on a small number of plants on a commercial berry farm in Kent as we requested but was not done in a replicated way that could be statistically analysed.

In addition to the work described above for this project, input into related projects (list) was provided as requested. This included presentations at workshops on SWD held at Melbourne airport (twice) and regular input to related project meetings via Zoom. Presentations to meetings of growers was severely reduced from what had been planned due to CoVid-19 regulations but presentations were given to meetings of growers in Victoria and Tasmania before the restrictions came into force.

Outputs

This project produced four tangible outputs to help prepare for the arrival of SWD into Australia. These outputs are all related to control of SWD within an IPM framework so that control of other key pests is not disrupted. These four outputs are as follows, with details of each provided in the Appendices.

1. A **Control Plan** for immediate implementation if SWD arrives in Australia and is deemed up to industry to deal with (see Appendix 1)
2. The Control Plan includes additional cultural control options not used in the UK at present.
3. Recommendations for insecticides to be registered or permitted for use against SWD in berry crops (see Appendix 2)
4. Costings for dealing with SWD in $Aus, (see Appendix 3)

Outcomes

This project has looked at what options for control of SWD are available and which are suitable for Australian berry production so that an IPM approach to dealing with all pests can be maintained. This means avoiding reliance on pesticides, especially broad-spectrum insecticides, which has been the approach taken in some parts of the world.

Given that effective biological control is unlikely to be an option in Australia in the short-term, and that reliance on a very few IPM compatible insecticides is unsustainable because of insecticide resistance, then the mainstay of control described here is cultural (management methods). The control options listed in Appendix 1 provide the best currently available methods for dealing with SWD and all other pests should it arrive in Australia. A costing of the additional measures required to deal with SWD has been prepared so that the industry is aware of what may need to be done.

This report also describes the additional cultural control options (using trap plants) that should be trialed in Australia when the pest arrives. This has the potential to reduce the cost of factors such as netting.

Monitoring and evaluation

This project had a very simple aim – to answer the question "Are there IPM compatible cultural controls that can be used to control SWD instead of disruptive insecticides?" This project answered that question in two parts. The first part is yes, there are a set of IPM compatible control measures that are currently being used in the UK and these are outlined in Appendix 1. In a second part, we believe that there are additional cultural control measures that could be used, involving trap plants, that are currently not being used in the UK.

The results of the project have been reported to the berry industry via articles in industry literature and by talks at industry meetings. CoVid-19 disrupted the number of meetings that were held during the last year of this project, but the industry articles provide a permanent description of the cultural control items in a format that growers could easily understand. These cultural control options were also provided to the sister project to use in any material produced there.

SWD has not yest been detected in Australia and so the findings of this project need to be kept available until that happens. The control options currently available are not complicated and are clearly outlined in Appendix 1. However, they are expensive and are not going to be implemented by industry until absolutely necessary. The potential cost of dealing with this pest is an important factor as individual growers will need to understand the changes required and the expense of making those changes.

The use of trap plants could significantly reduce the cost of control and so is an option that will need to be tested once SWD is in Australia.

All of these control options are presented in the Appendices of this report and will be accessible when required in the future.

Recommendations

There are two main recommendations arising from this project.

The first is to approve two insecticides for use against SWD in berry crops before the arrival of this pest so that there are IPM compatible insecticides available immediately when and if the pest is found in Australia. (See Appendix 2).

The second is to conduct full trials in commercial crops in Australia of the additional cultural controls using trap plants, as soon as SWD is found in Australia. Initial trials in the UK were promising but local trials on a larger scale will be required.

In addition, we recommend that the control options and likely costs of control provided in this report be produced as fact sheets for the industry when SWD arrives in Australia.

Refereed scientific publications

None to report.

Intellectual property, commercialisation and confidentiality

No project IP, project outputs, commercialisation or confidentiality issues to report.

Acknowledgements

This project depended on the (unpaid) support from entomologists and agronomists in the Denmark and England. We gratefully acknowledge the support given by Nina Jorgensen, Graham Moore and Rosie Houston who generously gave us their time and arranged meetings with growers and supported our idea to trial additional cultural control methods. In addition, we thank Rebecca Addison for assisting greatly with the estimates of additional costs in $Aus for dealing with SWD.

Appendices

Appendix 1: Control of SWD

There are three control options for any pest, including SWD, and these are: Biological, Cultural and Chemical controls. Effective Biological control agents for SWD are unlikely to be available in the near future. Chemical control options are limited, with products being either not compatible with biocontrol of other key pests or not available in Australia (spinosad) or facing problems with insecticide resistance.

So, the main control options are cultural (management). Cultural options are being implemented in the UK with good effect and these are listed here. We suggest that all of the measures listed be the basis for control of SWD until our suggested additional methods are tested in Australia.

Cultural Control Methods (current)

1. The first step is that an IPM approach is in place dealing with all other pests (at present mirids pose the most disruptive controls)

2. Hygiene. ALL Non-marketable berries need to be picked every 2 -3 days and destroyed, i.e. placed in a bin with a lid so adult flies do not escape.

3. Trim plants to remove suitable habitat for SWD.

4. Decrease planting density (blackberries and raspberries) and reduce humidity in the crop

5. Herbicide or otherwise keep area under plants bare

6. Use screens/curtains around the edges of the crop from where SWD may invade.

7. Use commercially available bait traps outside the crop area, on the perimeter where SWD is likely to be breeding.

Proposed additional Cultural Control method

In addition to the current methods, we believe that the use of trap plants, which could be the same as the crop plants but with a longer picking interval could be used. These plants would not be trimmed hard and so would provide an attractive place for SWD adults to shelter and oviposit in fruit. All fruit would be picked and removed but at a longer interval than the main crop. Pesticides could also be used on these plants if necessary, but not applied to the main crop, and so avoid disruption to key biological control agents over the main cropping area.

This proposal assumes that at some point in the season SWD adults will have broken through the barriers and be inside the crop typically in July/August. At this point growers start regular applications of pesticides because the cultural controls are not providing adequate control, in part because of the labour needed.

What we have learned about SWD from talking to growers, advisors and researchers is that SWD prefers the berries to the traps, so the traps have little effect on the population during the peak pressure period.

The adults seek shelter and humidity which is why canopy management or reducing the areas for them to shelter is an important cultural control option.

We propose to try and use a small portion of the crop as a “trap and kill” method by providing SWD with exactly what they want. The aim is to draw as many adults as possible to one small part of a tunnel to reduce the pressure in the rest of the tunnel. For example, this could be a 1m strip of plants with a leafier and more humid canopy at the end of each row where the picking interval is longer than in the rest of the crop so more red berries. This would provide an ideal habitat in which to trap flies. Large monitoring traps could be placed here as well.

The adult SWD flies can then be killed by insecticides in the trap crop and larvae removed simply by picking at a 4 - 5 day interval. This has the potential to reduce the need for as many pesticide applications over the whole crop that may interfere with biological control.

Provided that the trap crop is actively managed to prevent the flies from breeding and infesting the rest of the crop it is low risk. The assumption is that at this stage SWD is already established in the crop and not moving in from outside. So the trap crop will not be drawing them in. The trap crop is simply a way of managing the population breeding within each tunnel.

Possible Options:

Instead of strawberries, the trap could be a few pots of raspberries.

The trap area could be on the edge, and also in the centre of the tunnel.

If effective this approach would (i) reduce the costs to growers by reducing the commercial traps (ii) potentially reduce the frequency of insecticide applications and (iii) potentially reduce the requirement for complete screening.

Draft IPM Strategy Our Suggestions

Pest	Beneficial 1	Cultural 2	Chemical (3)
Spotted Winged Drosophila	**?**	• **Hygiene** • **Short pick cycle** • **Repellents** • **Screens** • **+ others**	**Spinosad?**
2-Spotted mite	*Persimilis* *Californicus* *Stethorus*	Hygiene Canopy management	Nil (Spray after Senescence)
Western Flower Thrips	Predatory thrips Predatory mites	Hygiene Canopy management	Nil (Seed dressing) (Spinosad)
Aphids	Hoverflies, lacewings, ladybirds, Parasitic wasps	Weed control	BT or GemStar*

Appendix 2: Suggested insecticides to be registered for control of SWD

Two insecticides that would be extremely useful with control of SWD within an IPM strategy are:

1. Spinosad. This is sold in Australia as "Entrust". It was formerly available as "Success" and "Success2". Note that this is a different active to that in "SuccessNeo" (which is Spinetoram).
2. Cyantraniliprole: This is sold in Australia as "Benevia".

We recommend that both of these products be approved for use against SWD. These products are currently available for use in a range of horticultural crops in Australia.

Appendix 3: The potential cost of dealing with SWD

The methods described in the first section of Appendix 1 are well established and being used successfully overseas. How much will this cost in Australia? We have attempted to put some $Aus values to each of these actions, and our assumptions are presented so anyone can adjust what might be different on their own farms. We have not provided a grand total as growers may choose to use some, but not all the methods described. If as a result of this current project (MT18010), the practice of using trap plants becomes an additional item, then we have also estimated some costing for this.

Installation of netting is one of the primary control methods to provide a physical barrier between SWD outside and the berry crops. This can be permanent structures (such as large orchard nets over Cherries but would require a finer/higher density net. As such this could require more support in some areas due to greater wind resistance of the net. This could cost approximately $150,000 per ha. Some growers may choose to drape netting over the tunnel but the high risk of wind damage to the net may mean that this is not the best option for most locations in Australia. Another alternative is to net the leg rows and tunnel ends with additional 'verandah' space at tunnel ends to help with access (approx. $17,000 per ha). One additional benefit would be reduced cost of controlling caterpillars and mirids, with reduced disruption of WFT and 2-spotted mite control by beneficial species.

Changes to picking schedules may be required on some farms to make sure all ripening fruit is picked. If picking every 2 days already then probably no change is needed but 3-day intervals may be too long. All fruit needs to be picked so labour costs may be 50% higher to ensure no ripe fruit is left.

Disposing of all fruit is required to remove all potential breeding sites for SWD. Extra costs will be associated with either labour to collect and remove waste berries, making and using pits or using contractors to collect and exchange sealed bins or even trucking all waste fruit off-site to a compost facility.

Changed canopy management is necessary to make the berry crops less attractive to SWD adults. Additional labour for leaf removal could cost around $10,000 per ha per year for strawberries and over $8,000 for raspberries.

Increasing plant spacing may also be required to reduce the density of the canopy. It is not certain that there would be a net yield loss as the plants could compensate, but if we assume that a 25% decrease in plant numbers will result in a corresponding yield loss of 15 – 20%, then losses could be around $105,000 per ha for strawberries and $142,000 per ha for raspberries.

Bait traps are widely used, although their impact may not be as great as hoped for. Depending on the type of traps used and the density of placement the costs could be around $1,500 per ha per year (including labour to place them)

If our suggestion of using trap plants at the ends of rows or tunnels proves effective, then there would be a loss associated with non-productive plants which still need to be maintained and picked. This could be around a total of $23,000 per ha per year for strawberries and $14,000 per ha per year for raspberries. However, if effective, this may mean that netting is not required and so reduce the cost there.