Article compendium to support for ongoing outreach related to raising awareness of the exotic spotted wing drosophila (*Drosophila suzukii*) in Australia

An output of MT17005: Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila (Drosophila suzukii)

Version 1-0

This content was developed as a part of MT17005 'Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila (Drosophila suzukii)', which was funded by Hort Innovation, using the strawberry, raspberry and blackberry, cherry and summerfruit research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture. Project partners were Plant Health Australia, ***cesar****, Plant & Food Research, and Horticulture New Zealand.*

Preface

Spotted wing drosophila (SWD: *Drosophila suzukii*) is steadily becoming a pest of concern for primary industries around the world. This exotic fly is cryptic (it looks very similar to *Drosophila melanogaster* (vinegar fly) and other *Drosophila* species, it can pierce and lay eggs in unripe fruits still on the vine, and overseas research has found this fly to be persistent across wide climatic conditions. Larvae stay protected from chemical controls as they feed within the fruit, and adult flies can quickly build up in large numbers, particularly if fruit waste is left to decompose in orchards. Grape, summerfruit, rubus, cherries, and strawberries can host SWD.

A number of factors will influence how SWD management and response decisions are made in an Australian context if the fly is detected in country. Crop phenology varies markedly between the northern hemisphere and Australia and will impact the flexibility of harvest schedules – a key management tool used in minimising SWD abundance. Within Australia, the wide climatic zones spanned by berry, cherry, grape, and summerfruit growing regions will require some unique management recommendations. Early detection of SWD will be important to ensuring that growers can execute effective management plans quickly. To achieve this, pro-actively raising the level of knowledge about this exotic pest within affected industries is key.

Project MT17005
In 2018, Hort Innovation initiated project MT17005 'Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila (*Drosophila suzukii*)'. This project was a collaboration between Plant Health Australia, **cesar**, Plant & Food Research, and Horticulture New Zealand. From May 2018 until June 2020 the project the research team investigated a range of topics to increase our understanding of how SWD could be eradicated, contained or monitored if there were an incursion in Australia or New Zealand. Areas of focus included:

- Modelling the most likely spread rates and establishment patterns
- How SWD was first detected overseas and best options for detection
- Predicting financial impacts on affected industries and key regions over time
- Identifying risk pathways into Australia
- Undertaking educational activities, such as workshops, development of information videos, and project articles

This project resulted in the development of several key outputs:

- A prediction model for the spread and establishment of SWD in Australia;
- Reports on SWD identification, global spread, trapping options, surveillance design; transmission pathways, and economic impact;
- Educational materials, including articles, training videos, and webinars; and
- An SWD preparedness plan.

How can you help to increase awareness?
Education packs supplied to extension professionals in cherries, stonefruit, berries, and grapes will support continued education about SWD following the project conclusion. This compendium of industry articles is one component of the extension pack. The content within these articles is designed to be used in future industry publications where the intent is to raise awareness about

SWD. Please use these articles to aid that purpose. If article content is used, we ask that you include the attributions as outlined in this document where appropriate:

Finally, a key message that should be included in any communication is '*To best protect Australia from this pest it will require a whole industry approach. If you see anything unusual call the Exotic Plant Pest Hotline on 1800 084 881.'*

Sincerly,

The MT17005 Project team

Attributions:

[Author/s] [(initial publication date)] [Article name], Hort Innovation project MT17005 'Improving the biosecurity preparedness of Australian horticulture for the exotic Spotted Wing Drosophila (Drosophila suzukii)'

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Researchers involved in this project: Dr Sharyn Taylor (Project lead, Plant Health Australia), Dr Daniela Carnovale (Plant Health Australia), Dr James Maino **(cesar)**, Dr Jessica Lye **(cesar)**, Raf Schouten **(cesar)**, Dr Lloyd Stringer (Plant & Food Research), Dr David Bellamy (Plant & Food Research), Dr Mark Bullian (Plant & Food Research), Anna Rathe (HortNZ).

Research report topics:

- Predicted economic impact of spotted wing drosophila in Australia
- Literature review of spotted wing drosophila detection and trapping options
- Predicting establishment and spread of spotted wing drosophila in Australia
- Modelling surveillance options for early detection of spotted wing drosophila in Australia
- Preparedness plan for spotted wing drosophila

MT17005 research reports developed thorughout the project, as well as a variety of outreach materials, can be accessed by contacting Hort Innovation.

Article 1

Spotted wing drosophila: Improving industry preparedness

*Author: Dr Jessica Lye, **cesar** (2019)*

Why was MT17005 undertaken?
The spotted wing drosophila (SWD: *Drosophila suzukii*) has emerged as a significant horticultural pest overseas. This exotic fly is cryptic (it looks very similar to *Drosophila melanogaster*: vinegar fly), it can pierce and lay eggs in unripe fruits still on the vine, and overseas research has found this fly to be persistent in both warm and very cold environments. Larvae stay protected from chemical controls as they feed within the fruit, and adult flies can quickly build up in large numbers, particularly if fruit waste is left to rot in paddocks.

During a two-year project (MT17005) researchers collected overseas data to gain robust, scientific information on best management practices and incursion response protocols. The project team also reviewed all the possible pathways by which SWD may arrive in Australia, as well as assessed the likely impacts for growers if it were to arrive. Information collected on best methods to trap for SWD is another important focus. Best baits? Best traps? When to trap? Where to place traps? This is information that industry (and government) will need if SWD is found in Australia. Further, the project took steps to build awareness around SWD in order to increase the chance of early detection.

Biology and ecology considerations
A number of factors will influence how SWD management decisions are made in an Australian context. Crop phenology varies markedly between the northern hemisphere and Australia and will impact the flexibility of harvest schedules – a key management tool used in minimising SWD abundance. Within Australia, the wide climatic zones spanned by berry, cherry, grape, and summerfruit growing regions will require some unique management recommendations.

The most likely times at which SWD populations would flourish in Australia would be heavily influenced by abiotic factors, such as day length and temperature. SWD females will undergo reproductive diapause when outside of 'goldilocks' conditions. Overseas research has shown that females enter reproductive diapause when the photoperiod is less than 14 hours at moderate temperatures (15 or 20 ºC), and at temperatures less than 10 ºC it will enter this diapause regardless of photoperiod. This is an adaptation that ensures eggs can be held over during leaner times and are laid at times when larvae stand the best chance of thriving.

In addition, if SWD were to be found in Australian production areas the surrounding landscape will play an important role in determining likely orchard infestation risk, with recent overseas research drawing a link between proximity of woodland refuges and early infestation of fruit. Australian landscapes are also abundant in non-commercial hosts, such as wild blackberry, which could support SWD populations in persisting. Understanding what these non-commercial hosts are is another key question that will need to be investigated as it is relevant orchard periphery and green bridge management on farms.

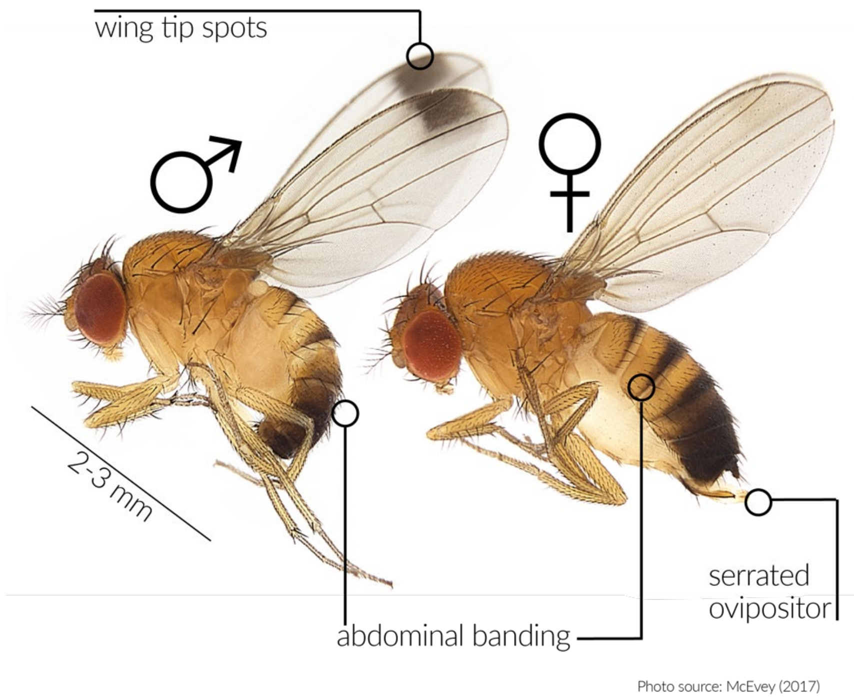

Figure 1. Male SWD (left) and female SWD (right). Note that only the male has wing spots. The female has a serrated ovipositor that enables her to pierce and lay eggs into unripe fruit. Sourced from McEvey (2017) [adapted].

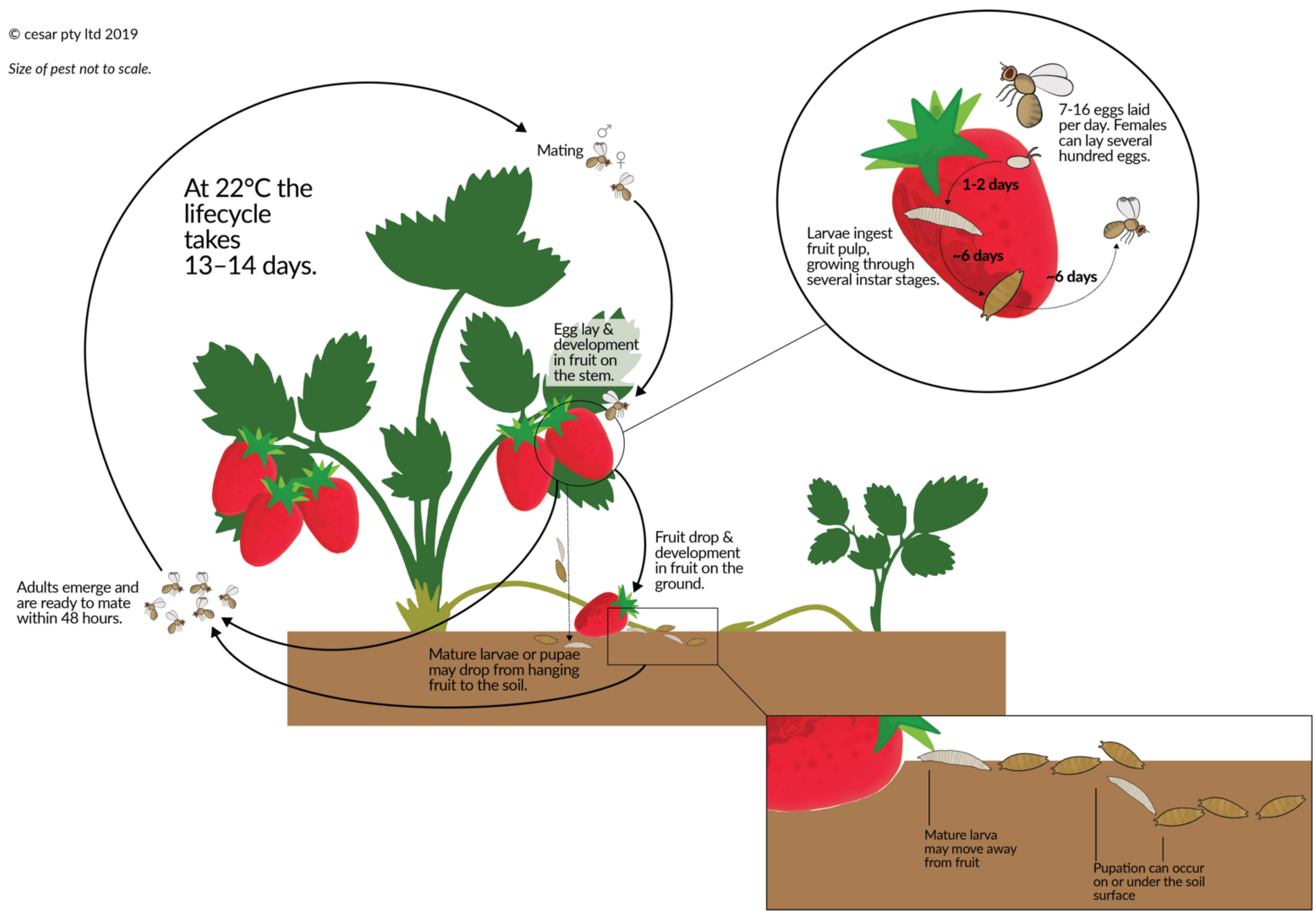

Figure 2. SWD lifecycle schematic. Credit: Dr Jessica Lye, **cesar**

To confound matters, SWD has two distinct morphs – a winter morph (cold adapted) and a summer morph (heat adapted). These morphs have different pigmentation, with the winter morph showing sporadic appearance of wing spots (it could look just like a vinegar fly). The occurrence of two morphs means that SWD can be well adapted to persisting in the environment throughout the year. Preliminary research from the United States suggests that winter morphs can 'smell' different volatiles to the summer morph. This means that each morph may be seasonally adapted to finding different hosts in cold and warm weather, further increasing its chance of persisting between cropping periods.

The right preparedness work is important to improve industry knowledge about the best tactics for managing SWD in specific regions, should the pest be found in Australia.

Figure 3. SWD on raspberry in the United States. Image credit: Hannah Burrack, North Carolina State University, Bugwood.org).

Mapping predicted spread and establishment

As part of MT17005 **cesar** developed an establishment and spread model that can simulate the movement of SWD across the Australian landscape. This includes short distance active dispersal (flight) and long-distance human assisted jumps (movement of infested fruit).

Surveillance data for the United States and Europe highlight the very fast rate of spread shown by this pest. Based on the Australian model, which was fitted against United States spread data and validated against Europe spread data, regions along the eastern seaboard and south-west of Western Australia would most support SWD establishment (figure 4). This model will aid biosecurity authorities and industry respond to an incursion effectively if an SWD incursion were to occur and will support industry in predicting where the fly would be most likely to establish.

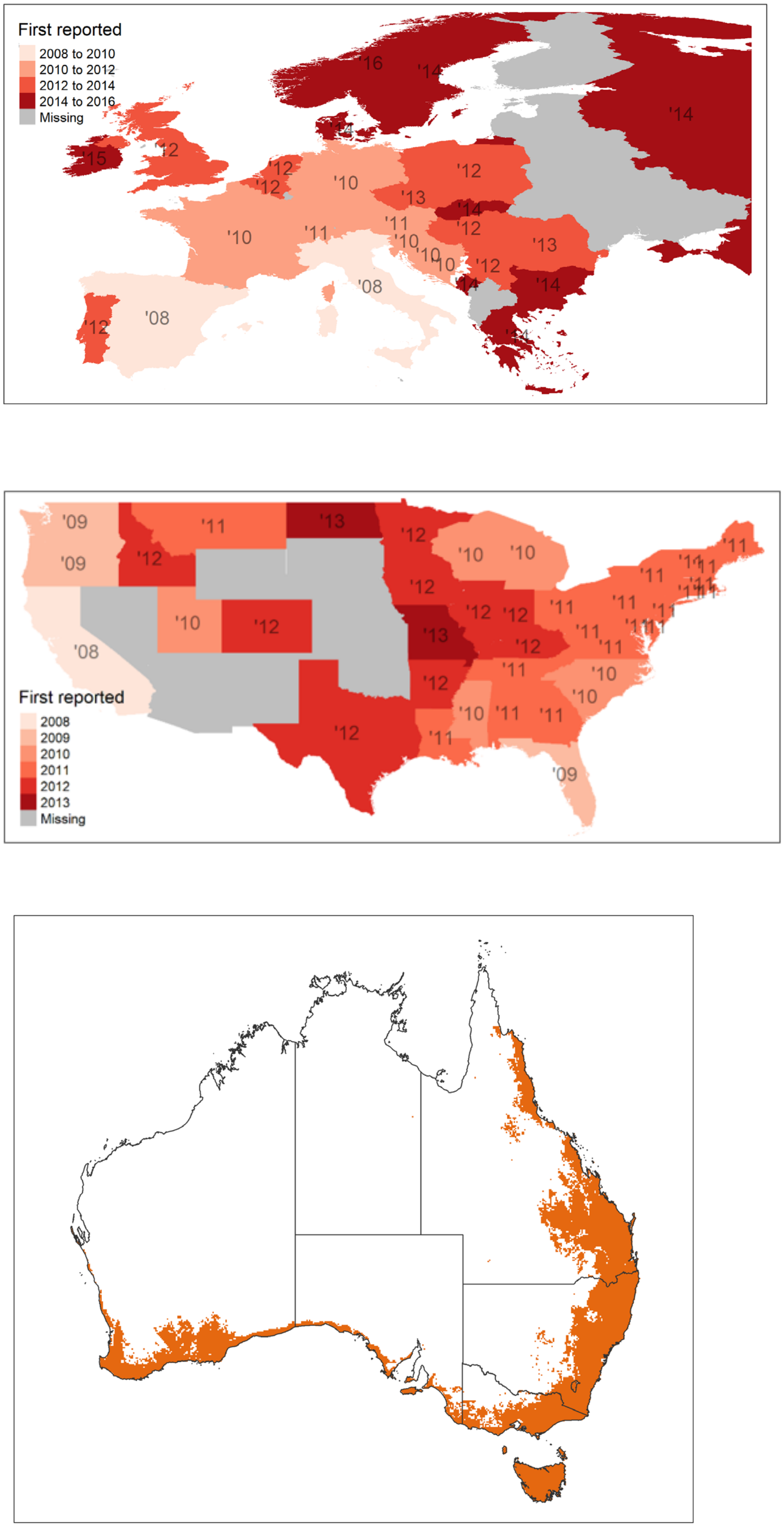

Figure 4. Rate of SWD spread in Europe (top), US (middle), and SWD establishment potential (bottom). Credit: Dr James Maino, **cesar.** Overseas spread data based on Ørsted & Ørsted (2018).

Sources:

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Article 2

Spotted wing drosophila: spread & establishment

*Authors: Francesca Noakes and Jessica Lye, **cesar** (2019)*

The spotted wing drosophila (SWD: *Drosophila suzukii*) is a global pest of soft fruit industries and was the subject of MT17005, a 2018-2020 Hort Innovation funded biosecurity project led by Plant Health Australia, in collaboration with cesar, Plant and Food Research NZ and Horticulture New Zealand. The SWD is not found in Australia, but recent incursions in the United States and Europe have raised concerns about the production impact if this fly were to breach Australian borders.

MT17005 further developing industry understanding of the SWD and the risks posed to Australian growers by this pest. Part of this research included developing models that predict the rate of spread and likely regions for establishment in Australia. Using these models, researchers were able to predict probable establishment regions in Australia, and therefore infer the potential impacts to key soft-fruit growing regions if establishment were to occur. The information generated from the models could be used for a variety of purposes, including use by government and industry groups to direct surveillance activities aimed at early detection of the pest. While building accurate prediction models can be complex, understanding how these models work, the underlying assumptions on which they are based, and what they are predicting is important if industry and government are to use modelling data effectively for eradication, containment or management efforts.

Predicting spread & establishment
The MT17005 spread and establishment model considers:

- Pest biology
- Climate
- Human movement
- Host availability

Each layer of data increases the accuracy of the model if underpinning assumptions about dispersal and growth potential are accurate. To test accuracy, **cesar** researchers fitted the final model parameters to known SWD spread data (from the United States) and then testing the model against another set of spread data (from Europe). A close fit between the MT17005 model spread and establishment prediction for Europe and the actual data gave researchers confidence that the model is robust.

Establishing initial parameters for growth
In building a model of SWD establishment researchers first began with what was known about the pest biology and the response of SWD population growth under different climatic conditions. By determining climatic growth parameters, researchers were able to map SWD establishment potential according to global climate data (figure 1). Based on a purely climatic perspective, temperate regions offer the most attractive conditions for population growth of SWD.

Note: while the climatic growth rate provides an indication of optimal conditions for population expansion (10°C-25°C), this doesn't mean that SWD cannot survive short-term fluctuations below or above these temperatures. Overseas studies have shown that the SWD can be found to survive in locations where temperatures reach up to 43°C or drop below 0°C.

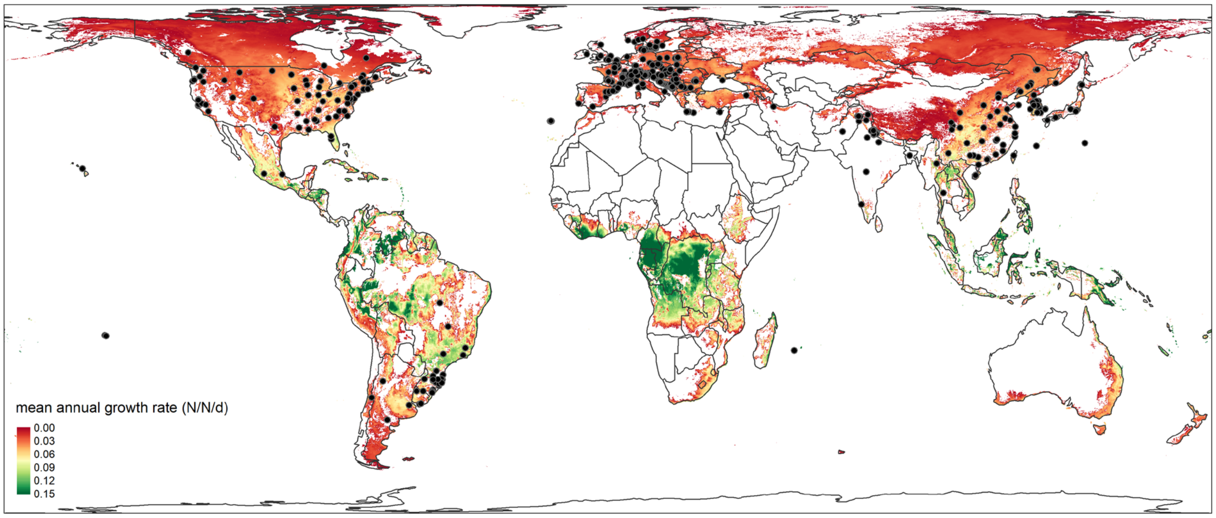


Figure 1. Mean growth rate potential for SWD based on climate, using MT17005 model. Dots indicate detections of SWD. Credit: James Maino, **cesar**

Nuancing the model to predict spread rate

While using pest biology and climatic data supports a basic model for predicting habitable regions for SWD, to really understand how quickly SWD could spread in Australia researchers developed a more nuanced and realistic model by incorporating known data relating to flight-based spread of SWD, and landscape level variables such as seasonality and human movement. Unfortunately for containment strategies, SWD can hitchhike in fruit carried by humans and in cargo. As a result, urban centres can often act as entry and dispersal points in the spread of the SWD. This means that a spread model needs to account for short-range dispersal (flight) and long-range dispersal (human-mediated movement of infested fruit).

The model also needed to account for something called the 'Allee Effect'. This stipulates the minimum number of individual flies that need to be present in a specific location for establishment to occur. This boils down to a numbers game – individual survival and reproduction depends on the presence of others of the same species.

Testing the model & making predications

To test the strength of the MT17005 model predictions, researchers validated the model against data for known dispersal patterns across Europe. By mapping the MT17005 model spread predictions against documented population movements over time, testing of the model indicated an accuracy of 75-85%.

Having validated the spread model, researchers applied predictions to the Australian context. To make predictions about what production regions would be most at risk by this species researchers simulated entry of the fly into Australia at different locations.

The prediction map in figure 2 assumes an incursion in Cairns and a spread rate over ten years. Under this scenario establishment is predicted to occur along the east and south-east coast of Australia where appropriate climatic conditions combine with large amounts of human movement and susceptible crops. The model was used to test what would happen if other cities are the entry point (Brisbane, Adelaide, Darwin, Bundaberg and Melbourne). Despite slight variability, establishment was similar across the different entry points modelled.

Note: While host densities were considered when building the model, an ability to account for their impact on likely establishment patterns was limited by data availability. For instance, the wild blackberry is a noxious weed throughout Australia and potential host for the SWD. However, due to lack of available data researchers were unable to include the impact of this host on establishment.

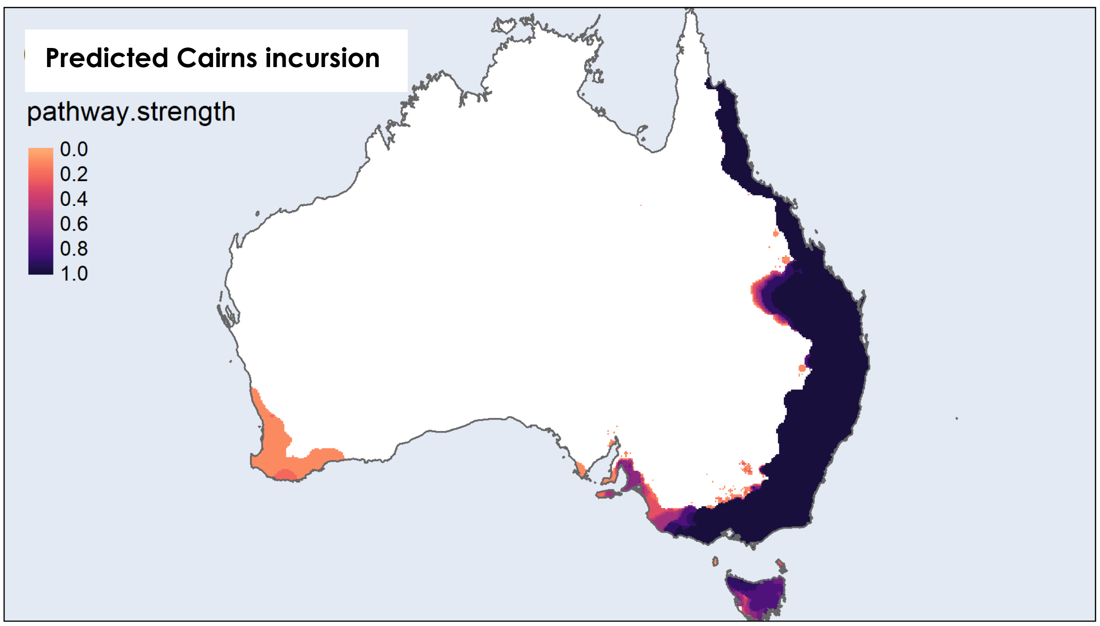
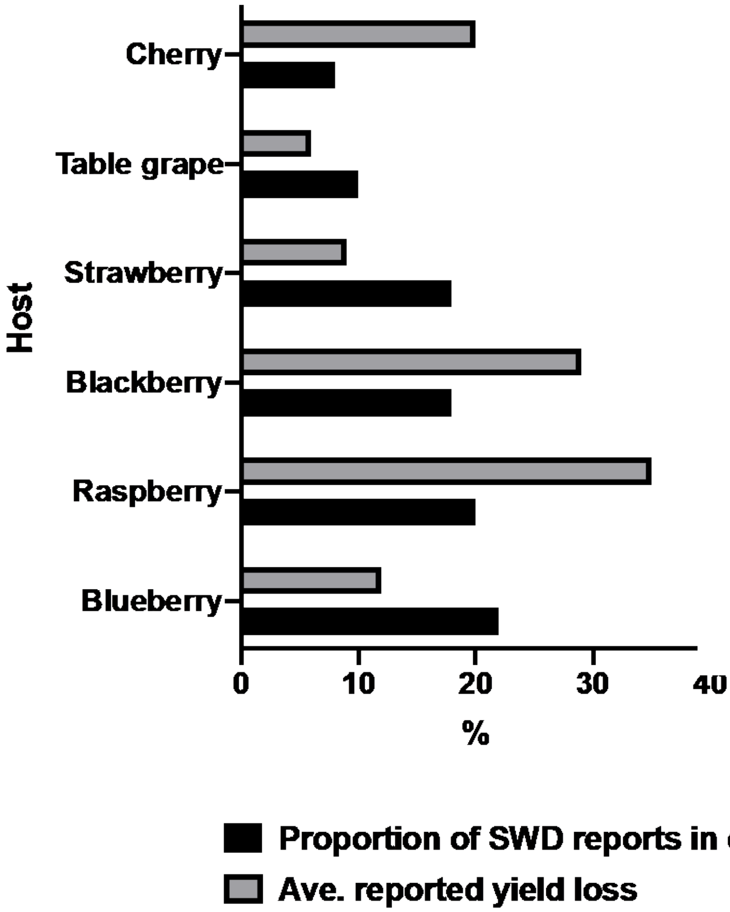


Figure 2. Predicted establishment using expected dispersal pathways for a Cairns incursion scenario
Source: James Maino, **cesar**

Predicted impact on host crop groups

To understand what industries are most susceptible to SWD, the research team referred to international research. The empirical data indicated a level of variability in production losses depending on region, variety, and management practices. While losses in the US and Europe as high as 80% have been reported among *Rubus*, strawberry and cherry crops, production losses of 20-40% on affected farms were found to be more common. The average production loss for affected raspberry crops tended to be highest (35% loss), however this was also subject to significant variability. The research also showed that the most affected industries (based on the number of documented incidents) are blueberries, followed by raspberries, blackberries, strawberries, table grapes and sweet cherries.

Mapping the overseas production impacts against our establishment model and affected commodity distributions, the results indicated an economic risk to most major soft fruit growing regions if SWD establishment were to occur in Australia. The modelling also indicated that attempts at eradication after establishment at a suitable location would likely have low rates of success due to rapid population growth and movement.



	Proportion of SWD reports	Ave. reported yield loss
Blueberry	22%	12%
Raspberry	20%	35%
Blackberry	18%	29%
Strawberry	18%	9%
Table grape	10%	6%
Cherry	8%	20%

Figure 3. The number of SWD reports per crop identified during review of the literature and reported yield loss. Data source: James Maino et al, 2019. [unpublished] Data sourced from European and United States primary reports.

Awareness is crucial

SWD is yet to reach Australian shores and our geographic isolation and border control efforts provide protection. However, given the fast spreading and invasive nature of this pest, developing targeted biosecurity measures and proactively developing a contingency plan is crucial. Industry awareness and on-farm monitoring in susceptible crops will support early detection. A detection made soon after the pest has arrived will give biosecurity authorities a better chance of eradicating the pest. As eradication will be difficult once establishment has occurred, early detection of the pest will be important for actioning effective management strategies.

Article 3

Spotted wing drosophila: the overseas experience

Author: Jessica Lye, ***cesar***

Researcher Dr Kelly Hamby from the University of Maryland has previously described the incursion of Spotted wing drosophila (SWD: *Drosophila suzukii*) in the United States: "*When SWD first invaded, growers and researchers scrambled to find quick solutions, which necessitated using insecticides…Outbreaks of pests that historically were not problematic have occurred in response to SWD management*." ('Growing Produce' Nov 2018).

Through a collaborative Australia-New Zealand research and extension approach (Hort Innovation project MT17005) researchers have investigated how SWD travels long distances, how quickly it would spread after an incursion, and the best methods to detect the fly (figure 1). Modelling work carried out throughout the project predicted that spotted wing drosophila would spread down the eastern seaboard of Australia, as well as Tasmania, and the south west of Western Australia within approximately six years in the absence of control measures.

Figure 1. SWD adults and larvae in raspberry. Source: Hannah Burrack, Bugwood.org

Another aspect of MT17005 included a literature review by Plant and Food Research Australia, which investigated how early overseas detections were made in over 30 countries spanning North America, South America, and Europe.

Fast spread throughout regions and between countries has been supported by this pests ability to survive in warm and cool climates (Figure 2). Only one year after a confirmed 2008 detection of SWD in California the fly had been found in 20 counties across the state, as well as the cooler climate states of Oregon and Washington, and the decidedly warm state of Florida.

How did it travel so quickly? SWD larvae make a home out of developing or ripe fruit until pupation. With the larvae hidden away, long range transmission is supported by movement of produce. In reviewing the academic literature, it was noted that South American researchers were able to rear SWD out of imported blueberries purchased at a Sao Paulo grocery store - blueberries that had been grown in an entirely different Brazilian state.

In fact, several first detections of SWD overseas have occurred near fruit transit hubs. Examples of this include near a grocery store in Sweden, by a selling point for imported fruit in the Netherlands, and in a tourist area in Croatia. The first detection in Hungary was at a highway rest stop. Detections near major seaports have also been common, which may indicate a higher risk of entry and establishment near seaports.

When it comes to more modest expansion of the fly range within a region or country, the rate of spread observed overseas suggests that vehicles play a role, rather than flight-based spread.

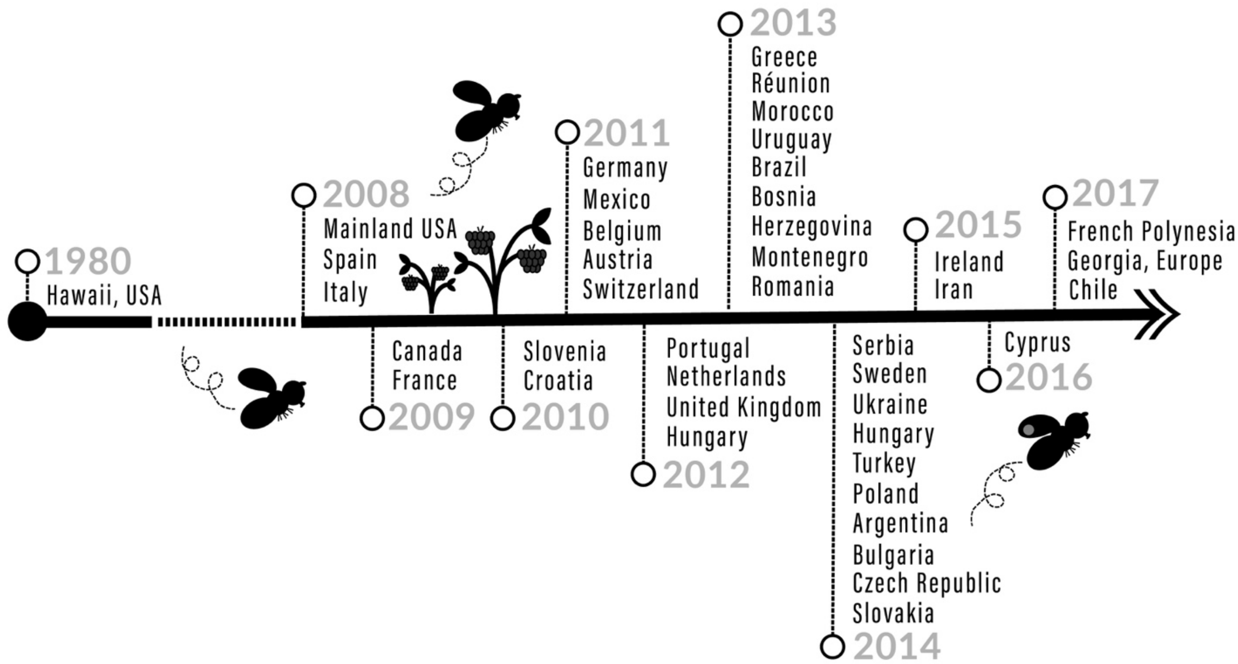


Figure 2. SWD global incursion timeline (1980-2017)

Likely incursion sites

The majority of early detections overseas have occurred in horticultural regions, although this may be a product of proactive trapping and grower vigilance, rather than the fly preferentially establishing in production zones. Indeed, past surveys have shown higher SWD trap counts in wilderness (woodland) areas compared to cropping areas, and those detections made at sites of fruit transit should also be taken into account. The location of proactive trapping efforts or regions where awareness is high is likely to play a large role in where this fly is detected first if it is found in Australia.

Researchers can only speculate on likely incursion sites in Australia at this stage. Early detections made in Europe, South America and the United States in recent years were not necessarily at the site of the initial incursion. Considerations for Australian incursion sites are included below.

- Our berry, grape and stone fruit production zones would be, on the whole, suitable for establishment;
- First detections of SWD commonly occur on the coast;

- Based on how SWD moves long distance (in imported fruit) urban areas are likely incursion sites;
- Imported fruit move through ports and airports, which have been common detection sites overseas;
- Wholesaler and retailer sites are important to consider - unsold imported fruit left in waste piles can present a risk;
- Detection of SWD all year round may be possible in temperate areas of Australia and New Zealand.

Long range movement of imported fruit is the standout risk for bringing SWD into Australia or New Zealand. If SWD were to arrive via long range movement of fruit and subsequently establish, it would need to survive and remain undetected in the face of biosecurity measures and environmental challenges. An on-shore incursion would require:

1. Infestation of fruit and larval survival of post-harvest/pre-export treatments;
2. Survival during shipping;
3. No detection during entry inspections;
4. Finding a mate, and subsequently a host for egg lay.

Catching an incursion early

Exotic pest incursions can be stressful and disruptive for businesses. If SWD were to be detected in a production zone, understanding how your farm can work with biosecurity authorities and minimise disruption of fruit sales from your farm or region is very important. For growers in high risk industries, such as rubus, strawberry and stonefruit, tactics for increasing business resilience are included below.

Table 1. Farm and local preparedness for SWD - action checklist

Preparedness activity	**Supporting actions** For SWD resources visit cesaraustralia.com and planthealthaustralia.com.au
Staff understand how to identify SWD adults or infestation.	• Circulate SWD identification video • Circulate Plant Health Australia SWD fact sheet
A farm operating procedure for reporting a suspect SWD infestation is in place.	• Source pre-emptive advice from your state Biosecurity Authority • Train staff in internal procedure for logging details of an infested site, containing the site, taking a fruit sample and making a report
Trapping protocol developed and ready for execution.	• Identify best trapping locations (heavily wooded areas, wild blackberry stands, fruit waste sites) • Develop data collection method with Biosecurity Authority
Farm biosecurity plan is up to date.	• Identify pest pathway risks

	● Use your Industry Biosecurity Plan to decide on actions to minimise pathway risks (available from your industry body or Plant Health Australia) ● Ensure farm staff have read and follow the plan
Local industry understands the risk.	● Add SWD as an agenda item for discussion at your next local grower group meeting ● Invite somebody from your Biosecurity Authority or Plant Health Australia to present on emergency response procedures to your local industry ● Take Plant Health Australia's online biosecurity training
Local industry has agreed on emergency actions.	● Agree on local level actions if a detection is made ● Set up a local emergency response working group that can be 'activated' to act as an information source and trusted communicator *(consider members from local government, agronomy groups, and influential community groups)*

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Article 4

Spotted wing drosophila: management considerations

*Author: Dr Jessica Lye, **cesar***

The spotted wing drosophila (SWD: *Drosophila suzukii*) is not found in Australia, although it now has a large distribution around the globe. This article discusses what practices growers overseas are using to manage this fly and highlights what Australian growers should consider if management of this fly is ever required.

During project MT17005 researchers collected reports of yield loss resulting from SWD infestation in a range of crops. Reported losses vary from no loss to 100% loss, with the majority yield loss reports arising from raspberry farms. Losses of 20-40% losses are most commonly reported. At least some of the reported yield loss variability can be explained if factoring in the amount of time passed since the initial incursion. When analysing data from US farms, we found that there is a negative trend between time passing and yield loss (figure 1), likely due to improved management practices over time.

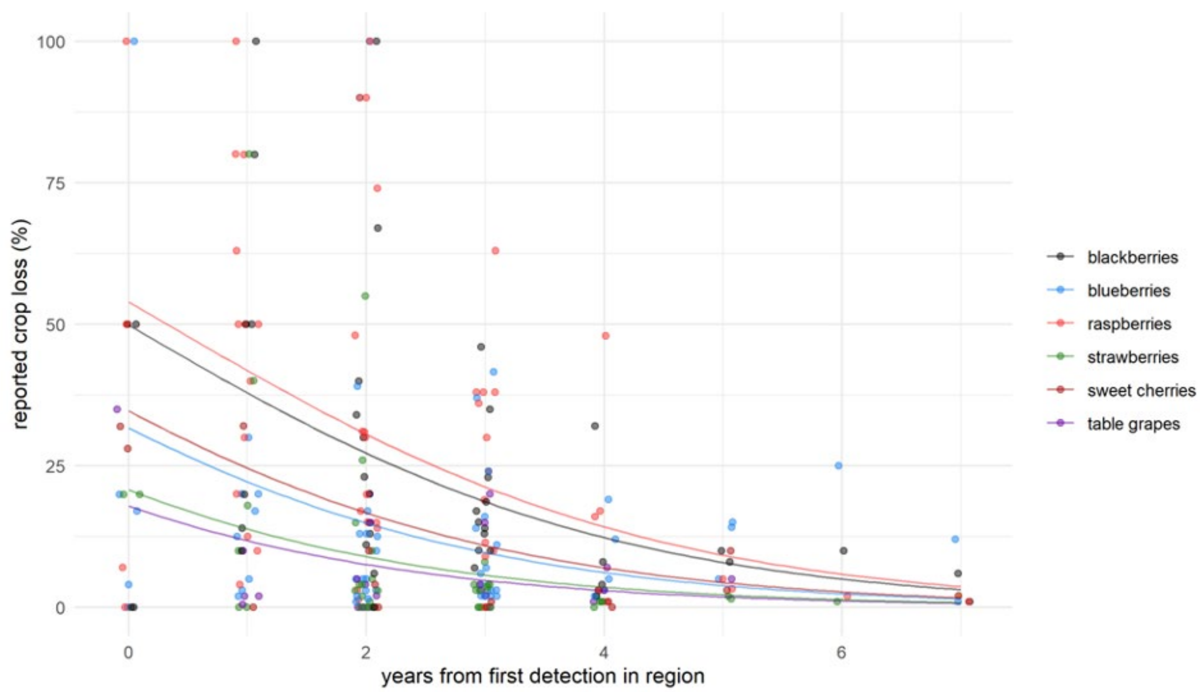

Figure 1. Reported yield losses in host crops overseas over time. Source: Dr James Maino, **cesar**

Management overseas follows an integrated approach, with a heavy focus on cultural controls. In Australia, like overseas, management would involve introducing a range of practices to maintain crop quality and minimize losses. Below we highlight key considerations for management, based on current practices and findings overseas.

Table 1. An integrated approach to SWD management, drawing from learnings overseas

chemical	cultural	biological
• Several products registered overseas. • Applications must be timed to kill adults (aided by precision monitoring). • Overusing of actives has led to resistance risks.	• Netting • Shorter harvest intervals • Careful canopy pruning • Row mowing • Laying plastic mulch • Mass trapping / precision monitoring • Waste disposal measures • Quality control procedures (e.g. floatation tests)	• No single parasitoid has been found to offer good suppression overseas. • Ground dwelling generalist natural enemies are known to help ‘mop up’ larvae and pupae. • Australian native parasitoid wasps of drosophila species may offer ecosystem services (research is ongoing).

1 –Generation time and fecundity

- A female fly lays 1-3 eggs per site and can lay up to 400 eggs throughout her lifetime.
- Population growth throughout a season is highly dependent on environmental conditions.
- SWD will rapidly increase its population size under mild conditions (approx. 22degC)

Table 2. The fastest scenario for population increase, based on work by Tochen et al. (2014)

	Generation time		**Reproductive rate**	
Temperature (degC)	**Cherry**	**Blueberry**	**Cherry**	**Blueberry**
14	43 days	39 days	Low	Low
22	24 days	25 days	High	High
28	12 days	12 days	Very low	Very low

2 – Host preferences

- Raspberries bear the brunt of egg laying compared to strawberries, blueberries, and blackberries.
- This may be due to the thin skin of the raspberry. Research into what drives preferences is ongoing.
- Use of the SWD Host Preference Index (Bellamy et al. 2013) indicates the following hierarchy: raspberry>strawberry>blackberry>cherry>peach>blueberry>grape

3 – Microclimate manipulation

- A humid environment is important for SWD viability.
- Strategic pruning and plant spacing will allow for greater airflow, better chemical coverage and reduce shading.
- Research into optimised pruning methods is ongoing overseas.

4 – Exclusion and mulches

- Exclusion netting must be at least 80 grams.
- Netting must be in place before SWD adults are detected in the area.
- Plastic weed barriers will stop larvae from burrowing into soil to pupate and will reduce presence of standing water, thus reducing humidity.

5 - Chemical control

- If detected in Australia, the minor use and emergency permit system (and registrations) would support access to appropriate chemistry.
- Chemical control must be timed to target the adult.
- Overseas, regular use of a limited number of chemicals has increased risk of resistance.
- Flare-ups of secondary pests, such as scale, has also been an issue.

5 – Natural enemies

- Hort Innovation funded research project reviewing Australian natural enemy options is underway (MT18010).
- Ground dwelling generalists, such as carabid beetles and earwigs are likely to have the greatest suppressive effect.

6 – Reducing harvest intervals

- Reducing harvest intervals will:
  - reduce olfactory attractants from over ripe fruit
  - reduce number of preferred egg laying sites
  - reduce number of larvae that develop into adults, limiting population growth
- Past studies on raspberry indicate harvesting every two days gives good protection from egg lay and does not significantly impact yield.
- Harvesting every three days resulted in a noticeable difference, with more eggs and larvae detected.

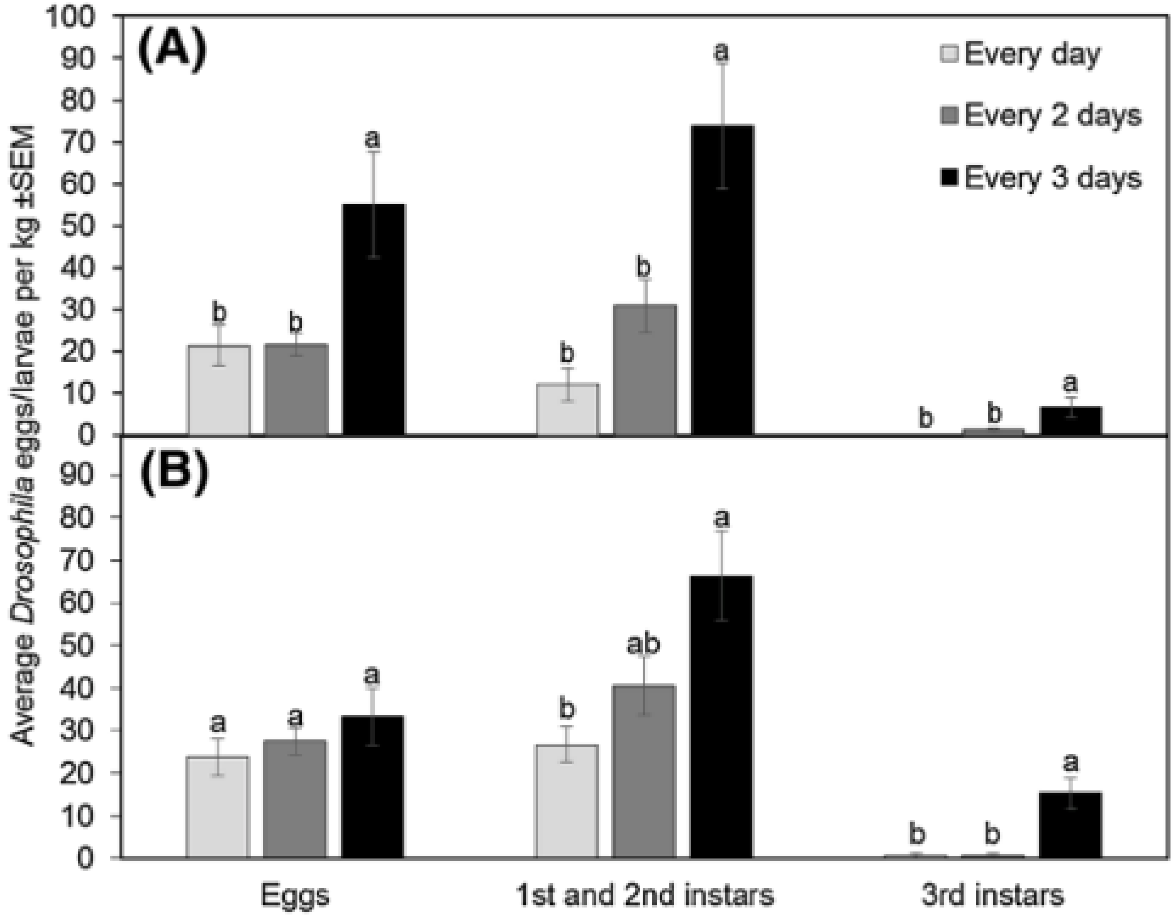

Figure 2. Effect of harvest frequencies on egg and larval presence. Source: Leach et al. (2017)

7 – Quality control

- The floatation test is often used as a batch test for infected fruit.
- Training packing line workers to remove fruit with feeding symptoms (sunken blemishes on fruit are an indicator) adds another layer of quality control.

8 – Waste disposal

- Fruit waste is removed during and after harvest. This includes fruit that has already dropped.
- Waste is sealed in pallet bins or drums. Fermenting of waste for 2-4 days at 18degC, creates an anaerobic environment that will kill larvae.

In Australia, the wide climatic zones spanned by host fruit growing regions will necessitate unique regional management recommendations. If there is an incursion, it is possible that efficiencies could be made by aligning certain practices with those used to manage Queensland fruit fly or Mediterranean fruit fly depending on location.

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