Final Report

Continuation of Pilot Systems to Validate Pest Free Place of Production for Queensland Fruit Fly in the Yarra Valley

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Delivery partner:

Department of Economic Development, Jobs, Transport and Resources

Project code:

MT15028

Project:

Continuation of Pilot Systems to Validate Pest Free Place of Production of Queensland Fruit Fly in the Yarra Valley – MT15028

Disclaimer:

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Content

Summary

Hort Innovation project MT15028 has successfully delivered ongoing market access for Yarra Valley fruit growers consigning produce to the Queensland Fruit Fly (QFF) sensitive markets of South Australia, Tasmania, and Western Australia. Forty nine businesses are accredited with Agriculture Victoria under the Pest Free Place of Production (PFPP) program to consign fresh produce to these markets.

The primary objective of this project has been to establish a QFF regional freedom protocol for domestic market access on an ongoing and sustainable basis. QFF regional freedom is underpinned by a surveillance trapping grid of 129 permanent QFF traps administered in accordance with the Code of Practice for the Management of Queensland fruit fly (the COP), and a plant health accreditation program for participating businesses.

A secondary objective of this project has been to transition the PFPP program to industry lead management upon the conclusion of this project. A new Industry lead Management Committee has been appointed to oversee the ongoing delivery of the program.

The committee has coordinated preparation of a regional QFF management plan and covers:

- communication strategies
- risk assessment and mitigation
- incursion response strategies
- QFF management and control

The findings of the economic evaluation completed on the project show the estimated value of the annual net benefits generated to be between $0.9 and $1.20 million per year across the 20-year evaluation period. This outcome illustrates that investment in the project has been a worthwhile one for both industry and government while these results will help guide our future government decision-making.

Keywords

Yarra Valley; Pest Free Place of Production; PFPP; Queensland fruit fly; QFF; cherry; rubus; strawberry

Introduction

On 1 July 2013, Agriculture Victoria changed its management of Queensland fruit fly (QFF) in Victoria. This loss of QFF freedom impacted Yarra Valley fruit grower's ability to export host produce to sensitive interstate markets including South Australia, Western Australia and Tasmania without the need for costly treatment.

Yarra Valley growers worked with Agriculture Victoria to find an alternative method to access these QFF sensitive interstate markets. The result was the development of an initial 2-year Hort Innovation (formerly Horticulture Australia) project, MT13031 Establishment of systems to validate Pest Free Place of Production for QFF in the Yarra Valley. The Pest Free Place of Production (PFPP) is aligned to the operational principles outlined within the International Standards for Phytosanitary Measures (ISPM) 10 and the technical requirements of the Code of Practice for the Management of Queensland fruit fly.

The objective of this project was to establish regional freedom for QFF for domestic market access. The PFPP status was achieved and maintained through the deployment of an extensive network of surveillance traps to verify the region's ongoing QFF freedom as well as legislation controlling fruit marketing arrangements into the region.

Hort Innovation project MT15028 – Continuation of pilot system to validate Pest Free Place of Production for Queensland fruit fly in the Yarra Valley, progressed the work of the initial project for another 2 years. The objective of this project was to extend the project for a further two years, and establish an ongoing and sustainable model for its ongoing delivery post HIAL investment. This project has also progressed the transition of the PFPP to a sustainable, industry-funded and industry-governed project.

Methodology

The following methodology was adopted to establish a governance framework to coordinate delivery of the project and to implement required surveillance and compliance programs in accordance with national pest management standards:

1. Project governance

The PFPP Management Committee has been diligently working during this project period to ensure a successful transition of the PFPP project to an industry-governed and industry-funded project upon the conclusion of the HIAL project on 31 May 2017.

In May 2017, a new Management Committee was elected and is comprised of members from PFPP accredited businesses. These members represent the main industries of strawberries, cherries and rubus. Additional members include the Victorian Strawberry Industry Development Officer, Shire Yarra Ranges, Yarra Valley QFF Regional Coordinator, and Agriculture Victoria.

Administration of the PFPP will now be conducted under the auspices of Agribusiness Yarra Valley. All fee collection and funds management will be through Agribusiness Yarra Valley, as well as the provision of secretary services for the Management Committee.

2. QFF surveillance

QFF surveillance within the Yarra Valley PFPP is undertaken in accordance with the requirements of the COP. Surveillance operations for the 2015/2016 season included the routine monitoring and maintenance of 126 permanent QFF traps within a defined management region. The traps are located on production and buffer areas. The 2016/2017 season saw trap numbers increase to 129. This increase in trap numbers was due to the addition of one new PS-37 Yarra Valley Pest Free Places of Production accreditation and two new businesses accredited as PFPP source properties.

During the course of this two year Hort Innovation project, a number of suspect QFF detections have occurred. The suspect detections are as follows:

- December 2016 – suspect larvae detection reported by a householder located outside the PFPP
- December 2016 – suspect egg detection reported by PFPP accredited business
- February 2017 – suspect larvae detection reported by PFPP source property
- March 2017 – six suspect QFF detected in one of the permanent surveillance traps located within the PFPP buffer

These suspect detections were confirmed by Agriculture Victoria entomologists as not QFF and required no further action to be taken.

Additionally, in February 2016, one confirmed male QFF was caught in a PFPP buffer trap. Although the COP required no further action to be taken in response to this QFF detection, Agriculture Victoria conducted a thorough investigation. This investigation included conducting larval searches in the area, and resulted in no further QFF being detected. No more QFF have been detected to date.

3. QFF awareness

A PFPP communications plan was developed and delivered in the PFPP region. The plan was developed to raise awareness of the PFPP project to local growers, as well as to raise awareness of the importance of QFF to local industry, community groups and the travelling public. This communications plan included PFPP information

sessions, which were conducted to encourage new participation in the program, as well as presentations conducted at the Raspberries & Blackberries Australia (RABA) annual general meeting. Annual information letters were also distributed to residents and businesses located in the PFPP management region encouraging implementation of hygiene measures to prevent the introduction, establishment and spread of QFF in the area.

The PFPP Management Committee is working closely with the Yarra Valley Regional Governance Group, and the newly appointed Regional Coordinator to deliver upon the Yarra Valley Regional Action Plan. The Action Plan is targeted towards a broad range of stakeholders and has a strong focus on community engagement and awareness of fruit fly. This community awareness will provide great benefit to the PFPP program as it will raise awareness of QFF and the PFPP program to the greater Yarra Valley region.

4. QFF compliance

PFPP properties have been gazetted as a Restricted Area under the Victorian Plant Biosecurity Act 2010 for the control of QFF. This Restricted Area restricts the receipt of uncertified QFF host produce by PFPP accredited business.

All PFPP participating businesses are accredited with Agriculture Victoria on one of two available arrangements. Nine businesses are currently accredited with Agriculture Victoria to consign fresh produce to interstate markets (PS-37 accreditation) and over 40 source properties are approved to supply the accredited businesses with produce.

Outputs

A fruit sanitation and hygiene manual for the district.

A fruit sanitation and hygiene manual has been developed and incorporated into the Yarra Valley PFPP Management Plan (Appendix 2). The Management Plan discusses options for packhouse and orchard hygiene and provides a QFF control activity calendar. The Management Plan also includes PFPP correspondence to local residents and businesses identifying measures that can be employed to assist in keeping the Yarra Valley free of QFF.

A chemical control plan for the district.

A chemical control plan has been developed and is also incorporated into the Management Plan (Appendix 2). The Plan discusses various options available for the control of QFF including bait sprays, mass trapping, cover sprays, and Male Annihilation Technique (MAT).

QFF monitoring requirements, including the adoption of third party monitoring services.

QFF surveillance is conducted in accordance with the COP, which outlines the frequency, rate of QFF monitoring and maintenance activities. The COP also outlines actions required following the detection of QFF and QFF area freedom suspension thresholds. These actions and thresholds are articulated in the Management Plan.

Trap monitoring and maintenance continues to be completed by Agriculture Victoria. The new PFPP Management Committee will work in conjunction with the Yarra Valley Regional Coordinator to assess whether third party trap monitoring will meet the long-term objectives of each program in a cost-effective manner.

A detailed risk assessment to support management decisions for sub-outbreak detections.

A risk assessment has been included in the Management Plan (Appendix 2) and is supported by an Import Risk Analysis undertaken by Agriculture Victoria. The risk assessment has used a number of factors including QFF biology and Yarra Valley climate conditions to assess the likelihood of QFF establishment and spread in the Yarra Valley. Establishment potential and spread potential have both been assessed as moderate for QFF in the Yarra Valley.

As with any pest, action is best taken when populations are at low levels. Once populations become established, eradication becomes more difficult and expensive. It is proposed that corrective action measures be implemented once low levels of QFF have been detected in the PFPP, rather than wait for levels to reach an outbreak threshold.

A QFF incursion contingency plan for the district.

A QFF incursion plan has been incorporated into the Management Plan (Appendix 2). This contingency plan acknowledges that management of a QFF incursion is a shared responsibility between growers, packers, local council(s), industry groups, the community and state government. The contingency plan articulates the roles and responsibilities of each party in the Yarra Valley.

A risk based fruit marketing protocol based on the requirements of ISPM-35.

The PFPP protocol is based on the following four-pronged approach:

- the receipt of uncertified QFF host produce by PFPP accredited businesses is restricted
- monitoring of a surveillance grid to provide ongoing assurance of QFF freedom
- removal of non-commercial QFF host plants from production site
- a final inspection of produce to ensure only QFF free host produce is consigned to fruit fly sensitive interstate markets

The proposed systems approach will see a continuance of the above measures, as well as implementation of corrective action measures, such as bait spraying, once a two-fly threshold has been reached.

Economic analysis

AV has undertaken an evaluation on the project to determine the level of economic return to the state. Findings of the economic evaluation show the estimated value of the annual net benefits generated by the project to be between $0.9 and $1.20 million per year across the 20-year evaluation period. This outcome illustrates that investment in the project has been a worthwhile one for both industry and government while these results will help guide our future government decision-making. A copy of the final evaluation is included as attachment 3.

Outcomes

Outcome: Achieve recognition by all domestic trading partners of QFF area freedom status for the Yarra Valley, and to advance international recognition.

Yarra Valley's QFF freedom status was recognised by domestic trading partners (South Australia, Tasmania, and Western Australia) in November 2013, which required changes to interstate market access legislation to be enacted by each of these states. To achieve this recognition, a detailed trade submission was developed and presented to South Australian, Tasmanian, and Western Australian plant quarantine officials for their acceptance. This trade submission addressed and demonstrated compliance with the requirements of International Standards for Phytosanitary Measures 10 (ISPM-10) titled *Requirements for the establishment of pest free places of production and pest free production sites.* ISPM-10 is universally accepted by domestic plant quarantine agencies as the standard for pest freedom trade negotiations of quarantine material.

The Yarra Valley PFPP project has successfully delivered four seasons of market access for Yarra Valley accredited growers consigning produce to the Queensland Fruit Fly (QFF) sensitive markets of South Australia, Tasmania, and Western Australia. The PFPP QFF surveillance grid continues to confirmed the Yarra Valley's QFF freedom status to domestic trading partners.

QFF area freedom status for the Yarra Valley PFPP is not currently recognised by international markets.

Outcome: Provide a template protocol for implementation of PFPP status for other regions in southern Victoria that can demonstrate, through trapping and inspections, that QFF is not present in their region.

Recognition of the Yarra Valley PFPP by domestic trading partners and subsequent acceptance of the PS-37 procedure has provided a template for implementation of Pest Free Status for other regions of Victoria.

A PS-38 Pest Free Production Site procedure was subsequently developed and accepted by domestic trading partners. The PS-38 procedure, while similar to the PS-37 procedure, has one major difference, PS-38 accredited businesses are not permitted to receive and certify produce from source properties. This arrangement is also underpinned by a surveillance trapping grid, which provides ongoing assurance to trading partners that the area around the production site remains free of QFF.

A business located in south eastern Victoria commenced operation under the PS-38 procedure in mid-2014. An expansion of the existing surveillance trapping grid for this business combined with further interstate negotiations have seen this business transition to a PS-37 accreditation, whereby allowing the business to receive and certify produce from additional source properties.

A further two businesses, one located in south eastern Victoria and one located in south western Victoria, are also successfully operating under the PS-38 accreditation. An additional surveillance grid has been established around a third business located in south western Victoria, in efforts to establish pest free status for this site in the near future.

Outcome: Build industry skills in the management of Biosecurity threats to the region, which may underpin its future with respect to securing international market access for the region's fruit producers.

The Yarra Valley PFPP Management Committee has developed a contingency plan for detections of QFF, which has

been incorporated into the Yarra Valley PFPP Draft Management Plan. This plan includes a QFF incursion response strategy, which is intended to provide a uniform approach to response to QFF detection(s) through adoption of a voluntary code of practice. It has been identified that management of a QFF incursion is a shared responsibility between growers, packers, local council(s), householders, industry groups, and state government. The plan identifies key QFF thresholds and proposes a range of measures for implementation at each level. Early intervention is key in preventing the establishment of QFF in the area.

Outcome: Enable growers to better understand the phytosanitary systems underpinning domestic trade of fresh fruit and vegetables as well as improved on farm Biosecurity strategies implemented to prevent the entry and spread of QFF and other threats to production.

The Yarra Valley PFPP program is unique, in that restrictions on QFF host produce only apply to those businesses choosing to participate in the program. Historically an area wide approach has been taken to fruit fly management (Sunraysia Pest Free Area). This creates a unique situation in which one business may have restrictions related to QFF host material and waste disposal, while the neighbouring business is not restricted on importing QFF host material into the region. This situation poses a risk to the maintenance of QFF freedom in the PFPP.

Evaluation and discussion

An economic evaluation was undertaken by Agriculture Victoria on behalf of the PFPP project. This evaluation took the form of a benefit-cost analysis to determine if commercial-scale growers and marketers of QFF host produce in the Yarra Valley will financially benefit from the continuance of the PFPP project into the long-term future.

The economic evaluation supports the continuation of the PFPP and confirms the PFPP as an economically efficient government-industry model for providing market access to QFF sensitive interstate markets.

Key findings of the evaluation include:

- the PFPP provides good value for money to participating businesses
- the PFPP project could provide large ongoing net gains with estimated annual net benefit of between $0.94 and $1.22 million per year over the next 20 years (dependent on speed of adoption)
- participation in the PFPP becomes a more attractive option for businesses as the costs associated with chemical disinfestation increase

A component of the economic evaluation, was a survey of commercial-scale businesses operating in the Yarra Valley. Forty-five businesses, including PFPP participants as well as non-participants, were invited to take part in this survey. A 65% response rate was achieved comprised of 20 responses from PFPP participants and 9 responses from non-participants.

The survey provided the following insights:

PFPP participant respondents

- all respondents indicated that market access opportunities encouraged their participation in the PFPP
- the majority of respondents indicated that additional factors such as support to other industries in the region, preventing QFF outbreaks, and maintaining relationships with trading partners were also factors in their decision to participate in the PFPP

Non-PFPP participant respondents

- barriers to PFPP participation include lack of knowledge/understanding in how to participate in the PFPP, not financially viable to the business, and the use of QFF treatment options such as fumigation

An annual survey of PS-37 accredited businesses has also been conducted to obtain statistical data around PFPP trade to domestic markets. Data for the 2015/2016 and 2016/2017 can be found in the below tables.

Table 1: Overview of PFPP Consignments for 2015/2016 and 2016/2017 season

	No. Plant Health Assurance Certificates Issued			No. packages			Kgs (estimated)		
	SA	WA	Tas	SA	WA	Tas	SA	WA	Tas
2015/16	184	74	0	20592	20712	0	152,537	2,358	-
TOTAL	258 PHACS			41304 PACKAGES			154,895 KGS		
2016/17	204	13	114	19684	3834	10748	78,694	4,075	42,992
TOTAL	331 PHACS			34266 PACKAGES			125,761 KGS		

Table 2:PFPP Consignments Based on Commodity for 2015/2016 and 2016/2017 season

	Packages			Kgs		
Commodity	SA	WA	TAS	SA	WA	TAS
Blackberry	8,355	1,452		12,533	2,178	-
Blueberry	48			72	-	-
Boysenberries	288			432		
Cherry	480	19,140	-	98,106	-	-
Raspberry	2,732	120	-	4,098	180	-
Red currant	804			1,206	-	-
Strawberry	3,531	-	-	14,320	-	-
Tomato	4,354			21,770		
2015/16 Totals	20,592	20,712	-	152,537	2,358	-
Blackberry	7,218	1,641		12,992	2,954	-
Boysenberries	336			504		
Cherry	607	1,560	-	10,835	-	-
Raspberry	5,033	573	-	9,214	1,031	-
Red currant	624	60		936	90	-
Strawberry	1,924	-	10,748	20,555	-	42,992
Tomato	3,942			23,658		
2016/17 Totals	19,684	3,834	10,748	78,694	4,075	42,992

During the2015/2016 season, approximately 154,895kg of produce was consigned to QFF sensitive interstate markets at an estimated value of just over $2 million. There was a decrease in consignment volumes during the 2016/2017 season with approximately 125,761kg consigned at an estimated value of approximately $1.3 million. This volume decrease has been attributed to unfavourable weather conditions resulting in a below average cherry harvest.

Recommendations

Industry and Government continue to support the Yarra Valley PFPP project and the Yarra Valley Regional Governance Group to:

- ensure continuation of domestic market access arrangements
- promote the benefits of QFF area freedom status for the Yarra Valley region

Scientific refereed publications

None to report

Intellectual property/commercialisation

No commercial IP generated

Acknowledgements

PFPP Management Committee:

Steve Chapman (Chair), Charlotte Brunt (Executive officer), Lou Zarro (Shire Yarra Ranges), Jonathan Eccles (Raspberries & Blackberries Australia (RABA)), Tim Jones (cherry grower and Cherry Growers Australia representative), Angela Atkinson (Victorian Strawberry Industry Development Officer), and John Calle (strawberry grower and Victorian Strawberry Industry Development Committee representative).

Agriculture Victoria:

Gabrielle Vivian-Smith (Chief Plant Health Officer), Gary D'Arcy (Manager Domestic Quarantine), Daniel Mansell (Senior Project Officer, Domestic Quarantine) and Tanya Krause (Project Officer, Domestic Quarantine).

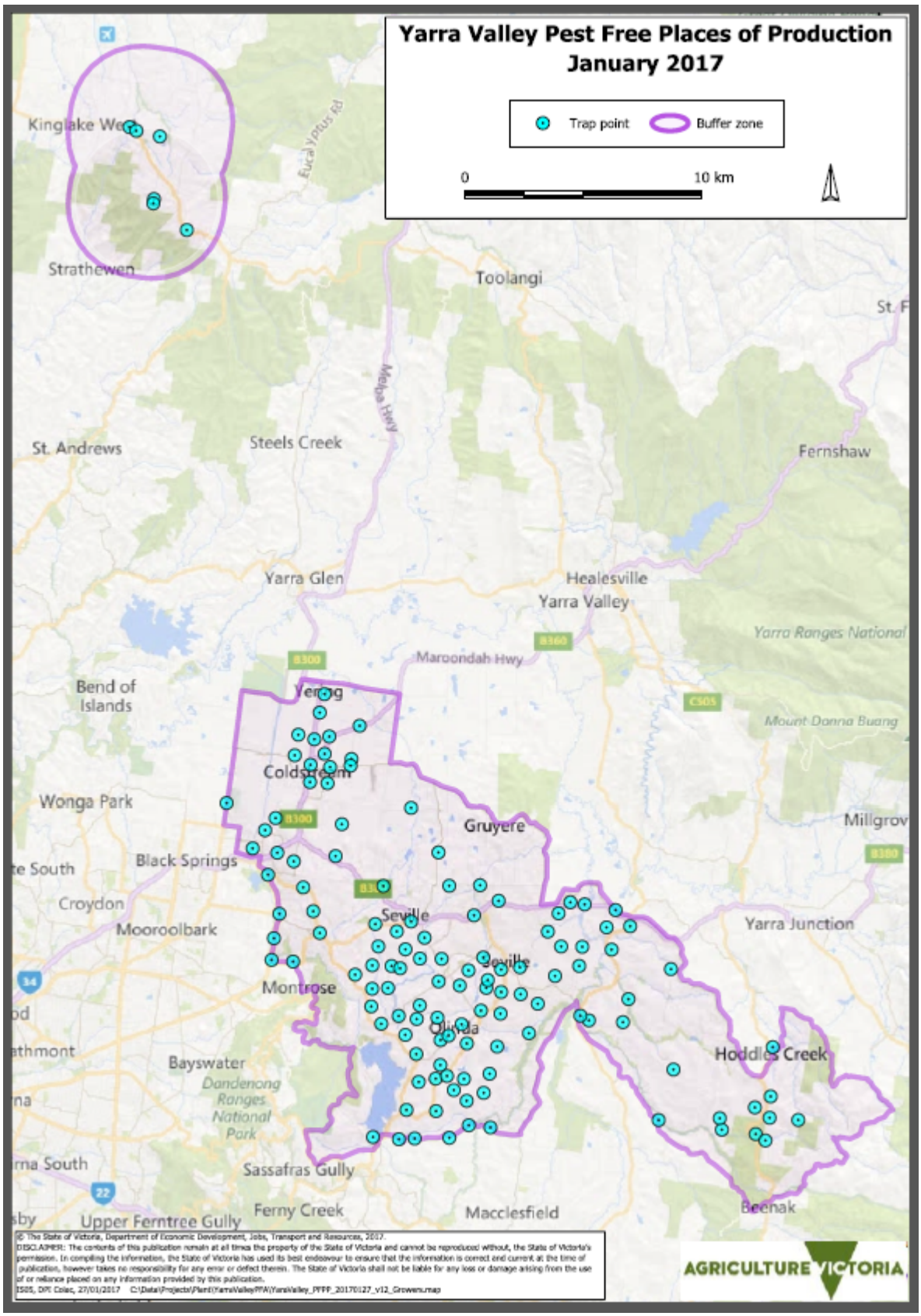
Appendices

Appendix 1: Yarra Valley PFPP Map 2016/2017 Season

Appendix 2: Yarra Valley PFPP Draft Management Plan

Appendix 3: Yarra Valley PFPP Economic Evaluation Report

Appendix 1


Yarra Valley Pest Free Places of Production
January 2017
Trap point
Buffer zone
0
10 km
Kinglake West
Strathewen
Toolangi
St. Andrews
Steels Creek
Fernshaw
Yarra Glen
Healesville
Yarra Valley
Yarra Ranges National
Maroondah Hwy
Bend of Islands
Yering
Coldstream
Mount Donna Buang
Wonga Park
Gruyere
Black Springs
Croydon
Mooroolbark
Seville
Yarra Junction
Montrose
Olinda
Hoddles Creek
Bayswater
Dandenong Ranges National Park
Sassafras Gully
Ferny Creek
Macclesfield
Upper Ferntree Gully
Beenak
AGRICULTURE VICTORIA

Appendix 2

2017

Yarra Valley Pest Free Place of Production

Draft Management Plan

A resource document to guide management of the PFPP

Yarra Valley Pest Free Place of Production Committee
3/17/2017

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Abbreviations and Definitions

CA-19	Pre-harvest monitoring, treatment, and Post-harvest inspection of fruit fly host produce from a low pest prevalence seasonal window
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
ICA 21	Interstate Certification Assurance 21: Preharvest Treatment and Post Harvest Inspection of Stonefruit, pome fruit, persimmons and blueberries
ICA 56	Interstate Certification Assurance 56: Emergency Pre-harvest Baiting and Inspection Protocol for Pest Free Areas
ISPM 10	International Standards for Phytosanitary Measures 10. Requirements for the establishment of pest free places of production and pest free production sites
ISPM 26	International Standards for Phytosanitary Measures 26. Establishment of pest free areas for fruit flies (Tephritidae)
PFPP	Pest Free Places of Production
PICS	Property Identification Codes
QFF	Queensland fruit fly
YV	Yarra Valley

YV PFPP project background

This document combines existing information with new research to provide a resource document for the management of the Yarra Valley Pest Free Place of Production.

THE REGION

Located on metropolitan Melbourne's eastern fringe, less than an hour from the Melbourne CBD, Yarra Ranges Council (synonymous with the Yarra Valley) has a population of 144,541 (Census 2011). The Yarra Ranges covers approximately 2,500 square kilometres and stretches from the densely populated outer suburbs up into the surrounding foothills, agricultural valleys and forested areas of the Great Dividing Ranges (http://www.yarraranges.vic.gov.au/About-Council/About-the-region).

The area is topographically and geologically variable and contains a variety of soil types including ferrosols and grey loams. Elevation ranges from 91m in Montrose to 569m above sea level in Olinda.

The region is a major Victorian producer of strawberries, blackberries, raspberries, apples pears, cherries and wine grapes. The 1850 agricultural properties (>10,700 Ha of crops and >20,000 Ha grazing land) have a combined economic benefit to the region of $818M (http://www.agribusiness-yarravalley.com/about-us/yarra-ranges-region).

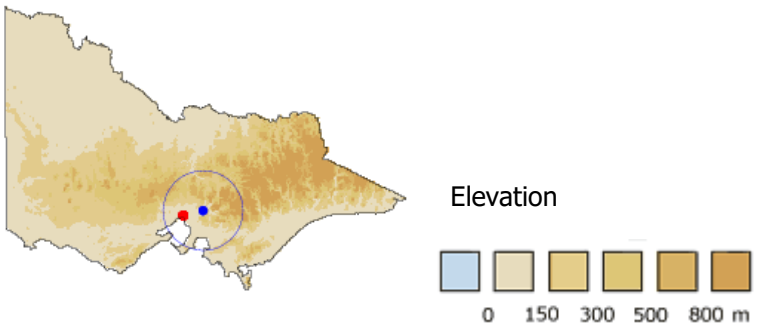


Figure 1: Location of the Yarra Valley in Victoria (BOM accessed 17/4/16)

CLIMATE

Rainfall is winter/spring dominant, with a relatively cool, dry and humid summer. Annual average rainfall ranges between 750-950mm. There is a limited maritime influence and relatively small diurnal temperature range (http://wineyarravalley.com.au/the-yarra-valley-wine-region/climate).

During winter, there are 21 days per year (on average) when minimum daily temperatures are below zero, however significant inter-annual variation exists. For example, in 2013, 26 days below zero were recorded for Coldstream, whilst, in 2014, there were only 10 days. Average maximum and minimum temperatures for Coldstream are shown in Figure 2 below:

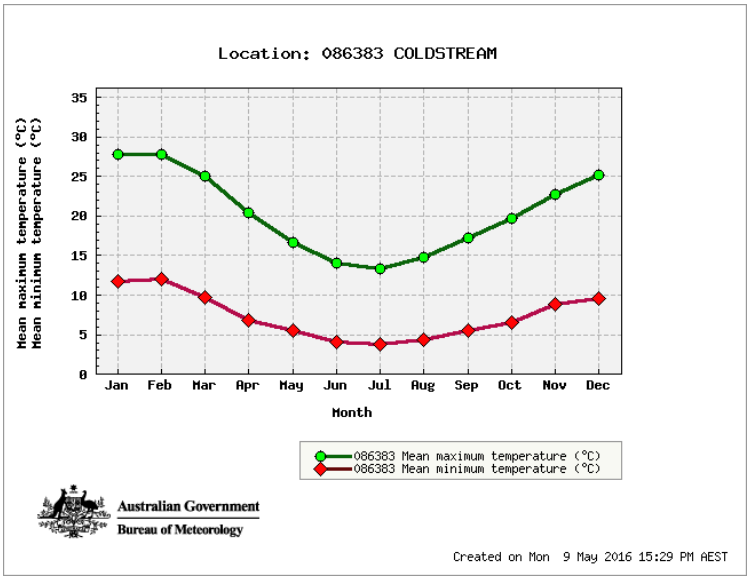


Figure 2: Mean maximum and minimum temperatures (1994-2016 from BOM)

ESTABLISHMENT OF THE PFPP

The Yarra Valley Pest Free Places of Production (PFPP) was developed as a co-funded initiative between industry and the Department of Economic Development, Jobs Transport and Resources (DEDJTR) to facilitate market access in the Yarra Valley (YV). The PFPP provides YV fruit industries with access to area freedom status for QFF, which in turn allows local fruit to be exported to QFF sensitive markets without the need for chemical or cold storage treatment. For the past three years the project has successfully coordinated the maintenance of an extensive network of fruit fly traps and legislation, which applies to individual accredited properties.

Area freedom provided under the PFPP can provide local fruit industries with a significant advantage in comparison to QFF affected industries. These advantages include improved market access opportunities, avoided QFF management and disinfestation costs, and improved fruit quality and shelf life condition.

The PFPP has provided significant benefits to YV fruit industries, with in excess of 160 tonnes ($2 million) of fruit traded from the region to QFF domestic markets in 2014/15 and 2015/16 under area freedom certification. Trade in 2016/17 was lower at 125 tonnes ($1.3 million) due to a poor cherry harvest.

Funding has been secured until May 2017 to continue to allow for fruit fly trap monitoring and project governance. During this time, industry representatives and government will work together to develop a transition plan so that the PFPP operates as a systems approach, is self-funded, self-governed and sustainable into the future.
Queensland fruit fly has been historically absent from the greater Yarra Valley region and southern Victoria. A single detection was made (February 2016) since the trapping grid was significantly expanded with the deployment of over 120 traps under the PFPP program since 2013 (see Figure 3).

However, fruit flies are extending their range and moving into more marginal habitats. The Goulburn Valley has seen unprecedented numbers of flies in the 2014-15 season and areas such as Alexandra, north of the Divide, have seen fruit flies for the first time in the same season.

Figure 3: Map showing area covered as a PFPP

Keeping the Yarra Valley fruit fly free is essential to the success of the PFPP.

TRANSITION TO SYSTEMS APPROACH

The YV QFF program has been designed in accordance with technical specifications described within the Code of Practice for the Management for QFF and International Standards for Phytosanitary Measures (ISPMs), international agreements which underpin trade. Specifically, ISPM 10 (*Requirements for the establishment of pest free places of production and pest free production sites*) and ISPM 26 (*Establishment of pest free areas for fruit flies [Tephritidae]*).

Due to the increasing incidence of QFF across much of Victoria further amendments to the YV protocol are required to better reflect its delivery as a risk based systems approach which should provide greater

opportunity to adopt novel treatment approaches in the event of a QFF incursion in the region. This distinction allows for control before outbreak thresholds are reached, thereby enabling the best possible chance of incursion control whilst allowing trade to continue.

Domestic quarantine allows the movement of fruit from areas where fruit fly is deregulated into fruit fly sensitive markets under Interstate Certification Assurance schemes. It is envisaged that in the future, PFPP packhouses will accept cherries for packing under the cherry systems approach (CA-19 Pre-harvest monitoring, treatment, and Post-harvest inspection of fruit fly host produce from a low pest prevalence seasonal window or equivalent), much as they currently accept fruit coming in under ICA21 (Preharvest Treatment and Post Harvest Inspection of Stonefruit, pome fruit, persimmons and blueberries).

Details of the systems approach may be found under "Actions and thresholds" in this document.

OPPORTUNITIES

Export recognition: Growth in Australian fruit industries is largely contingent on accessing export (domestic and international) markets that are currently restricted due to perceived risks associated with regional QFF status.

The CSIRO have submitted a proposal to Agricultural Trade and Market Access Cooperation programme (ATMAC) to develop a generic, prototype systems approach for gaining market access by fruit fly affected commodities. The Yarra Valley is identified as a case study region and if successful, the Yarra Valley may have international market access without the necessity of an end point treatment, much as Tasmania and the Riverland have today.

There are also synergies with the PFPP and the cherry industry/NSW DPI/Vic Govt systems approach trials which also have an international export market access focus.

GOVERNANCE

The current governance structure is lead by DEDJTR and supported by a Steering Committee with members from industry, the local government and a paid secretariat. Current membership includes:

- Steve Chapman, Chappies, Chair
- Daniel Mansell, DEDJTR
- Tanya Krause, DEDJTR
- Charlotte Brunt, Secretariat
- Lou Zarro, Yarra Ranges Council
- John Calle, Victorian Strawberry Growers
- Jonathan Eccles, Raspberries and Blackberries Australia
- Megan Knigge, Driscolls
- Peter Bursac, Fruit Growers Victoria
- Tim Jones, Wandin Valley Farms

GOVERNANCE TRANSITION

To enable the transition from government, to industry with government oversight, a new structure will be created. It will be governed by a board, with administration and accounting functions auspiced under Agribusiness Yarra Valley.

The focus of the PFPP is domestic market access, however, the probability of the region remaining fruit fly free is greatly enhanced though synergies with the Victorian Government's Queensland fruit fly action plan. The Yarra Valley has been identified as one of three areas for funding, but the Yarra Valley is unique in that it is fruit fly free. A regional co-ordinator will be appointed under this scheme and the regional co-ordinator and the PFPP committee will work together to reduce the probability of QFF entry and take action to eradicate any outbreaks or incursions. If established, the cost of treating for fruit fly is estimated in excess of $400 per hectare. Continuing fruit fly freedom in and of itself has significant benefits for growers.

The cost of participating in the PFPP program are expected to increase significantly in the future. Several models have been developed (see doc PFPP budget estimates) including contributions for background trapping (buffer trapping) funded d under the Regional Action Plan.

Many commercialisation options exist, including:

- User pays – e.g. voluntary contributions – levies by carton or volume, production area, upfront fees, growers paying for their own trapping.
- Industry Development Order (similar to the Greater Sunraysia Pest Free Area)
- Co-operative or company structure

Costs of any future program will include:

- Trap monitoring – DEDJTR or third party accredited.
- Trap surveillance and reporting
- Management of new entity
- Finances and collection of monies
- Governance through steering committee / board or similar
- Coordination and grower support
- QFF outbreak management
- Liaison with State (and Federal) governments

DEDJTR will continue to provide support and oversight by continuing to be involved in:

- Government to Government negotiations;
- Accreditation and auditing;
- Development of contingency plans and operating procedures;
- Assist in incursion management and communications;
- Observers of the new commercial entity when it is established.

Communication strategy

Dr. Tereso Morfe from DEJTR is evaluating economic drivers and the value of the PFPP to local business and Dr. Mick Blake from the Centre for Biosecurity Excellence at Boxhill College of TAFE in Lilydale plans to conduct research into the drivers for adoption of preventative actions. Once understood, these research projects will contribute to informing and further developing communication strategies, messages and materials.

It is the role of all stakeholders to create awareness of their needs and requirements.

- State government has a key role in creating regulatory awareness of the requirements for interstate trade
- Community groups needs to develop awareness mechanisms to inform their stakeholders of the community's needs
- Growers need to create awareness mechanisms for visitors and farm workers of the biosecurity requirements for entry of potential fruit fly host produce onto their property.

A draft communication strategy targeted to ensure awareness in community, travelers and other businesses has been developed by DEDJTR and is outlined below:

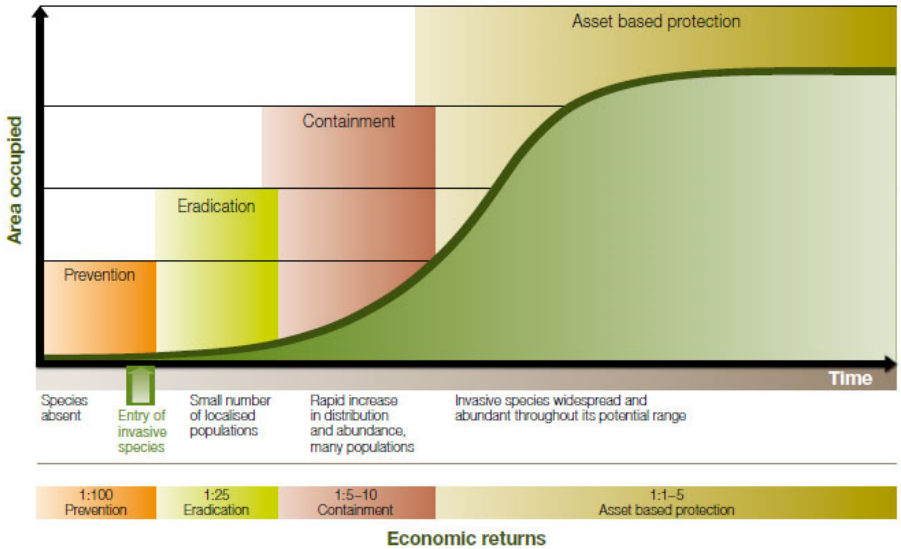
Objective

- To inform identified Victorian growers, industries and residents about the Pest Free Places of Production (PFPP) program operating in the Yarra Valley and encourage non-participating growers to become involved in the program.
- To inform growers and pack houses how fruit must be consigned to meet market access requirements.
- To promote on-farm biosecurity and the benefits offered by the plant property identification code (PIC) program to growers and industries.
- To educate local residents about QFF and its management to help protect the Yarra Valley from QFF infestation.

Key messages

Growers, industry

- It is essential that the Yarra Valley remain fruit fly free. Once established, fruit fly is difficult to eradicate and will impact on export, local growers and gardens. The cost of implementing a commercial fruit fly control program is in excess of $400 per hectare.
- It is much more cost effective to prevent establishment than to eradicate fruit fly



http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/protecting-victoria-from-pest-animals-and-weeds/invasive-plants-and-animals/invasive-plants-and-animals-policy-framework

- A Pest Free Place of Production (PFPP) program is operating in the Yarra Valley to allow participating growers to export QFF host produce to sensitive interstate markets without the need for chemical or cool storage treatments that are detrimental to fruit shelf life.
- Participating growers benefit from access to QFF sensitive markets without the need for costly treatments which are detrimental to fruit shelf life.
- The Yarra Valley PFPP production program is available to all local cherry, rubus and strawberry growers. Contact Tanya Krause – 0412 021 136, to learn more about the program and become a PFPP grower.
- Growers wanting to supply produce to QFF sensitive markets need to meet accreditation requirements set by destination market to maintain market access.
- It remains an offence to sell QFF infested fruit.
- DEDJTR is introducing Property Identification Codes (PICs) to clearly identify grower properties which will help to minimise the impact of a pest or disease outbreak on horticultural production and market access.
- Improve biosecurity on your property to ensure your business is not left exposed to the damaging effects of a plant pest or disease outbreak. Apply for a PIC today.
- Benefit for growers in Tasmania – with special dispensation from DEDJTR, produce can be grown in Tasmania and packed in the PFPP without loss of access to domestic fruit fly sensitive markets.

Local residents

- Queensland fruit fly (QFF) attacks a wide range of fruits and fruiting vegetables, leaving them inedible.
- To safeguard local fruit growers and residents, horticultural industries and government are working together to keep the Yarra Valley QFF free.
- QFF adults are approximately 7 millimetres long, reddish-brown in colour, and have distinct yellow markings.
- Include photos of what QFF adults and larvae look like, and insects such as hoverfly which can be mistaken for fruit fly.
- Development of an QFF ID App which allows residents to take photos, geo-locate and send in for identification.
- If you suspect that you have QFF on your property, report it to DEDJTR on 8371 3500 (Melbourne Markets).
- You can minimise the risk of attracting QFF to your garden by picking fruit as it ripens and disposing of unwanted, fallen or rotten fruit.
- For more information on QFF, visit the DEDJTR website, www.DEDJTR.vic.gov.au/qff or speak to your local nursery, hardware or chemical retailer.

- Include fruit fly segment in gardening show – this has been shown to have a large impact on awareness.

Audiences

- Participating fruit growers and industries (strawberry, rubus, cherry)
- Local residents
- Non-participating local growers and associated businesses (pack houses)

TOOLS & TACTICS

Tool	Description	Timing	Cost	Actioned by
Ministerial - New protocol bears fruit for Yarra Valley growers	Promote new pest-free protocol in place which has allowed Yarra Valley berry and cherry growers to ship to fruit fly sensitive domestic markets without the need for disinfestation treatment.		DEDJTR contribution	DEDJTR
Industry/grower liaison	Attend industry meetings to promote and explain how the PFPP works, its benefits to growers, how PICs can help improve biosecurity on-farm and encourage other Yarra Valley producers to become involved		DEDJTR contribution	DEDJTR
DEDJTR and HIN websites	Maintain PFPP and QFF information on DEDJTR website	Ongoing	DEDJTR contribution	DEDJTR
CSC FAQ	Revise/develop FAQs for Customer Service Centre to handle incoming queries relating to the newly formed Yarra Valley PFPP and QFF	Ongoing	DEDJTR contribution	DEDJTR (T. Krause)
Direct mail/email	Correspondence with participating businesses and industry on PFPP issues	Ongoing	DEDJTR contribution	DEDJTR
Industry updates (email/direct mail, fact sheets)	Notices to industry and YV PFPP accredited businesses about market access requirements and trading restrictions to enable continued market access	Ongoing	DEDJTR contribution	DEDJTR
Industry				
YV PFPP management committee meetings	Hold regular meetings with PFPP management committee members, provide progress reports, discuss and work through any issues and priorities. (Comprises DEDJTR, participating industry reps, some growers and local shire representative)	Monthly, as required	$0	S. Chapman / C Brunt
Newsletter	Include DEDJTR media release in industry newsletter/on website	March 2014	$0	Industry
Grower meetings	Promote and explain how the PFPP works, its benefits to growers, encourage other Yarra Valley producers to become involved	Ongoing	$$	Industry
Participating industry website	Post information about the PFPP, its benefits and how to become involved	Ongoing	$0	Industry
Local media release – about QFF	Reminder about QFF and garden hygiene needed during spring to minimise the risk of attracting QFF	September	$0	Industry
Local media release – PFPP	Promote PFPP, encourage non-participating industry growers to join	TBA	$0	Industry

Local media release – QFF Dec holiday reminder	Encourage visitors to not bring QFF host produce into the Yarra Valley over the holidays	December	$0	Industry
Poster	Develop A3 pdf poster for use by participating businesses, highlighting the need for property visitors to follow entry conditions.		$$	Industry
Local media release – summer garden hygiene	Encourage residents to implement good garden hygiene to minimise risk of QFF infestation		$0	Industry or DEDJTR
Local media release – QFF holiday reminders	Encourage residents to implement good garden hygiene, remind visitors to not bring QFF host produce onto participating PFPPs over the Easter holidays (Note: only relevant if there are businesses who run tourism arm on their PFPP)		$0	Industry
Participating growers (typically those with tourism business)				
Property entry signage	Promote the need for participating businesses to purchase and use biosecurity signage to help notify visitors to contact the property owner before entering production areas	Ongoing	$40 each www.farmbiosecurity.com.au	Growers
Participating grower website	Include message for visitors to not bring QFF host produce onto properties		$0	Growers
Poster	Display poster at frequently visited indoor places on property (e.g. café, tearoom, chemical shed, restroom) to reinforce the need for visitors to avoid bringing QFF host fruits onto the property	Ongoing	$0	Growers
Local council				
Local council website	Include project snapshot on 'What's New' and business section and FAQs , add QFF to pest control – insects and bugs page	Ongoing	Council contribution	Local council
Direct mail/letterbox drop/insert	Inform households about the new PFPP, what they can do to help support local growers and their community		Council contribution	Local council
TOTAL			$	

DRAFT CALL FOR APPLICATIONS:

Yarra Valley Pest Free Places of Production for Market Access

Call for Applications

The Yarra Valley Pest Free Places of Production (PFPP) Management Committee are seeking applications from businesses in the Yarra Valley to participate in the project. The Yarra Valley PFPP was developed to provide flexible market access opportunities for local Yarra Valley fruit industries and has now been successfully operating for two years.

Why participate?

- Access the markets of South Australia, Western Australia and Tasmania without treatment for Queensland fruit fly
- Better fruit quality and shelf life when compared to available treatment options for these interstate markets
- Reduced logistical requirements – can send straight from farm any day of the week
- Obtain accreditation from the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) to self-certify produce

Currently, Yarra Valley businesses not involved in the project must treat and certify produce destined for to the Queensland fruit fly (QFF) sensitive domestic markets of Western Australia, Tasmania and South Australia.

Yarra Valley businesses that obtain accreditation with DEDJTR are not required to treat QFF host produce consigned to Western Australian, Tasmanian and South Australian markets.

If your business would like to be involved in the Yarra Valley PFPP, please contact:

XXXXX

A set of questions and answers are attached which provide further information regarding the Yarra Valley PFPP.

DRAFT FAQ

Yarra Valley Pest Free Places of Production Frequently Asked Questions

What is a Pest Free Place of Production (PFPP)?

A Pest Free Place of Production (PFPP) is a program that aligns with the International Standards for Phytosanitary Measures (ISPM) 10 *Requirements for the establishment of Pest free places of production and Pest free production sites*.

Why does the program align to ISPM 10?

ISPM 10 sets internationally recognised standards for the development of Pest Free Places of Production. By aligning the Yarra Valley PFPP with ISPM 10, domestic and international market access negotiations are more likely to be accepted by trading partners.

Will I need to change my business practices to participate?

Participating businesses may need to change some current practices to participate in the Yarra Valley PFPP. General requirements for participating business will be:

- Obtain DEDJTR accreditation for issuing Plant Health Assurance Certificates (PHAC)
- Only receive certified produce, or produce from other Yarra Valley PFPP participating growers
- Non-commercial host plants must be removed from the production site
- Waste QFF host produce must not be disposed on site

Will my business be impacted if I do not want to participate?

No, businesses not wishing to participate in the Yarra Valley PFPP will not be impacted in any way. Non-participating businesses may still receive uncertified produce for packing or forwarding and are still able to consign their produce to QFF non-sensitive markets (e.g. Melbourne, Sydney, Brisbane). It remains an offence to sell produce that is infested with QFF in Victoria.

How much do I have to pay to be part of the Yarra Valley PFPP?

Currently, businesses will not have to pay for the management of the Yarra Valley PFPP. Businesses seeking domestic market access under the Yarra Valley PFPP will need a DEDJTR accreditation, which will cost around $400-500 annually.

Why do I need accreditation with DEDJTR to participate?

Domestic quarantine authorities require a Plant Health Assurance Certificate (PHAC) to accompany consignments of QFF host produce. A PHAC can only be issued by a Victorian business accredited with DEDJTR. The certificate provides assurance that the consignment has been prepared in accordance with the jurisdictions' quarantine entry conditions.

What markets can I access under the Yarra Valley PFPP?

Tasmania, South Australia and Western Australia accept produce consigned under the Yarra Valley PFPP DEDJTR accreditation. The Yarra Valley PFPP is not currently recognised by international markets.

DRAFT LETTER TO RESIDENTS

Our ref:

Enquiries: Lou Zarro

Phone: 9294 6271

Date XXX

Mr XXXX XXXX
XXXXX XXXX XXX
PO Box XXX
WANDIN NORTH VIC XXX

Important Queensland Fruit Fly Information for Residents and Businesses

Yarra Valley QFF project is financially supported by:

Queensland Fruit Fly (QFF) is one of the world's worst pests of fruit. Its presence can pose a serious threat to both commercial fruit growers and home-grown fruit in urban gardens.

Two years ago, industry representatives in conjunction with local growers, the state government and Council developed the Yarra Valley Pest Free Places of Production (PFPP) QFF management program to obtain market access to South Australian, Western Australian and Tasmanian markets. The PFPP has been successful in providing market access for Yarra Valley fruit growers, packers and agents for the two year period since implementation of the program. To date the traps in place around the Yarra Valley have not detected any QFF, however it is important to remain vigilant to protect against the pest.

The Yarra Valley PFPP Management Committee is seeking new applications from horticultural businesses in the Yarra Valley to participate in the project and gain market access through the PFPP. Details on how your business can nominate are attached.

QFF is still a very real threat to the viability of horticulture in the Yarra Valley. We ask that residents and businesses in the region help ensure that the Yarra Valley remains free from QFF. Please assist by observing the following actions.

How residents in Yarra Ranges can assist:

- You may see traps hanging from trees along the roadside or on farms around the municipality. Please do not interfere with them, inspect them or remove them. They are different to wasp traps and only attract the QFF pest.
- If you have fruit fly host plants in your garden, you should:
    - Prune your fruit trees regularly to a manageable height

- Remove any ripe fruit from host plants before it has a chance to fall on the ground
- Collect fallen fruit immediately and dispose of it in your general waste (not compost)
- Remove any unwanted fruit trees from your property

- Avoid bringing fruit into the area from high risk areas such as northern Victoria or interstate
- Don't discard unwanted fruit into your compost or on the roadsides or in the open
- Protect the region by keeping backyard fruit trees free of over-ripe fruit
- Report any suspicious looking maggots or unknown pest flies that you find in your fruit to a State Government officer. The Council hotline can provide you with those details.

How businesses in Yarra Ranges can assist:

Establishment of the Pest Free Place of Production does not mean that you cannot transport fruit to and from the area. Fruit can be moved between farms or brought into the region for packing. However, it is illegal everywhere in Victoria to transport fruit that is known to be infested with QFF.

The Yarra Valley is one of the main fruit production regions in Australia, especially for berries and cherries. Please help protect jobs and businesses in the Yarra Valley by following this advice regarding fruit management:

- Unwanted fruit and over-ripe fruit should be removed from production areas, this includes fruit that will not be harvested due to damage or other factors
- Waste fruit should be routinely removed from the property
- Avoid disposal of waste fruit on site. In particular, do not spread waste fruit in paddocks or bury it in the soil, as part of the QFF life cycle includes larvae pupation in the soil.

For more information contact the Yarra Ranges Council Community Link on 1300 368 333

EXAMPLE COMMUNITY LETTER FROM SUNRAYSIA

Dear Visitor

Welcome to our beautiful region, we hope you will enjoy your stay and come back to visit many times. Bring your family and friends with you, but please do not bring fruit flies (*Bactrocera tryoni*) and help us protect our agricultural industry by following a few simple rules.

Our fruit industry at risk

Fruit flies are the world's worst fruit pest. Fruit fly has the potential to threaten Australia's $6.9 billion horticultural industry. Our region is particularly affected, with millions of dollars and hundreds of jobs at risk.

The impact of fruit flies on fruit and vegetables

Fruit fly larvae (maggots) cause fruit and vegetables to turn into a soft, mushy mess. Adult female fruit flies lay eggs in the flesh of ripening and ripe fruits and vegetables. Once the eggs hatch, the larva feeds on the fruit, causing it to rot and drop to the ground. This damage will make fruit inedible.

Just one fruit fly can cause an outbreak

Female fruit flies can lay 500 to 800 eggs in their six month life. Fruit flies emerge, feed and mate in two to four days in summer and they hatch in just six to eight days.

This can translate in 700,000 flies in one season originating from just one fly.

You can help

Fruit flies destroy fruit and vegetables grown commercially and in home gardens. Commercial growers have put strategies in place to control fruit fly in their crops, but they cannot control outbreaks in home gardens or caused by spreading fruit flies through travel. Penalties apply for taking fruit, vegetables, plants or flowers across State and quarantine borders.

Please consult the "Traveller's Guide to Australian Interstate Quarantine" or visit www.depi.vic.gov.au/psb for more details.

The future of the valuable Swan Hill region horticulture industry is in your hands.

Council and growers urge you to help reduce the threat that fruit fly poses to the region.

REMEMBER "IF IN DOUBT, THROW IT OUT"

Thank you

Mayor and summerfruit president signatures and logos

Risk assessment and mitigation

The establishment of fruit fly is a real risk: There are no barriers to movement and many host crops. Degree day modeling shows that 2-3 generations of fruit fly would be expected in the Yarra Valley if it became established, making it unsuitable to marginal fruit fly habitat. Whilst not ideal for fruit fly, numbers could build up very quickly if crops were left hanging after adverse hail or rain events and appropriate orchard hygiene was not observed.

Placement of signs alerting travelers that they are entering a "Fruit Fly Free Zone" at major entry points and bins could be considered as a risk mitigation strategy.

OVIPOSITION PREDICTIONS (404DD, SINGLE TRIANGLE MODEL)[1]

Egg laying, or Oviposition dates were determined from the first possible date at which a female fly could reach sexual maturity and have viable eggs using a degree day (DD) model with an interval of 404 degree days, lower developmental threshold of 12.405C and an upper threshold of 36C.

Studies have shown that even if eggs have matured and are viable, mating may be delayed until a sunset temperature of at least 15C is reached (Jessup, 2014). To account for this effect, sunset temperature was calculated when egg development in the overwintering generation was completed (66DD). Sunset temperature was calculated as 70% of the maximum daily temperature.

The models assume that there is a resident population and that overwintering female flies have resorbed their eggs over winter. Flies moving in from other areas are not accounted for.

Single triangle results for oviposition dates for each generation are shown for the Yarra Valley in Table 1 below (data collection for 2016 finished at the end of April 2016):

Data set	**2010-2015**	**2015-2016**
U & L thresholds	12.4C, 36C	12.4C, 36C
Gen 1	7 Jan	19 Dec
Gen 2	26 Feb	6 Feb
Gen 3	NO	29 Mar

Table 1: Oviposition predictions for the Yarra Valley

Two to three generations are predicted for the Yarra Valley. If fruit fly were present, it would be classified as unsuitable to marginal. Predictions indicate that the first generation would be sexually mature and ready to oviposit towards in early January in an average year or mid December in warmer than average years (2015 was the warmest year on record).

[1] Information courtesy of Cherry Growers Australia *Seasonal Pest Absence: Cherry export orchards, mainland Australia* 2017.

POSSIBLE INCURSION SOURCES AND PROJECT RISKS

Once a fruit fly population becomes resident they are much more difficult and expensive to eradicate – it is much better to keep the Yarra Valley fruit fly free. Risks may arise from:

- Fruit moving into the PFPP for packing from regions where fruit fly is endemic. This risk could be managed by firstly identifying high risk areas and deploying traps (juicing plants, un-accredited packing sheds, abandoned orchards). Routine or implementation of voluntary best practice controls mandatory controls at these sites may be necessary.
- Farmers markets
- Incursions may result in increased management costs or suspension of trade
- QFF or other exotic flies caught in private "on farm" traps and not communicated to government, e.g. cherry export traps. If trap catches are not communicated to government, an incursion may be present, but not officially detected. This could potential undermine the state system and reduce confidence with trading partners. The easiest solution is to have mandatory reporting of trap catches by growers which would increase the sensitivity of the trapping grid at no extra cost.

Changes to governance arrangements

- New entity non-functional or functions poorly
- New entity not financially sustainable

Changes in conditions to trade:

- Increased local production in WA and SA
- Export evaluation does not proceed – lost market access opportunities.

Incursion response strategy

This contingency plan is intended to provide a uniform approach for industry to enter into a voluntary code of practice to be used in the event of QFF detection(s).

Once low levels of fruit fly have been detected, management must be swift to avoid establishment. In the event of a QFF incursion, management is a shared responsibility between growers, packers, local council(s), industry groups and state government. Roles and responsibilties include:

Regional co-ordinator: Preparation of the regional plan. QFF and exotic fruit fly species education materials for growers, residents and the community (including factsheets). Prepare case studies e.g. WFT, summerfruit export, table grapes growers. Provide "call centre help-desk" for advice on managing and/or identifying fruit fly. The call centre function could extend to growers reporting abandoned orchards, fruit dumps etc which could then be mapped and managed. Co-

ordinate control activities in conjunction with DEDJTR. Liaise with all stakeholders. Implement signage at major gateways into the region.

PFPP Committee: Preparation of QFF education materials for growers, residents and the community. Work in collaboration with the regional co-ordinator on management aspects peculiar to the PFPP (the PFPP is a subset of the regional action plan). Co-ordinating control activities in conjunction with DEDJTR and the regional co-ordinator.

On-farm biosecurity: The role includes pest management in the case of an outbreak, placement of signage on farm entry points, communication and training of farm biosecurity requirements for visitors and workers and interaction with neighbours. This role is the responsibility of land occupiers and producers. All costs associated with training and signage for on farm biossecurity are to be borne by the land occupier.

PFPP on-farm traps: The cost associated with the monitoring, servicing and deployment of traps on PFPP accredited businesses or properties are to be borne by the accredited business or property.

On-farm pest control: The role includes the choice of control techniques in the event of an outbreak, selection of pesticides, treatment on farm and possibly outside the perimeter (after consultation with appropriate land owners), funding all control measures and contact with neighbours. This role is the responsibility of the land occupiers.

Abandoned orchards and high risk areas: The responsibility for mapping high risk areas such as abandoned orchards lies with the PFPP committee and regional co-ordinator. The responsibility for enforcing the removal of trees from infested lands lies with DEDJTR.

Pest control on local government land: It is the Shire's responsibility to control incursions on council land and roadsides. The cost of control activities, including tree removal is to be borne by council. VicRoads?

Residents/backyard fruit fly management: The role includes fruit fly management and tree husbandry in urban backyards and home orchards on rural blocks or associated with commercial orchards. This is effectively the same as on-farm biosecurity for non-commercial fruit production sites. This role and costs associated with control activities are the responsibility of the land occupier. Decision on management arrangements may be based on information sourced from a range of organizations, including council. However, the sourcing and use of that information is the responsibility of the land occupiers or producers.

Community based fruit fly management: Community group may be formed to service the needs of urban and rural groups. Community guidance on fruit fly management may be based on information sourced from any organisation, including the Shire or YVPFPP, however, sourcing that information is the responsibility of the community group.

Trapping of QFF and exotic fruit fly species: Many interstate and export markets require a demonstration that exotic fruit flies are absent from production areas supplying those markets. It is the role of the state government to oversee all surveillance activities such as trap type and lure, placement and the employment of third party trap inspectors. Costs associated with the monitoring and maintenance of the State trapping grid are to be borne by the State

Integration with on-farm export trapping requirements would vastly improve the resolution of the grid, confidence and early detection of these species. Trapping costs associated with export requirements are to be borne by the export registered business.

Diagnostics: Diagnostics is the identification of suspect flies caught in traps. This is normally conducted in accredited laboratories for flies in state government traps. No formal identification is required for export or other forms of private trapping, but is highly recommended.

	Responsibility				
Role or activity	**Resident**	**Grower /packer**	**Local council**	**State Government**	**Community**
Property biosecurity					
Property pest control					
Community fruit fly management					
Legislation					
Stakeholder awareness					
Trapping of QFF and exotic flies				State Govt traps	
Diagnostics				State Govt traps	
Removing feral trees					
Removing abandoned orchards					

Table 2: Roles and responsibilities in fruit fly management

ACTIONS AND THRESHOLDS

Under the new systems approach:

- Traps will be monitored in accordance with the Code of Practice;
- Corrective actions will be implemented at a 2 fly threshold; and
- Suspension/outbreak is triggered as per the Code of Practice. If an outbreak is triggered, then
- ICA-56: emergency pre-harvest baiting and inspection is implemented.

ICA-56 covers treatment, inspection and certification for produce that has undergone a program of pre-harvest bait sprays for the control of QFF or MFF in areas monitored in accordance with the applicable Code of Practice where a fruit fly outbreak has been declared.

The procedure is separated into two sections, Part A covering grower activities of baiting and inspection, and Part B covering packer activities for packing and certification.

The procedure is only applicable for properties:

- located within the Suspension Area (15km radius) and more than 1.5km from a QFF/MFF outbreak epicentre; and
- where at least one QFF/MFF trap has been installed on the property and is being monitored by the Department of Primary Industries.

Properties located within 1.5km of the outbreak are suspended.

ICA56 is not currently accepted by Tas or WA, but may enable trade to continue with SA.

If multiple outbreaks occur, the management committee is to review situation internally and with trading partners.

In the case of an incursion, the release of sterile flies through the 'SIT Plus' program is likely to be a useful intervention http://horticulture.com.au/what-we-do/sitplus/

Incursion management funding

A small amount of funding for incursion management activities has been included in the budget. However, in any year, trapping funds could be diverted to management activities in the event of an outbreak. A trapping shortfall will then be experienced, but if fruit fly is not controlled, there is no point monitoring. As most outbreaks occur in March or April, very little monitoring funds will be available. Assistance under the regional plan or from other government department could be sought.

It would be prudent for the new committee to amass funds for incursion management.

PFPP ACCREDITED GROWER PROPERTIES

Growers can implement QFF hygiene and control measures at any time. However, trapping with pheromone based lures and MAT is not recommended on YVPFPP participating properties as it can interfere with DEDJTR trap catch numbers (e.g. catches could go unreported and as MAT also contains Cue-lure the population could be underestimated).

However, if 5 or more QFF trap detections have been made within 1 km over a two week period, or outbreak is otherwise declared (a gravid larvae or female detected), MAT may be used on grower properties until area freedom is regained. However a reinstatement period of one generation + 28 days is required if MAT is used.

Bait sprays or cover sprays may be used at any time (according to label directions).

In the event of a single detection, control measures are at the discretion of the land occupier. DEDJTR will not deploy supplementary traps.

Corrective Action Threshold: If 2 to 4 flies are caught within 1 km over a two week period, all host plants (with fruit at a susceptible stage) on accredited properties within 1km of detections is to be treated with a program of at least two (2) bait sprays (not counting repeat spraying if rain occurs within two (2) hours of spraying).

If the 1km zone extends outside of orchard, then consult with council regarding roadsides or public land to spot spray. Alternately, baiting on roadsides/public land could be carried out atthe discretion of the grower

DEDJTR will deploy supplementary trapping for 200m around the site of the detection

Suspension threshold: Suspension is declared if a larvae or a gravid female fly are detected or if five or more flies are caught within 1 km over a 2 week period;

DEDJTR will deploy supplementary trapping over a distance of 200m from the detection (s)

Suspension area: 15km from outbreak epicentre

In situations where orchards are suspended, fruit can be moved interstate using an approved end point treatment such as cold storage (ICA04) or fumigation (ICA07) or preharvest baiting and inspection (ICA-56). If suspension occurs early in the season, pre-harvest treatment and inspection procedures could be considered (ICA21)

Suspension action: Once the suspension threshold has been breached, growers are to implement:

- Orchard hygiene and
- Bait sprays and Biotrap perimeter trapping; OR
- Bait sprays and MAT on their properties OR
- Coversprays

Outbreak duration/Reinstatement period: The area will be reinstated after no flies have been trapped for one generation plus 28 days based on Lenswood data from the COP or Yarra Valley modeling. The beginning of the reinstatement period does not begin until all MAT are removed.

As the PFPP is not managed as a government program, cessation of bait spraying is not is not required before commencement of the reinstatement period.

NON-PFPP ACCREDITED PROPERTIES – FRUIT PRODUCTION SITES

As per PFPP properties

Funding for action? Warchest or if adjacent grower participating in the PFPP, the neighboring grower could supply chemical and / or treat.

PFPP ACCREDITED PROPERTIES – PACKING SHEDS

Corrective action threshold: 2+ flies within 1km over a 2 week period.

Corrective action: Deployment of Biotraps or bait sprays around the perimeter of shed. If using bait sprays, the area must be treated with a program of at least two (2) bait sprays (not counting repeat spraying if rain occurs within two (2) hours of spraying).

Cost to be borne by accredited property.

Suspension threshold: 5+ flies within 1km over a 2 week period.

NON-PFPP ACCREDITED PROPERTIES – PACKING SHEDS

As per PFPP properties for management. No suspension threshold applies

URBAN RESIDENTIAL

Corrective action threshold: 2+ flies within 1km over a 2 week period.

Corrective action: Mail out communications. Reinstatement date does not apply.

Deployment of Biotrap(s) at an approximate spacing of xx within 400m radius of the detection(s). Biotraps have a lifespan of 3-4 months. Suggest that the traps be supplied free of charge. Cost to be borne by? Community groups could be used to deliver traps for a fee (e.g. $2) in the case of an outbreak. This strategy would be cheaper than paying a contractor.

Consider rented residential properties.

COUNCIL, VIC ROADS OR STATE GOVERNMENT LAND OR FACILITIES

Corrective action threshold: 2+ flies within 1km over a 2 week period.

Corrective action: deployment of biotraps/ bait sprays or cover sprays as appropriate. Fruit tree removal as appropriate.

Could engage with Landcare program to remove feral trees from roadsides or public land. Abandoned orchards?

Next steps:

1. Come to a consensus on the new management structure and arrangements
2. Come to a consensus on details of the systems approach, including thresholds and suspension radius and negotiate with trading partners
3. Identify high risk areas; monitor and communicate with landholders
4. Develop signage for Systems Approach accredited properties to raise awareness of fruit fly in the region
5. Seek to understand drivers for preventative action (social, economic etc) so that we have the best chance of keeping the Yarra Valley fruit fly free. – Mick Blake Centre for Biosecurity Excellence

QFF Management - Growers

INTRODUCTION

Fruit flies are extending their range and moving into more marginal habitats where numbers can build up very quickly if not controlled. For example, reports of the number of eggs a female Queensland fruit fly (QFF) can lay in her lifetime range from 800 to 2000 and under favourable conditions (e.g. warm, wet weather), the minimum generation time can be as short as 22 days.

Daily temperatures, moisture availability and the availability of host fruit have a significant effect on QFF survival. Warm, humid areas across Australia can support up to 10 generations per year, whereas colder climates may only be able to sustain 2 generations per year or none at all. QFF will not survive in very cold climates and/ or very dry climates.

The table below (Figure 1) shows the theoretical population increase from the introduction of a single gravid female if there was a) 100% or b) 5% survival from egg to egg-laying female adult at reported egg laying rates of a) 800 or b) 2000 per female in each generation. (Note: The natural sex ratio of QFF is 1:1.) It is not uncommon for flies to mate with siblings.

Reported egg laying rate (eggs/female)	Estimated survival rate	Introduced gravid female	No. of adult females in the first generation	No. of adults in the second generation
800	100%	1	400	320,000
800	5%	1	20	800
2000	100%	1	1000	2,000,000
2000	5%	1	50	5,000

Figure 1: Potential population increases from the introduction of a single gravid female fruit fly

MANAGEMENT OPTIONS

Understanding fruit fly biology allows controls to be put in place at the appropriate time, thereby increasing their effectiveness. The implementation of IPM compatible strategies will not significantly disrupt beneficial insects and should give good control when numbers of QFF are **low**. These methods work synergistically if combined and appropriately timed. For example, good orchard hygiene helps support management strategies such as bait spraying, MAT and perimeter trapping. Good reference material may be found on the Plant Health Australia (PHA) website http://preventfruitfly.com.au.

Figure 2 outlines the fruit fly life cycle and possible interventions at the appropriate stage.

The actions described in Figure 2 are especially useful where a discrete QFF outbreak has occurred in a previously fruit fly free area. In areas where fruit fly is endemic or established, several QFF lifecycles may overlap during the year, especially in areas where weather conditions are warm and humid and a succession of host crops are ripening.

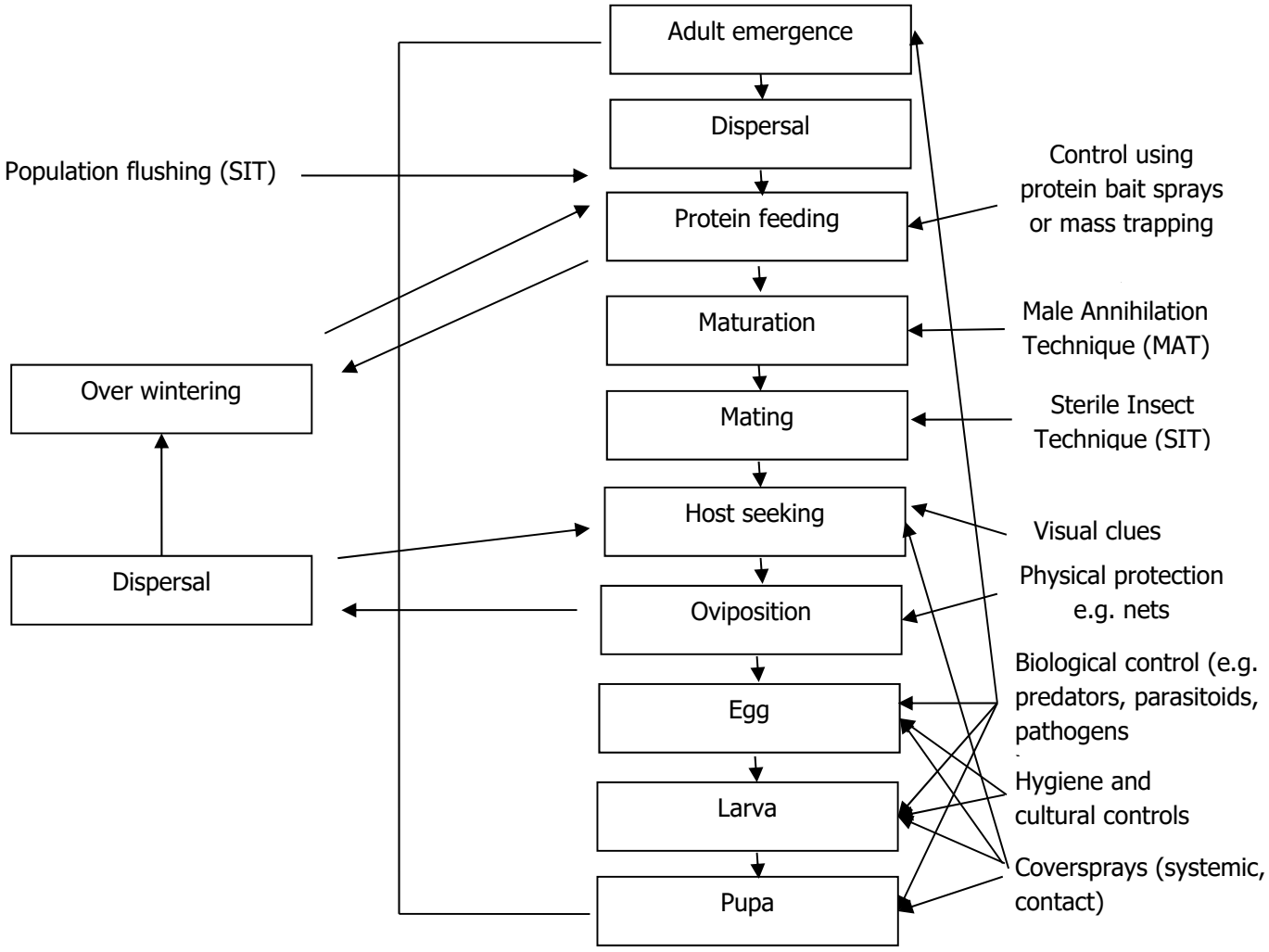


Figure 2. Schematic representation of the life cycle of QFF and potential intervention points for control procedures (modified from Mahat, 2009).

MONITORING

Monitoring is essential to understand Queensland fruit fly population dynamics and pressure. It is also essential for export compliance to protocol countries.

Traps with a Cuelure parapheromone are generally used for monitoring populations and scheduling control activities. Male QFF are not attracted to cue-lure until they are sexually mature. To reach sexual maturity, protein in the form of fungi, bacteria or from other sources is required by male flies.

1. **Monitoring for export compliance (no government monitoring)**

   To comply with export requirements one QFF trap is required per export registered block. If the block is greater than 10Ha, an additional trap must be deployed for each additional 10Ha or part thereof. For example, a 33Ha block would require 4 QFF traps.

   Traps are best placed in the eastern part of the tree to avoid intense afternoon sunlight.

   At a minimum, fortnightly trap monitoring is required from budburst to harvest. It is good practice to monitor weekly after the first fly is caught and to continue trapping until the end of autumn. Record trap catches on the CGA export crop monitoring App.

2. **Monitoring under the Systems Approach (2016/17)**

   In areas where there is area freedom (PFA, PFPP) or state authorised trapping under the Systems Approach, growers should not deploy additional cuelure traps beyond that monitored by the government.

   To avoid interference with trap catches, MAT cups and bait traps/mass traps (e.g. Biotraps, Ceratraps) should not be deployed in systems approach accredited orchards as the population density will not be reflected accurately (Dominiak and Ekman, 2013).

   For more information, contact CGA data@cherrygrowers.org.au.

PACKHOUSE HYGIENE

Good packhouse and orchard hygiene prevents future generations of QFF from infesting the crop by removing larvae and pupae from these sites (IUCN, n.d.). It is a key component of an Integrated Pest Management Program.

PFAs and PFPPs are covered by legislation regarding disposal of fruit and fruit movement. They are not covered in this chapter.

Acceptable methods for disposing of waste fruit in non-PFA or PFPP areas include:

- Cold storage for a minimum of 3C or less for 14 days
- Burning (Dodds et al. 2015)
- Boiling or cooking (Dodds et al. 2015, Clarke, 2014)
- Freezing (DEDJTR and Murray Valley Citrus, n.d.)
- Fermented under plastic (Clarke, 2014).
- Feeding to livestock
- Deep burial – with **at least one metre of compacted soil** on top of waste fruit. **Caution**: Shallow burial or burial without compaction will help pupae and subsequent adults survive and create more problems (Dodds et al., 2015). Deep burial may also not work if the soil cracks or is in dry sandy soil. This method of disposal should be tested for each disposal site to make sure of its efficacy (Jessup, *pers. comm.*)

Small quantities of fruit:

To kill eggs and larvae in small quantities of fruit from packing sheds, campsites or households:

- Place unwanted fruit into a plastic bag and tie shut.
- Either place the bag in the freezer for 24 hours, or leave it in the sun for 3 days, so the heat can kill the fruit fly eggs and larvae.
- Dispose of the bag through the garbage system (do not bury the bag) (IUCN n.d.)

ORCHARD HYGIENE AND CULTURAL CONTROLS

- Host trees (including shade trees) removed or appropriately managed. This includes backyards, on-farm non-commercial and feral trees on property boundaries etc. Appropriate management includes bating, trapping and if necessary cover spraying.
- Erecting biosecurity and fruit fly recognition signage

- Training pickers and packers to recognize fruit fly and stings
- Replacing sprinklers with underground drippers could reduce populations through reducing access to water (Dominiak and Ekman, 2013).

Figure 3: Example of biosecurity signage alerting workers to fruit fly risk

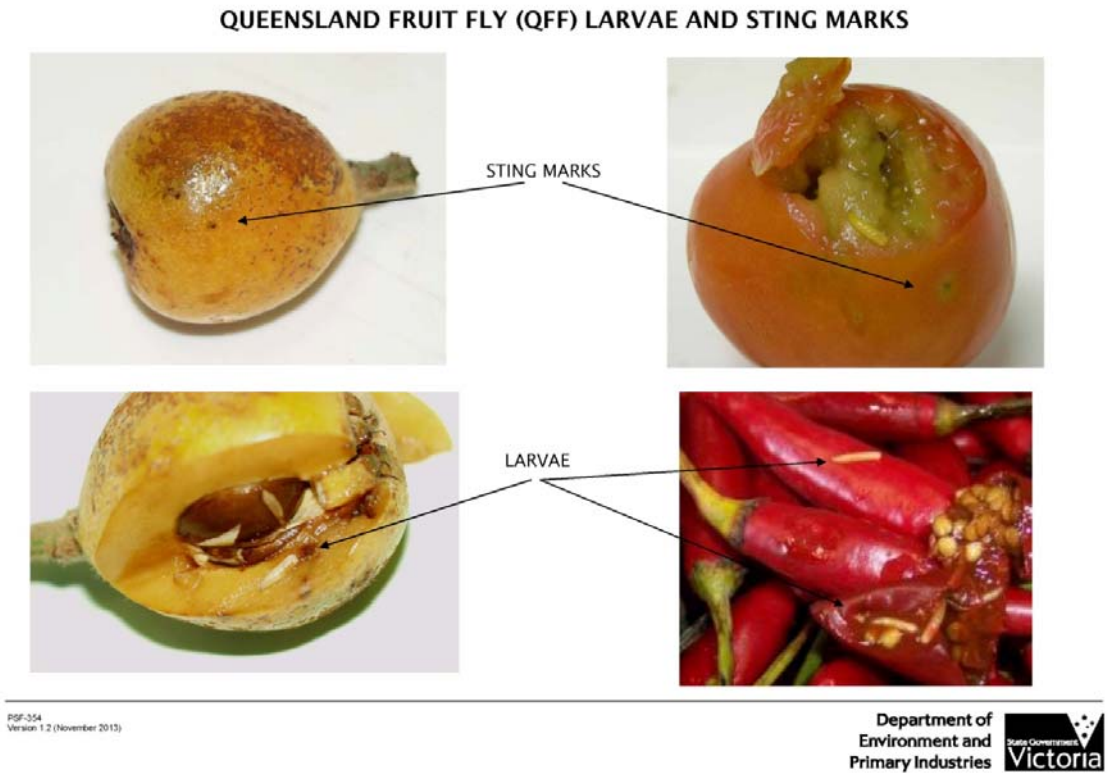


Figure 4: Example of signage for employees on what to look for and how to identify fruit fly (Courtesy EcoDev).

AFTER HARVEST CONTROL METHODS FOR FRUIT LEFT ON TREES AND WINDFALLS

Controlling fruit fly after harvest is critical to ensure that the population going into winter is as low as possible for seasonal window under a systems approach pathway. This can be done by:

- Applying a dimethoate cover spray for unpicked fruit (in the case of hail or rain damage) or otherwise fallen and/or retained fruit – see APVMA permit PER13859.
- Stripping and removing all late-hanging and fallen fruit in autumn (Dodds et al., 2015; Hardy and Jessup, 2012; Williams and Filippi, 2015; IUCN, n.d.) and disposing of them as per guidelines under Packhouse Hygiene in this chapter. This is especially important for late apples and quinces as it is possible that flies can overwinter in these fruits when left on the trees.
- Using bait sprays after harvest to treat flies as they emerge from fallen produce and fruit left on trees (Clarke, 2015)
- Sweeping and mulching fallen fruit on the orchard floor. The key is to break fruit up as desiccation of the fruit halts the development of larvae. This should be done every 10-12 days (or more frequently) (Williams and Filippi, 2015) https://www.youtube.com/watch?v=KadVy8DE9Mw. Sweeping and mulching may be problematic around sprinkler heads, irrigation pipes, training wire, stakes and other apparatus protruding from, or adjacent to, the soil surface.
- Ploughing between rows – soil disturbance – this will work to some extent as ploughing can impact physically on larvae, pupae and emerging adults and also expose these life stages to predators and desiccation (Vargas et al. 2015; Jessup, *pers. comm.*).
- Letting chicken, cattle and sheep into an orchard after harvest will aid in cleaning up fallen fruit which may be infested.

BAIT SPRAYS (PROTEIN)

Baiting is most effective when flies are emerging as adults (from pupae) and in search of protein for development. At this stage, protein baits attract both males and females (IUCN, n.d): Protein is required by female flies for ovarian and egg development (Vargas et al., 2015) and by male flies to reach sexual maturation.

Baiting is most effective when combined with monitoring and good orchard hygiene. If the pressure is moderate to high, female biased traps (mass traps) or MAT may be used in conjunction with bait sprays.

Bait sprays work best when:

- Populations are low (Mahat , 2009)
- Other sources of protein are scarce (e.g. early in the season)
- Applied over the entire area rather than just a few blocks
- Applied in areas where populations may build up or enter the orchard e.g. along watercourses, at the bottom of slopes and on windbreaks surrounding the orchard (Bugs for Bugs, n.d.; see review on this subject by Dominiak and Ekman, 2013)
- Applied in the morning when flies are more likely to feed (Hardy and Jessup, 2012; IUCN, n.d.) and also to reduce fruit and leaf damage caused by dry heat that may occur if applied later in the day (refer to product label)
- Reapplied after hot or rainy weather (Mahat, 2009) or after overhead irrigation
- Applied weekly or twice-weekly, starting early in the season, about 6 weeks before harvest, through harvest and for at least two weeks after harvest in areas where fruit fly is endemic
- Applied inside the crop canopy
- Do not apply bait sprays on the ground as it is ineffective.
- It may be worthwhile targeting the emerging overwintering population e.g. bait spray at 66-82 degree days as a prophylactic measure. Degree day calculations for fruit fly are described at the end of this chapter.

Bait sprays should be applied according to risk. Adjust the frequency of the bait program as needed but avoid contact with fruit and therefore any potential MRL problems.

The addition of gels or thickeners to improve rain-fastness and/or rewetting is recommended by some manufacturers (refer to the chemical label).

Baiting may not be very effective when fruit fly pressure is high (Jessup, 2012) or during periods of frequent showers or rainfall (Bugs for Bugs, n.d.). In these situations bait sprays should be used with other treatments (ICUN, n.d.) such as MAT, mass trapping (BioTrap Gel, Cera trap) or coversprays.

Product details for commonly used bait sprays can be found in Appendix A.

MASS TRAPPING AND PERIMETER TREATMENTS

Mass trapping (e.g. BioTrap Gel® bait trap, Ceratrap etc) are alternatives to using bait sprays. The bait is enclosed in a trap rather than sprayed on the trunk or foliage of the trees. Having the bait and toxicant enclosed in a trap reduces concerns over pesticide residues in fruit or fruit burn as there is no contact with the fruit. Labour costs are also reduced as the traps are effective for a much longer interval than bait sprays (6-12 weeks for traps cf. 7 days for bait sprays) (Hardy and Jessup, 2012). Traps are also rainfast.

Mass-trapping can be effective under high fruit fly populations if used with other activities such as monitoring, baiting, orchard inspection and orchard hygiene (Jessup, *pers. comm.*).

The Greater Sunraysia Pest Free Area has abandoned the traditional 12 week baiting program as outlined in the Queensland Fruit Fly Code of Practice in urban areas because these traditional methods were too labour intensive and expensive (GSPFAID, 2015). The Sunraysia program is now based on a mass trapping matrix with MAT and female targeted lure traps (GSPFAID, 2015).

MAT and mass traps can be deployed as perimeter treatments to reduce the number of flies moving into the orchard from surrounding areas, or high risk areas such as water courses, dams or worker campsites. MAT and mass traps should both be supported by an internal baiting and orchard hygiene program.

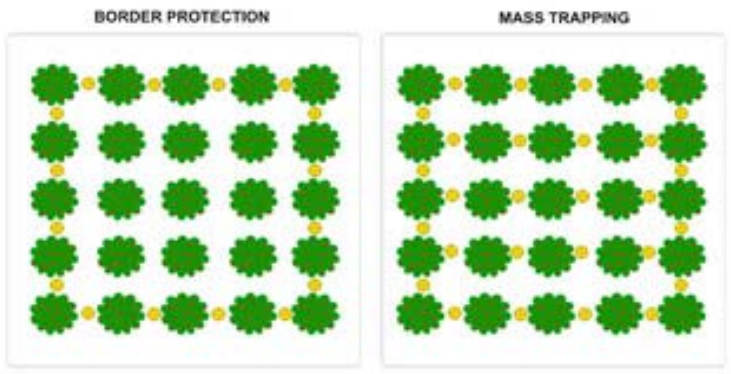


Figure 5: Diagram showing the difference between perimeter treatments (border protection) and mass trapping (from Williams and Filippi, 2015).

MALE ANNIHILATION TECHNIQUE (MAT)

Male Annihilation Technique (MAT) for QFF is based on the same parapheromone as is used for monitoring (Cuelure). The aim of MAT is to suppress male populations so that females cannot find a mate. MAT applications are best suited to isolated environments such as orchards surrounded by grass paddocks, over large areas, or as a perimeter fence to limit migration into the orchard (Dominiak and Nicols, 2012). Control is maximized when MAT is combined with a baiting program or other control methods (Sarwar, 2015, Dominiak and Nichols 2012, Allwood et al., 2002). Deploy 6-8 weeks before harvest.

MAT cannot be used in the Pest Free Areas of the FFEZ or Sunraysia (Dominiak and Nicols, 2012) and should not be used within 200m of a monitoring trap.

MAT products are described in Appendix A.

Figure 6: MAT blocks and cups

COVER SPRAYS

Systemic cover sprays target the adult flies sheltering in the tree canopy and will also kill larvae in the fruit (IUCN, n.d.). Traditionally, the insecticide sprays dimethoate, fenthion, and trichlorfon have been used for this purpose, but the Australian Pesticides and Veterinary Medicines Authority (APVMA) has greatly restricted their use in many crops due to public health and environmental concerns. Fenthion can no longer be used in Australia.

Much of the new chemistry is not systemic and acts only on contact or through ingestion, with the exception of Clothianidin (Samurai) which also has larvicidal action.

Cover sprays are often used in combination with bait sprays to achieve suppression of high QFF populations (IUCN, n.d). Cover sprays in combination with bait sprays and ground sprays have provided the cornerstones of protection in the former Fruit Fly Exclusion Zone (FFEZ) and Risk Reduction Zone (RRZ) (Dominiak, 2012).

A list of cover sprays for cherries is included in Appendix B. **CAUTION: If exporting, be sure to check export MRLS.**

PREDATORS AND PARASITOIDS

As control measures, predators and parasitoids are very ineffective on their own, but can augment IPM programs and other strategies. They are included for interest.

- Natural enemies include birds, rodents and possums (Clarke 2014), amphibians and predatory insects. Letting chicken, cattle and sheep into an orchard after harvest will aid in cleaning up fallen fruit which may be infested (Clarke, 2014).
- Parasitoids (opiine braconids) of the order Hymenoptera lay their eggs into the eggs or larvae of fruit fly. Their distribution varies spatially and temporally: there are more parasitoids in northern than southern Australia and rates of parasitism are highest in late fruit (Clarke, 2014)
- The parasitic wasp, *Fopius arisanus* was released in many locations in Australia (IUCN, n.d.) and has become established in a few places.
- The augmentorium technique uses netted fruit to build up parasitoid numbers in a crop. Stung fruit is netted to trap emerging pupae but parasitoids are able to escape through the holes in the net (Vargas et al, 2015).

DEGREE DAY CALCULATIONS

In areas where fruit fly are endemic, degree day calculations can assist in determining when the overwintering population will emerge and be damaging and to model emergence of subsequent generations. This method is suitable for cooler areas where flies are not active in winter, but not suitable for warmer areas where flies are still active in winter or where there are overlapping generations.

Degree day calculations are based on maximum and minimum temperatures and the model assumes that overwintering female flies have resorbed their eggs over winter (e.g. have become sexually immature).

If using this method to determine when flies are expected to be active; begin degree day calculations on 1 July using temperature data from a nearby weather station. Degree day calculations will not account for flies moving in from other areas. Monitoring will always be very important to understand what is happening with fly populations and to compare predictions with what is happening on the ground.

The fruit fly phenology / degree day relationship is outlined in Table 7 below:

Generation	**Degree Dayss >12.4C**	**Accumulated Degree Days**	**Life Stage**
Generation 0	66-82	66-82	Female flies of the overwintering generation are attracted to bait sprays
Generation 1	404	470	First generation after winter emerges
Generation 2	808	874	Second generation after winter emerges
Generation 3	1212	1278	Third generation after winter emerges

Table 7: Fruit fly phenology as it relates to degree day accumulation. Modified from Jessup, 2014.

The spreadsheet is based on single triangle calculations and can be used for other pests that require degree day calculations such as light brown apple moth or codling moth. Different thresholds apply for different pests. These can be changed in the upper left hand corner. 12.4C is the recommended lower developmental threshold for fruit fly. 36C can be used for the upper threshold if desired.

In addition to determining when generations will emerge or oviposit, degree day calculations can also be used to time interventions such as bait sprays for the overwintering population (e.g. 66-82DD - see calendar of control activities).

For copies of the spreadsheet, please contact Cherry Growers Australia (data@cherrygrowers.org.au).

Appendix A: QFF control activity calendar

Modified from Jessup, 2014. Correlating fruit fly with climate. **Disclaimer:** The information here reflects search results compiled over the past months and is not meant as a recommendation for the use of any products. It is provided as a reference tool only. There is no guarantee that the information provided is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this document.

MONTH		QUEENSLAND FRUIT FLY CONTROL ACTIVITY CALENDAR – SUGGESTIONS	SYSTEMS APPROACH (2016/17)
MAY TO JUNE		• Clear weeds in and around orchards • Clear/mulch or treat (permit 13589) fallen and unwanted unharvested fruit left hanging • Consider clearing (or treating) alternative host and refuge plants within 100m of the orchard perimeter (including the boundary) with special attention to plants in the house block, feral trees and non-commercial fruit trees. Management options include baiting, trapped and, if needed, cover spraying. • Consider host removal in the wider community – backyards, scrub lands, council property, crown land. • Consider underground drippers instead of sprinklers in new blocks or retrofitting – this change could reduce populations through reducing access to water.	Follow recommendations for general QFF control activities in left hand column. • Crop monitors to continue monitoring and recording fruit fly trap catches until the end of Autumn. • In warmer areas it is advisable to continue monitoring for 12 months of the year.
JULY		• Consider degree day calculations to determine generation timing. Recording daily minimum and maximum temps from 1 July for use with the DD spreadsheet on the CGA website	Follow recommendations for general QFF control activities in left hand column. • Continue monitoring in warmer areas
AUG		• Purchase traps, baits and cover sprays approved for fruit fly management /control for the coming season • Put biosecurity/QFF signage out • In warmer areas, put traps out at the start of August or better still, monitor for 12 months of the year	• Sign up to the Systems Approach program with the relevant State government and complete associated paperwork • Implement management procedures for non-commercial hosts within orchard boundary

SEPT		• Train picking and packing staff to identify fruit fly and stings • If doing degree day calculations, apply bait spray when 66-82DD have accumulated (that is, when flies have reached sexual maturity) to target the overwintering population • Set out **traps for monitoring** – 1 per block up to 10Ha. Monitor traps fortnightly from budburst to harvest for **export compliance**. It is best practice to continue monitoring until the end of Autumn to curb any populations that may build up after harvest. • If you are in a moderate to high pressure region, consider Mass trapping – spaced around the orchard perimeter with male traps every 100m and female biased traps between the male traps every 20m. • Also consider putting out MAT along the perimeter, internally or high risk areas, but ensure that MAT is not within 200m of any monitoring traps.	• Implement procedures as outlined within the systems approach program • GAP • Orchard hygiene • Maintain records for pest control and spray diaries
SEPT TO HARVEST	 	ORCHARD • Consider monitoring traps weekly after first flies found and keep records. • In areas where fruit fly is endemic, apply bait sprays weekly or twice-weekly, starting early in the season, about 6 weeks before harvest, through harvest and for at least two weeks after harvest • If fly numbers continue to build up use a registered cover spray (CAUTION: this may not be an option for export markets) • Commence checking fruit for sting marks and infestation. If found, apply a registered cover spray PACKING • Dispose of waste fruit in an appropriate manner through cold-storage (3Cor < for 14 days) burning boiling or cooking, freezing, fermented under plastic, feeding to livestock or deep burial with at least 1m of soil over the top and compaction (CAUTION – see notes in chapter)	• **Systems Approach Corrective Action** Thresholds In the event that zero (0)- one (1) fly is trapped then no action is required. In the event that two (2) to four (4) flies are trapped within 1km within 2 weeks, all host plants (with fruit at a susceptible stage) on registered properties within 1km of detections to be treated with a program of at least two (2) bait sprays (not counting repeat spraying if rain occurs within two (2) hours of spraying). • **Systems Approach Suspension** Threshold: In event that 5 or more flies are trapped within 1km within 2 weeks - registered property or properties are suspended under the fruit fly systems approach for the remainder of the season.
AFTER HARVEST		• Maintain traps to assist in clearing out remaining flies • If baiting was commenced keep baiting once a week for three weeks after harvest to assist in clearing out remaining flies as they emerge from fallen produce left on trees. • If fruit fly populations were very high and required the application of twice weekly baits or cover sprays OR fruit was unpicked (e.g. hail damage) consider using dimethoate (e.g. Rogor) as an after harvest clean up treatment (Permit 13859). • Sweeping and mulching fallen fruit on the orchard floor. This should be	Follow recommendations for general QFF control activities in left hand column.

		done every 10-12 days (or more frequently) as it will limit the number of larvae exiting the fallen fruit and pupating • Stripping and removing all late-hanging and fallen fruit in autumn and disposing of correctly. This is especially important for late apples and quinces as it is possible that flies can overwinter in these fruits when left on the trees. • Ploughing between rows – soil disturbance can work to some extent as ploughing can impact physically on larvae, pupae and emerging adults and also expose these life stages to predators and desiccation • Evaluate years' work and fine tune plans for next year	

You tube videos on fruit fly control:

- Targeted control
- Monitoring
- Food-based baits
- Male annihilation and female-biased traps
- Netting, repellents and field hygiene

Appendix B: QFF chemical control options for cherries

Disclaimer: The information here reflects search results compiled over the past months and is not meant as a recommendation for the use of any products. It is provided as a reference tool only. There is no guarantee that the information provided is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this document.

Product	Attractant	Toxicant	Target	Application	Limitations and comments	Replacement interval
Bait Sprays						
Hym-lure (Biotrap)	Protein – low salt formulation	Approved insecticides (maldison pref.)	Females and males	Bait spray.	Low phytotoxicity	Approximately weekly
Yeast hydrolysate*	Protein - yeast	Chlorpyrifos	Females and males	Bait spray	80g plus 600ml yeast per 30L. **Chlorpyrifos Registered for NSW and QLD only.** *Sometimes yeast hydrolysate is specified in the label, but may not be available in Australia.	Approximately weekly
Pinnacle, Flavax , Natflav	Protein - autolysate	Maldison, chlorpyrifos, trichlorfon	Females and males	Bait spray	Do not apply maldison with the protein Flavax. Check with State authorities as these applications are not registered in all States.	Approximately weekly
Naturalure (DOW Agrosciences, OCP)	Protein autolysate	Spinosad	Females and males	Bait spray.	Potential for resistance. Spinosad has been shown to lose efficacy in the field after 3 days. Slow acting insecticide.	Approximately weekly
Male Annihilation Technique (MAT) – perimeter or high risk area treatment						
Amulet C-L pads (Cropcare, BASF)	Cuelure	Fipronil	Males	MAT	Not a stand alone treatment – best supported by bait sprays. Fipronil is a slow acting insecticide and MAY be passed on to females during mating causing secondary mortality.	16 pads per hectare, replaced every 3 months.
MAT cups (B4B)	Cuelure	Maldison	Males	MAT	Not a stand alone treatment – best supported by bait sprays	3 times per year. Leave in orchard for 12 months of the year.
Mass Traps/bait traps, perimeter or high risk area treatment						
Ceratrap	Protein autolysate in liquid	Pest drowns in liquid.	Females and males	Bait trap	To be supported by an internal baiting program and monitoring program. Approved for organic growers.	Top up with Ceratrap lure as liquid desiccates

Product	Attractant	Toxicant	Target	Application	Limitations and comments	Replacement interval
Biotrap	Gel protein lure in trap	Dichlorvos (knockdown)	Females and males	Bait trap	To be supported by an internal baiting program and monitoring program.	Replace Dichlorvos cube every 3 months
Crop care Ball trap	Torula yeast pellets	Dichlorvos (knockdown)	Females and males	Bait trap	To be supported by an internal baiting program and monitoring program.	4-8 weeks depending on environmental conditions

Cover sprays				
Product	**Toxicant**	**Crop and jurisdiction**	**Application and effect**	**Permit/Registration and comments**
Samurai®	Clothianidin	Persimmons, pome fruit and stonefruit. All States.	Contact and larvacide.	Permit 80790 exp 30th October 2018. Dangerous to bees.
Various	Dimethoate 400g/L- Registered or suspended products	All fruit fly host crops	Orchard hygiene for the control of fruit fly **following the completion of harvest**	Permit 13859 exp 31st July 2024. **Produce treated under this permit must not be harvested, collected or supplied for human or animal consumption.**
Delegate	Spinetoram	Pome and stonefruit: NSW and QLD only.	Suppression only	Permit 12590 exp 31st May 2016.
Imtrade Tryanex 500 SL	Trichlorfon	Stonefruit. QLD, NSW, Vic, WA and NT only.	Non-systemic (contact and ingestion)	Registered. 1st spray 250ml/100L water. AppLy at start of stinging. Repeat at half concentration every 7-10 days.
Dipterex, Lepidex	Trichlorfon	Registration for stonefruit: QLD, NDE, Vic, WA, NT only. Permit for Cherry: ACT, NSW, NT, QLD, SA, Vic, WA.	Non-systemic (contact and ingestion)	Registration for stonefruit. Permit 12450. Exp 31st January 2021. Dangerous to bees.
Fyfanon, Hymal	Maldison	Stonefruit: ACT, NSW, NT, QLD, Vic, SA, WA	Non-systemic (contact only)	Permit 12907. Exp 31t May 2021.

Permits and Registrations for lures and baits

Readers are advised to source a copy of the full permit document from the APVMA website and understand and comply with its contents.

Permit 13785 allows for the use of **lures, attractants, pheromones and certain toxicants** in traps for the purpose of **monitoring and mass trapping** of fruit flies until 30th April 2019.

Fipronil (Amulet Gel®) has label registration for use as a **bait spray on Stonefruit trees and non-fruiting refuge vegetation (except Cherries**). Fipronil is also included as the active ingredient in the Amulet Cue-Lure Fruit Fly Stations®.

Maldison (Hy-Mal®) has label registration for use in combination with **yeast hydrolysate** as **a bait** to control or eradicate fruit fly species. Maldison is also included as the active insecticide in several trap systems and/or replacement wicks including the Q Fly Wick®, Eco-Lure® Male Fruit Fly wick and the Dak Pot® Lure and insecticide trap.

Spinosad (eg Eco-Naturalure®) has label registration as a premixed **fruit fly bait** concentrate for use on fruit trees.

Trichlorfon (eg Lepidex® 500) has label registration in **NSW for use as a bait** in combination with yeast hydrolysate.

Dichlorvos (**BioTrap**® DDVP Cubes) has label registration for use in conjunction with available traps containing a suitable lure for QFF monitoring

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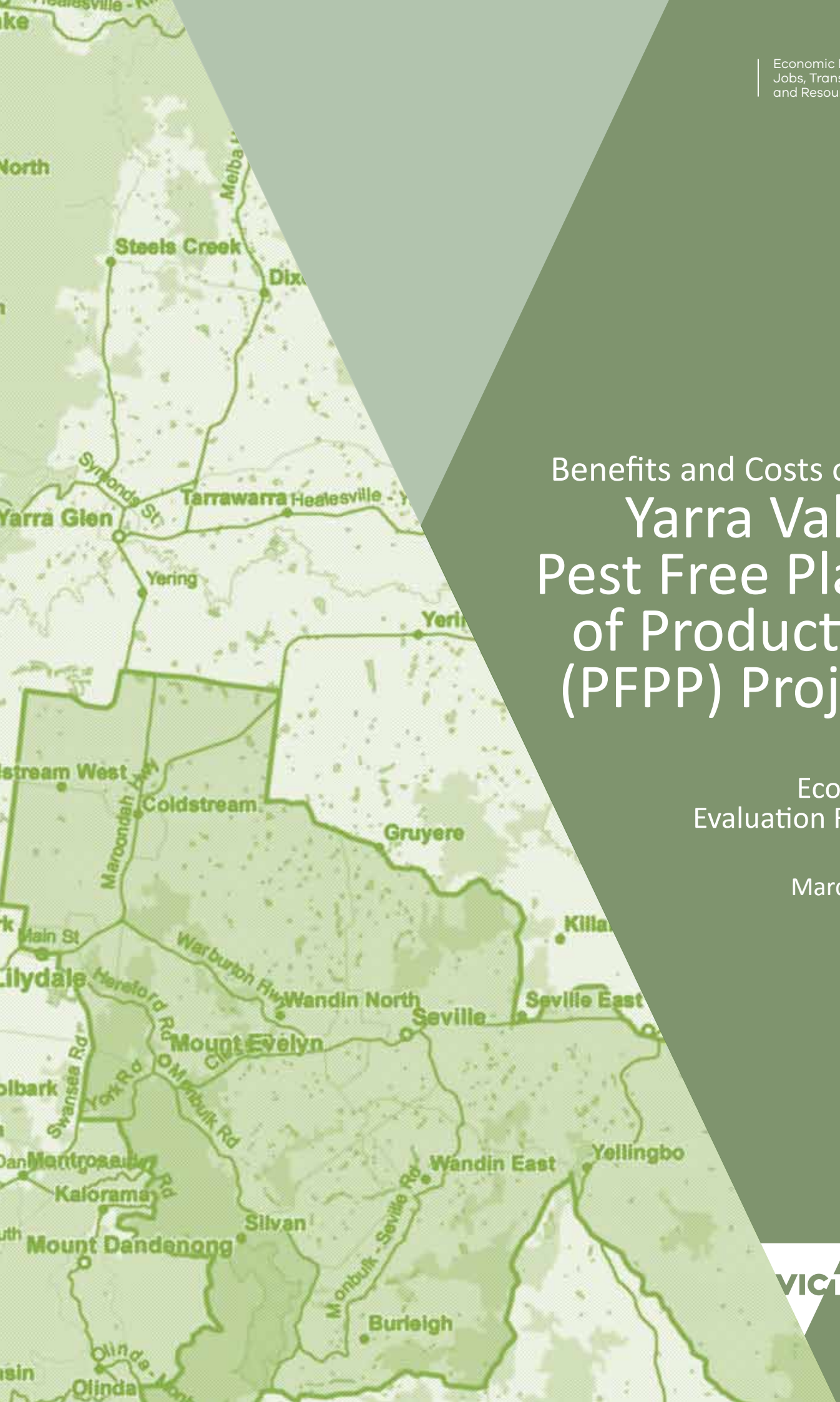

Economic Development, Jobs, Transport and Resources

Benefits and Costs of the Yarra Valley Pest Free Place of Production (PFPP) Project

Economic Evaluation Report

March 2017

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Preface

This economic evaluation was undertaken by Agriculture Victoria on behalf of the Pest Free Place of Production (PFPP) project piloted in 2013 in the Yarra Valley region. An accreditation system has underpinned the PFPP concept as a strategy for enabling market access to Queensland fruit fly (QFF) sensitive markets. The overall aim of this evaluation was to assess the economic merits of the PFPP accreditation system which is an alternative to the existing chemical-based approach to complying with the phytosanitary standards of QFF-sensitive interstate markets. The key question that this evaluation sought to answer was: Are commercial-scale producers and marketers of QFF-host fruits in the Yarra Valley financially better off if the PFPP project were to carry on over the long run?

Methodology

The primary methodology adopted in this economic evaluation was benefit-cost analysis. This was supplemented by a survey of project participants and non-participants to collect project-level data relating to trade benefits, as well as gain some insight into the motivating factors affecting the speed and level of project uptake by industry.

Key findings

The evaluation found that the PFPP project could provide large ongoing net gains to participating businesses, including commercial-scale producers and marketers of QFF-host fruits in the Yarra Valley region. Depending on the speed of adoption, the most likely value of annual net benefit was between $0.94 and $1.22 million per year over the next 20 years.

The estimated value of project benefits, valued in 2016 dollars and discounted at seven per cent comprise about 80 per cent cost savings and 20 per cent avoided losses. Commercial-scale businesses taking up the project system in the Yarra Valley could capture these long-term benefits.

Conclusions

There is economic evidence to suggest that the project is an economically useful model for enhancing access of QFF-host fruits from the Yarra Valley to QFF-sensitive interstate markets. This means the PFPP accreditation system under the pest free place of production concept is a worthy alternative to chemical disinfestation particularly when relatively broader adoption occurs.

Efforts to increase both the speed and level of adoption of the PFPP accreditation system would raise the project's chances of achieving a net gain.

Lessons identified

Based on the findings of this economic evaluation, this report outlines that the PFPP project should consider the following actions:

- Government, community and industry continue to collaboratively engage to promote the private and public benefits of the broader adoption of the PFPP accreditation system to accelerate return on investment
- beneficiary groups to identify strategic opportunities for investment to improve management and fruit marketing arrangements
- streamline government regulatory processes to reduce compliance costs to beneficiary groups
- adopt a long-term funding arrangement between AgVic and the beneficiary industries to ensure compliance with the phytosanitary standards set by different markets
- allow for flexibility in setting the geographical coverage of production areas and the type of produce to include in the project
- work collaboratively with relevant federal and State Government agencies to explore international export market opportunities.

1 Introduction

In July 2013, the government introduced changes to Queensland fruit fly (QFF) management in Victoria. Those changes affected several QFF-free regions including the Yarra Valley. It meant fresh fruits dispatched from the Yarra Valley to QFF-sensitive interstate markets had to undergo disinfestation treatment before consignment.

Following the changes, Agriculture Victoria (AgVic) progressed the testing of the Pest Free Place of Production[1] (PFPP) accreditation system in collaboration with cherry, strawberry and rubus[2] producers and marketers in the Yarra Valley. Horticulture Innovation Australia Limited (HIAL), voluntary contributions and in-kind government contributions, has funded this project. The two main objectives of the PFPP project were to:

- prove the absence of QFF within the Yarra Valley PFPP region for domestic market access through QFF surveillance; and
- provide ongoing assurance that the area remains free of QFF.
- deliver a program compliant with ISPM-10[3] (Pest Free Places of Production) as a basis for interstate trade.

The PFPP accreditation system allows interstate trade of QFF-host fruits without the need for costly pre- and post-harvest treatment. A reliable surveillance data pool collected from approximately 120 permanent QFF traps and fruit inspections support the integrity of the PFPP system. AgVic provides this data to interstate biosecurity agency counterparts as proof of the Yarra Valley region's freedom from QFF.

Participating commercial-scale businesses[4] have so far traded more than 300 consignments of QFF-host fruits from the Yarra Valley without treatment for QFF over a two year period. Businesses under the PFPP system have consigned fruits to Tasmania, Western Australia and South Australia.

The PFPP Management Committee has sought AgVic support in conducting an economic evaluation of the project. For this evaluation, cost savings and avoided losses are looked at as project benefits. Cost savings comprise of three components: those from fumigation, spraying (chemical, machinery and labour) and handling (businesses staff time). The avoided loss refers to the damage caused by chemical treatment of fresh fruits. The estimate of project costs includes government and industry contributions necessary to deliver the PFPP project in the Yarra Valley over the 20-year evaluation period.

1 A "pest free place of production is an area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period. It provides a means for an exporting country, if so required by an importing country, to ensure that consignments of plants, plant products or other regulated articles produced on, and/or moved from, the place of production are free from the pest concerned, because it has been shown to be absent from that place over a relevant period of time...A pest free place of production may be situated in an area where the pest concerned is prevalent and is isolated, if at all, by creating a buffer zone in its immediate vicinity." (FAO 1999, p.5)

2 For this analysis, 'rubus' or berry includes raspberries, cultivated blackberries.

3 International Standard for Phytosanitary Measures 10 (Requirements for the establishment of pest free places of production and pest free production sites) Secretariat of theInternational Plant Protection Convention (IPPC)

4 Here, 'businesses' refers to commercial-scale producers and marketers of QFF-host fruits operating in the Yarra Valley.

1.1 Evaluation aim

The overall aim of this evaluation is to assess the economic merits of the Yarra Valley PFPP project.

1.2 Objective

The specific objective of this evaluation is to carry out a benefit-cost analysis of the PFPP project to inform the PFPP committee about the economic justification for its investment. The key question that this evaluation sought to answer was: Are commercial-scale producers and marketers of QFF-host fruits in the Yarra Valley financially better off if the PFPP project were to carry on over the long run?

2 Methodology

Established analytical approaches, including benefit-cost analysis (Sinden and Thampapillai 1995) and survey (Babbie 2013) were used in this evaluation.

2.1 Benefit-cost analysis modelling

Benefit-cost analysis (BCA) is a formal approach to looking at the economics of government programs, projects and policy initiatives. BCA is a well-known and leading practice in economics. In fact, BCA is the preferred approach across the Victorian Government. BCA applies an ordered process of modelling the benefits and costs of project investments (Appendix 1).

The economic merits of the PFPP project were assessed to determine whether the project provides a net gain to society as a whole. The net present value (NPV) was estimated and used as the main yardstick for recommending whether to support the PFPP project to continue into the future. The NPV is one standard measure for economic evaluation (DTF 2013).

Table 1 overleaf outlines the formula for calculating NPV and the recommended decision to endorse subject to whether the NPV is positive, zero or negative. For example, the NPV criterion suggests that if NPV is more than zero dollars then the PFPP project is economically worthwhile and subject to available budget, should be continued. The NPV was calculated by taking away the discounted value of PFPP project costs PVC from the discounted value of project benefits PVB. For proper weighing up of benefits and costs, all future values were adjusted to present day (2016) dollars using the normal discounting process. The PFPP benefits and costs were adjusted using a seven per cent social discount rate[5].

5 Represents the real rate of discount that future streams of cost and benefit were discounted to account for the fact that society values them less than if these streams were available today.

Table 1 Formula used to calculate net present value NPV and the decision to endorse based on this value.

	NPV	Recommended Decision
NPV = PVB - PVC Where: NPV = net present value PVB = present value benefit PVC = present value cost PVB=B0 + B1/(1+i)1 + … + Bt/(1+i)t Bt = project benefit at period t PVC=C0 + C1/(1+i)1 + … + Ct/(1+i)t Ct = project cost at period t i = social discount rate t = year	NPV > 0 NPV = 0 NPV < 0	Consider continuing support to the PFPP project (subject to the available budget) A matter of indifference; If the project is continued, then only the original investment will be recovered Consider discontinuing the PFPP project

For this analysis, the value of PFPP project benefit Bt at time t was calculated using **Equation 1**:

Bt = (CF0,t + CG0,t + CH0,t + D0,t) – (CA1,t + CFG1,t + CH1,t + D1,t) **Equation 1**

Where:

0 and 1:	the first subscripts refer to 'without PFPP' and 'with PFPP' case, respectively
CF0,t :	fumigation cost
CG0,t :	spraying cost
CH0,t :	handling cost
D0,t :	damage due to fumigation
CA1,t :	accreditation cost
CFG1,t :	fumigation & spraying cost
CH1,t :	handling cost
D1,t :	damage due to fumigation

On the other hand, the value of project cost Ct at time t was calculated as the sum of the contributions by the Victorian government and industry. The annual value of benefit and cost were adjusted by multiplying each by the discount factor 1/(1+i)t. Parameters i and t are as defined in **Table 1.**

For convenience, NPV was converted to annual net benefit, (or annual equivalent value of net benefit AEV).

Equation 2 was applied to calculate this value of annual net benefit AEV [6] measured in dollars per year.

$$AEV = i(NPV)/1-(1+i)^{-T}$$

Equation 2

Where:

AEV :	is the value of annual net benefit, measured in dollars per year
i :	is the rate of discount per year i.e., 7%
T :	is the term of evaluation period that is 20 years in this case

As basis for filling in the modelling requirements, the Australian Bureau of Statistics (ABS) official publications were reviewed. Along with ABS statistics, the BCA model variables were calibrated using project-level estimates taken from available documents, reports, survey and relevant notes. The document review includes sources such as:

- Yarra Valley PFPP project documents and web page (DEDJTR 2015)
- official publications such as ABS agricultural commodity statistics, 2012/13-2014/15 series
- QFF-related benefit-cost analysis reports (Access Economics 2010; BDA Group 2010; Kalang Consultancy Services Pty Ltd. 2008; Hafi et al. 2013; Hafi et al. 2015)
- published literature on adoption theory (Rogers 1983)
- PFPP project staff interviews
- relevant emails
- project milestone reports for 2015 and 2016
- 2015 grower survey
- tele conference notes, and
- others (FAO 1999; FAO 2006)

6 See http://www.financeformulas.net/Equivalent_Annual_Annuity.html

'Basic' and 'advanced' spreadsheet models which incorporate the developed adoption scenarios were put together to appraise the 'without PFPP' situation and the 'with PFPP' project case. Three adoption speed scenarios for interstate market access under the 'with PFPP' project case were developed. These were 'slow', 'average' and 'rapid' adoption pace. To build these scenarios, a well-known adoption theory by Rogers (1983) was applied. Using the Rogers (1983) adoption theory, the fraction of project adopters was calculated for each category, including early majority (34%), late majority (34%) and laggards (16%).

2.1.1 Basic model

A basic, (or deterministic), model was applied to obtain an initial estimate of the PFPP project net benefit over a term of 20 years. Deterministic models use a fixed set of point estimate for every model input. Here, this set is provided as mean value. These model inputs include market price, fumigation, spraying (chemical, machinery and labour) and handling costs (businesses staff time), total volume and value of fruit production and total number of businesses in the Yarra Valley. Project beneficiaries would include the commercial-scale producers and marketers of fresh cherry, strawberry, rubus and pome fruits who adopt the PFPP system.

For the basic model, each adoption setting was modelled in the best way possible so that it would not exceed the maximum potential project uptake particularly in terms of the volume and value of production and the number of participating businesses.

The basic model assumed a PFPP project adoption scenario[7] where an 'average' speed and level of uptake occurs. This model idea means that the

7 All adoption scenarios have been simplified by assuming that no participant withdraws once a business takes up the project system.

PFPP project would have added new adopters. The timeframe over which each adopter-category was assumed to commence taking up the PFPP system under the various adoption speed scenarios are outlined in Appendix 2. For example, under the average speed of uptake, the basic model assumed 22 current adopters with another 15 new adopters by the end of 2020 and at least seven more by the end of 2025 would take up the PFPP system (that is, 44 adopters in total). This assumption is conservative, as there are around 30 businesses now using the PFPP project system. Thus, it is likely that project adoption is already well within the 'early majority' phase. The rest of the data and assumptions applied in the basic model are shown in Table 2. Note that average values are applied in the basic model while the most likely, minimum and maximum values are used in the advanced model. The average values were based mainly on published secondary sources such as the Australian Bureau of Statistics (ABS) data for Melbourne Outer East region, assumed applicable to the Yarra Valley region.

In the basic model, the net benefit of the 'with PFPP' project case under the 'slow' (pessimistic) and 'rapid' (optimistic) adoption speed assumptions was recalculated one at a time. The same mean value estimates for all the model inputs were used for each adoption speed.

The sensitivity of the initial estimate of the PFPP project net benefit to changes in the assumed adoption speed was tested using the advanced model. Most of the model input values were based on data collected through a survey of both participating and non-participating businesses in the Yarra Valley along with selected industry estimates provided by key informants. For a majority of the variables (Table 2 under Advanced model column), the minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

Table 2 Data and assumptions applied to calculate net present value NPV using the basic and advanced models

	Basic model	Advanced model		
Variables	**Average**	**Most likely**	**Minimum**	**Maximum**
Maximum level of adoption (%)	80	80	60	90
Total number of businesses per type of fruit commodity[a]				
Cherry (no./yr)	16	11	8	14
Strawberry (no./yr)	22	12	9	15
Berry (no./yr)	10	22	17	28
Pome fruits (no./yr)	7	12	9	15
Sub-total	55	57	45	72
Total volume of production per type of fruit commodity[b]				
Cherry (kg million/yr)	0.37	0.92	0.68	1.14
Strawberry (kg million/yr)	3.08	1.37	1.02	1.71
Berries (kg million/yr)	0.15	0.24	0.18	0.30
Pome fruits (kg million/yr)	2.39	3.32	2.49	4.15
Sub-total	6.00	5.84	4.38	7.31
Gross value of production per type of commodity[c]				
Cherry ($ million/yr)	4.42	10.70	4.70	13.72
Strawberry ($ million/yr)	20.46	7.44	3.28	28.60
Berries ($ million/yr)	4.37	5.88	1.88	12.16
Pome fruits ($ million/yr)	4.46	8.54	4.23	12.45
Sub-total	33.72	32.57	14.10	66.94
Unit price per type of commodity				
Cherry[d] ($/kg)	nr	11.70	6.85	12.00
Strawberry[e] ($/kg)	nr	5.43	3.20	16.70
Berries[f] ($/kg)	nr	24.20	10.30	40.05
Pome fruits[g] ($/kg)	nr	2.58	1.70	3.00
Discount rate (%)	7	7	4	10
Maximum level of adoption (%)	80	80	60	90
Fumigation cost[h] ($/kg)	0.21	0.21	0.16	0.26
Cost of spraying[i] ($/kg)	0.15	0.15	0.11	0.19
Quality loss due to fumigation[j] ($/kg)	0.10	0.10	0.08	0.13
Cost of handling[k] ($/kg)	0.14	0.14	0.11	0.18

Table 2 Footnote: The average values are applied in the basic model while the most likely, minimum and maximum values are used in the advanced model. The values are rounded-off figures.

a The estimated average values represent 50% of the ABS reported estimate for Melbourne Outer East region which was assumed applicable to the Yarra Valley region (Source: ABS (data series) Cat. No. 71210 Agricultural Commodities, Australia, 2012-13, 2013-14, 2014-15 for Melbourne Outer East region); with an assumed maximum adoption level of 80%, total number of adopters used in the basic model was 44 consisting of (13) cherry, (18) strawberry, (8) berry and (6) pome fruit businesses. The most likely estimate was based on a list of growers for the first and second seasons of the PFPP project that responded to the 2016 survey of businesses operating in the Yarra Valley. The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate. The estimates consider only one main fruit commodity per grower. These estimates therefore did not capture the possibility that some businesses produce or trade other types of fruit as well.

b The estimated average values represent 33% of the ABS reported estimate for Melbourne Outer East region which was assumed applicable to the Yarra Valley region (Source: ABS (data series) Cat.No.71210 Agricultural Commodities, Australia 2012-13, 2013-14, 2014-15 for Melbourne Outer East region). The most likely estimate was based on the results of the 2016 survey of businesses operating in the Yarra Valley. The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

c The average values represent 50% of the ABS reported estimate for Melbourne Outer East region which was assumed applicable to the Yarra Valley region (Source: ABS (data series) Cat.No.75030 Value of Agricultural Commodities Produced, Australia 2013-14, 2014-15 for Melbourne Outer East region). The most likely gross value of production GVP was calculated by multiplying the most likely unit price per kg of a commodity by the most likely estimate of total volume of production for that commodity based on the results of the 2016 survey of businesses. The average prices ($/kg) at interstate markets used to calculate GVP have been sourced from various sources including industry estimates and ABS statistics.

d The notation nr means data on unit prices were not necessary. The unit prices for the relevant fruit commodities were not collected because these were not used in the basic model. The unit prices however were necessary in the case of the advanced model to be able to derive an estimate of the gross value of fresh fruit production in the Yarra Valley. The most likely and maximum values were based on industry estimates provided by key informants while the minimum value was sourced from DEDJTR (2014) Gross Unit Value (GUV) of production 2012-13 Available from URL: http://agriculture.vic.gov.au/__data/assets/pdf_file/0003/292188/9-Fruit-and-Nut-Industries-Profile_December-2014-Update_MASTER1.pdf [accessed 10 November 2016]

e The most likely estimate was calculated by dividing the Gross Value Production sourced from ABS (2016b) Cat.No.75030 by the volume of production sourced from ABS (2016a) Cat. No. 71210 Agricultural Commodities, Australia 2014-15 for Melbourne Outer East region; the minimum and maximum values were sourced from URL: http://dpipwe.tas.gov.au/Documents/Strawberry%20Profile%20updated%20March%202014.pdf [accessed 10 November 2016]

f All values were based on industry estimates provided by key informants

g The most likely and maximum values were sourced from Apple and Pear Australia Ltd Available from URL: http://apal.org.au/melbourne-wholesale-apple-price-trends-tell-us/ [accessed 10 November 2016]; The minimum value was based on ABS (2016b) Cat.No.75030; Price per kg was derived using one carton equivalent to 12 kg, with price per carton ranging between $26 and $36 each.

h The average and most likely estimates were based on industry estimates for fumigating cherry and berry. The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

i The average and most likely estimates were based on industry estimates provided by key informants. The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

j Calculated as the dollar value of the detrimental impact of methyl bromide on cherry fruit quality and shelf life based on best guess industry estimate provided by key informants. The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

k Calculated by dividing the cost of handling activities including controller, dispatcher, wrapping and assessments i.e., $50 (2hrs @$25 per hour per pallet) vs $84 with fumigation, by the total weight per pallet in kg i.e., 3.50 kg/carton multiplied by 140 cartons/pallet; handling costs of $0.10 and $0.17 per kg for with and without fumigation or an average of $0.14 per kg; The minimum value was assumed 75% of the most likely estimate while the maximum value was calculated as 25% more than the most likely estimate.

2.1.2 Advanced model

Some of the data inputs used in the BCA basic model may be incorrect and therefore could lead to unreliable NPV estimates. For example, in the basic model, we have set the maximum level of adoption to an average of 80 per cent of the total commercial-scale businesses in the Yarra Valley. However, this level could be between 60 and 90 per cent. To address this weakness an advanced, or probabilistic, model[8] that does not rely solely on point estimates was used to describe all potential outcomes and give some measure of how likely each one is to occur. This probabilistic type of model allows exploration of the effect on the estimate of net benefit of changes in the model inputs. The range of values (most likely, minimum, maximum) for the advanced model variables indicated in Table 2 was used to test the sensitivity of the modelling results to data uncertainties.

8 As the future state of PFPP project cannot be exactly predicted, the future can only be described as a random variable using an alternative probabilistic-type model.

Simulation[9] was performed to pinpoint which key factors, and to what extent, add to the uncertainty of outcomes. Each simulation was appraised based on the probability distribution of the results. The key factors that may have a marked impact on the project's outcome metric AEV were examined and, then ranked in order of their importance. This approach ensured that the evaluation was conducted in line with departmental[10] guidelines on handling risk and uncertainty[11] in economic assessment.

'With PFPP' scenarios

Three adoption scenarios were analysed in order to bring up possibilities that otherwise might not be considered. The 'with PFPP' case simulation under the 'slow', 'average' and 'rapid' adoption scenario was carried out one after the other with each one repeated 10,000 times. This repetition was done to ensure a fair sampling of the changes in the values for each factor fitted in the model.

Slow adoption

'Slow adoption' assumed poor learning conditions hold back potential business-adopters from gaining the required knowhow. Under this scenario, the switching cost could also delay likely adopters of PFPP to make an early switch to the system.

Average adoption speed

In the event that would-be adopters have a good grasp of the commercial gain that they can get out of the PFPP system, these businesses are more likely to make the switch relatively sooner rather than later.

Rapid adoption

A 'rapid adoption' pace assumed the project invests extra effort to facilitate the uptake among potential adopters. Case in point, the project could achieve rapid adoption by coordinating aggressive and targeted promotional campaigns.

'Without PFPP' case

The counterfactual, or 'without PFPP' project case, assumed that all parties - government, industry and community, withdraw their support to the PFPP project. This means the PFPP accreditation system that enables commercial-scale businesses in the Yarra Valley region to access QFF–sensitive interstate markets ceases. This also implies the chemical-based disinfestation treatment would become the major or default system for QFF control among businesses in the region that access these interstate markets.

2.2 Online survey

To supplement the economic evaluation, an online survey of businesses in the region was conducted to collect project-level data that are important for a reliable appraisal of project benefits and costs. The survey was also done to gain some insight into the extent to which key motivating factors may have been affecting participation (or non-participation) of businesses in the PFPP project. The survey involved 29 commercial-scale businesses, including both PFPP

9 We applied Monte Carlo Simulation (MCS) technique to develop a probabilistic model of scenarios and test the sensitivity (Saltelli, A. and Annoni, P. 2010) of the initial results to input changes. Monte Carlo simulation procedure is a risk analysis technique (Palisade Corp. 2010) that varies all uncertain inputs simultaneously and then builds a range and distribution of the possible output that could occur in this case, the value of annual net benefit. In applying the MCS method, uncertain inputs including maximum adoption rate, fumigation cost, handling cost, cost of spraying, discount rate were represented using ranges of possible values and described using probability distributions. The MCS method could reveal which model input or factor that has inherent uncertainty had the biggest effect on the value of annual net benefit estimate. Monte Carlo simulation is an effective method for it can tell us not only what could happen, but how likely it is to occur. In this report, we use the MCS method to produce distributions of the annual equivalent value of net benefit AEV.

10 DEDJTR: Department of Economic Development, Jobs, Transport and Resources under which AgVic belong.

11 Risk is an event characterized by a probability of occurring and an expected impact if the event did occur. The event is not in the projects baseline plan that is an undesirable outcome (discrete risk). It can also be an opportunity if the outcome of the event is a positive outcome. Uncertainty represents our fundamental inability to perfectly predict the outcome of a future event. It is characterised by a probability distribution. Available from URL < http://intranet.economicdevelopment.vic.gov.au/business-support/research-and-statistics/economic-assessment-information-portal/Guidance-on-particular-economic-assessment-processes,-methods-and-variables#5 >[accessed 10 November 2016]

participants and non-participants[12].

Production and trade figures[13] from both PFPP participants and non-participants were collected through the survey of businesses operating in the Yarra Valley (Appendix 3). The pooled sets of survey data (see Appendix 4) enabled the evaluation team to determine the proper range of value estimates to use as model inputs. The data set includes the total volume and value of QFF-host fruits produced in the Yarra Valley region. This data also included the number of businesses who could by all accounts adopt the PFPP in this region.

The project-level data collected have enabled the evaluation team to validate and assess the reliability of the appraised benefits and costs.

It was anticipated that the survey findings would also provide some insight into the feasibility of scaling up of the PFPP project to maximise its market access prospects, both domestically and internationally, once the key motivating factors affecting participation have been identified.

12 Estimation of the total number of participants was based solely on the list of grower information for first and second seasons of the PFPP project prepared by the PFPP committee at the time of the survey. We confirmed the number of non-participants of the PFPP project in Yarra Valley by using PFPP committee information. Because not all 29 respondents answered each survey question completely, the collected data may not represent the true quantities and values.

13 To improve the reliability of the results, project-level data collected through the survey of businesses were applied as data inputs to the BCA advanced model in lieu of the relevant estimate based on the Australian Bureau of Statistics (ABS) production statistics (Appendix 5).

3 Results and Discussion

3.1 Benefit-cost analysis

The benefit-cost analysis results reported below consist of two types of estimate. First, the point estimate calculated using the basic model. Second, the range of values, including the mode, minimum and maximum values calculated using the advanced model.

3.1.1 Basic model's point estimate

The year-by-year difference in costs under the 'without PFPP' and 'with PFPP' project for all commodities including cherry, strawberry, berry and pome fruits were first calculated.

The costs of fumigation, cost of spraying, cost of handling and value losses due to fumigation damage, were each calculated to represent the cost impact under the without PFPP project case over the 20-year evaluation period. On the other hand, the cost of accreditation and handling were calculated to represent the cost impact under the 'with PFPP' project case; the costs of spraying and fumigation were both zero under this case. The present value of project benefit in terms of cost savings and the value of avoided loss were calculated by subtracting the cost and loss impacts under the 'with PFPP' project case from the estimated impacts under the without PFPP project case (Appendix 6a) over the 20-year period. The present value of the PFPP project cost (PVC) comprising of government and industry contributions over the 20-year period was subtracted from the present value of benefit (PVB) to derive an estimate of the PFPP project net benefit (NPV) (Appendix 6b).

The BCA basic model's point estimate under an average adoption speed is first provided below. This is followed by the results under the slow and rapid pace of adoption scenarios.

Average speed

- The basic model's estimate of net benefit suggests that QFF-host fruit businesses in the Yarra Valley region would be financially better off if the PFPP project were to continue. A comparison of the assessed values of benefit and cost under the modelled average speed of adoption support this finding.
- The basic model results indicate the value of project benefits over a 20-year period could pay for the PFPP project investment cost. Fig.1a and 1b below show the point estimate of the PFPP project benefits and costs under the assumed average speed of adoption scenario.
- The PFPP project generated $4.21 million of avoided losses and $17.93 million of cost savings (Fig. 1a). In this case, the total benefit (PVB) was $22.14 million over the 20-year evaluation period.
- The average present value of the total project cost of about $1.35 million over the 20-year period was extended by AgVic, voluntary contributions and industry levies. The AgVic contributed $0.53 million and the remaining $0.82 was jointly financed by the relevant fruit industries (Fig. 1b). This means the cost sharing between AgVic and industry was roughly 40:60.
- Should the assumptions on project adoption, volume and value of fruits produced and sold and the costs and quality losses remain valid, the Yarra Valley PFPP project is likely to bring a total of about $20.79 million in net benefits over the next 20 years; that is, $22.14 minus $1.35 million. Converting this total value of net benefits to an annual value discounted at a rate of seven per cent per annum, means that an annual average net return of $1.96 million per year is likely.

- The PFPP project achieved the assessed level of project outcome subject to certain terms. One, if approximately 44 businesses adopted the PFPP system. Two, if such uptake enabled interstate consignment of around 4.80 million kilograms of fresh strawberry, cherry, berries and pome fruits each year from 2026 to 2036.

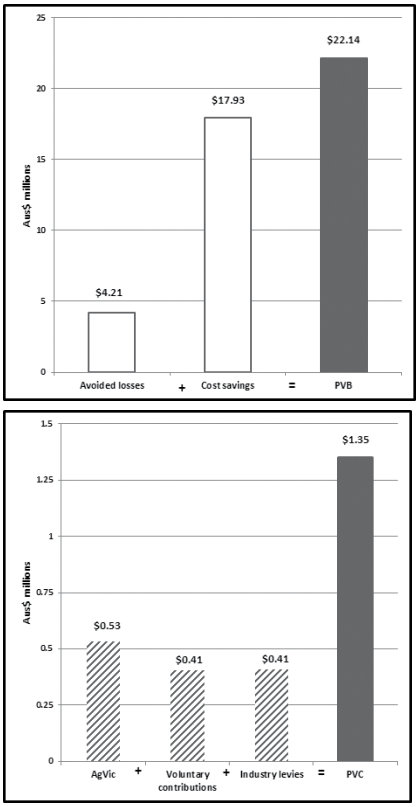

Figure 1 Estimated mean value of benefits and costs over a 20-year period (in 2016 $millions); note that the Y-axes are not to the same scale

Slow and rapid speed

- Taking into account a slow adoption pace, this analysis shows a relatively lower value of annual net benefit of $1.88 million per year over the next 20 years (Fig. 2) that is, compared to the annual return of $1.96 million per year under the average adoption speed. Under a rapid pace of adoption, the annual net benefit of $2.05 million over the same period was highest. All values were adjusted using a seven per cent discount rate over the 20 year evaluation period. Confidence in the use of these estimates would be based on the notion that all modelled data were good approximates of the true values at the time of the analysis.

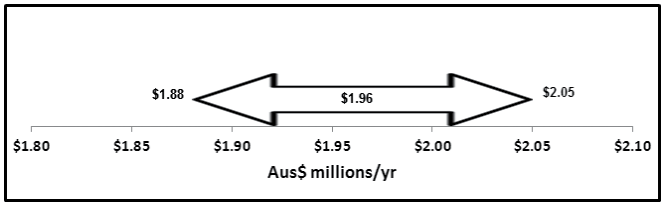

Figure 2 The range of values of annual net benefit of PFPP project given varying adoption speed

3.1.2 Advanced model's range of values

- The advanced model results provided economic evidence that support the continuance of the PFPP project. The PFPP system was found to be economically worthwhile as an alternative to chemical-based disinfestation of fresh fruits for consignment to QFF-sensitive interstate markets. This is evident especially when a relatively faster adoption of the project occurred. The increasing values from left to right hand column in Table 3 that represent increasing adoption speed support this observation.
- The most likely value of annual net benefit (or the mode AEV in Table 3) was estimated to be between $0.94 and $1.22 million per year across the 20-yr evaluation period depending on the speed of adoption. The range of annual net benefit value estimates for all the adoption scenarios are all positive. These values indicate that there was a strong chance that the PFPP benefits would compensate for the project costs.

Table 3 Selected estimates of the annual net benefit for each adoption speed scenario

	Adoption speed scenario		
	Slow	Most likely	Rapid
Annual net benefit (AEV)	(2016 $ million/yr)		
Mode	$0.94	$1.08	$1.22
Minimum	$0.54	$0.65	$0.76
Maximum	$1.47	$1.70	$1.82

Footnote: Mode: value that appears most often in the set; Minimum: lowest estimate of the expected value of annual net benefit; Maximum: upper bound estimate; all estimates are in 2016 dollar values obtained over a 20-year evaluation period [results of model ran on 22 March 2017 using 10,000 repetitions]

- Fig.3 shows the estimated range of value of PFPP project annual net benefit under the modelled average adoption speed[14]. This range of values shows there was at least a 74 per cent chance that the annual net benefit could be greater than $1.0 million per year. Fig.3 also shows that the minimum assessed value of net benefit was around $0.65 million per year. This result suggests that achieving a net loss, that is, net benefit being negative was not likely.

14 For brevity, we show details only of the simulation results for the 'average' adoption speed.

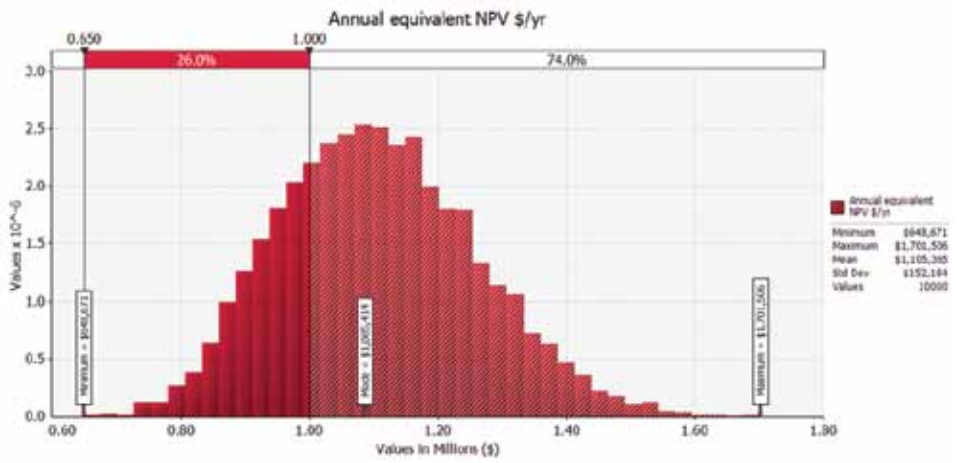

Figure 3 Estimated range of value of PFPP project annual net benefit over a 20-yr simulation period, under the average adoption speed scenario

- Fig. 4 opposite illustrates the ranking of each of the model inputs (or factors) under the average adoption speed scenario, displaying the simulation result using a 'tornado' graph. This graph shows the change in the annual net benefit estimate in response to the 'high' or 'low' value of a factor, or variable (see Table 2). This graph allows identification of the most crucial factors based on the change in the assessed value of annual net benefit credited to each factor. The wider the range of the annual equivalent value of net benefit, the more influential a factor is on this PFPP project outcome metric.
- The longer bars at the top of Fig. 4 represent the factors with the greatest effect on the annual net benefit. The lowest average values of annual net benefit are represented at the left edge of the bar and the highest average values by the values at the right edge of the bar. The 'baseline' ($1.10 million, a rounded-off figure), refers to the overall average of the annual net benefit.
- Fig. 4 suggests that the five most influential factors in the scenario simulations were (1) maximum adoption rate, (2) discount factor, or rate, (3) fumigation cost, (4) cost of spraying and, (5) cost of handling.
- Note here that adoption rate refers to the maximum level of adoption, which was modelled as the maximum achievable proportion of total businesses in the Yarra Valley to adopt the PFPP system. Alternative rates of 60 and 90 per cent were used as the 'low' and 'high' values. The top most bar in Fig. 4 indicates that adoption rate caused the average value of annual net benefit to change a great deal, that is, as low as $0.92 million a year and as high as $1.28 million per year (also rounded-off figures). This result suggests that business participation was the most serious factor that could enable the PFPP project to reach its desired outcome. This means that the total number of businesses taking part each year was causing the annual net benefit to sway the most compared to the other factors examined.
- The discount rate was the second-most influential factor we found with four and 10 per cent as the 'low' and 'high' values tested. The discount rate was the only factor with a negative

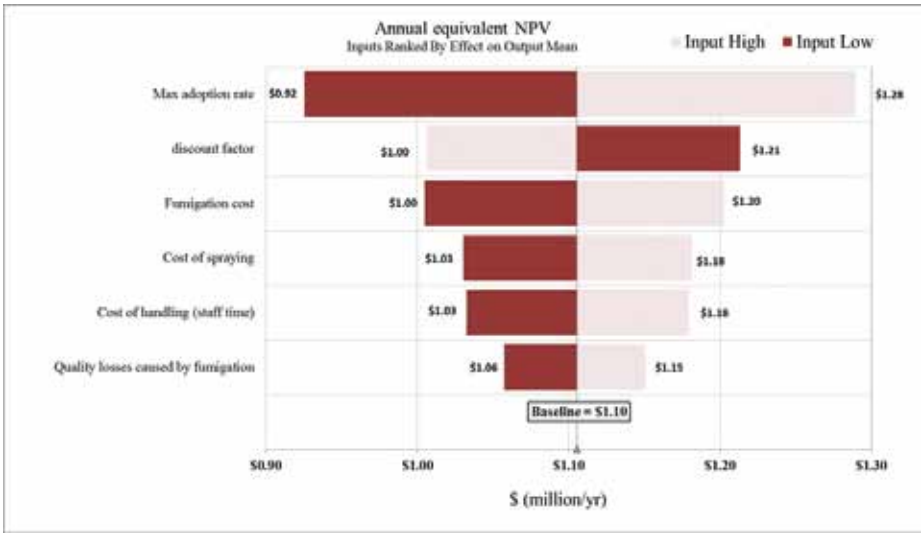

Figure 4 Tornado graph showing the model inputs or factors ranked by their effect on the average annual equivalent value of net benefit

effect on net benefit. For example, when its value was 'high' (10%), the annual net benefit decreased from approximately $1.1 to $1.0 million. Three other influential factors in the simulation that had key effects were fumigation cost ($0.16 and $0.26/kg as the range of values applied), costs of handling ($0.11 and $0.18/kg) and spraying cost ($0.11 and $0.19/kg). This result confirms the basic model finding that indeed the bulk of the assessed project benefits were in terms of cost savings.

- Other factors examined including the price of pome fruit in the interstate markets and the volume of pome fruits and cherry produced in the region and the government contribution were found not to matter much (hence, not included in Fig. 4). The findings of this economic analysis however need to be interpreted in the light of the following limitations:
    - **Use of overly simplified adoption scenario model in estimating project benefit.** This report estimated the net benefit of the PFPP project using simplified scenario models based on a widely popular theoretical framework for technology adoption (see Rogers 1983). Oversimplifying the adoption model scenarios may not truly capture the future trend in the adoption of the project in the Yarra Valley. For example, it is unclear how prohibitive the true costs of learning and adjustment (Brandyberry 2003; MacVaugh and Schiavone 2010) are to potential adopters in order to switch from the old (chemical-based approach) to the new (PFPP accreditation system).
    - **Unreliability of the preliminary estimate of benefits and costs due to the failure of this evaluation to incorporate potential impact of QFF incursion.** The BCA modelling did not capture the effect of potential occurrence of QFF outbreaks (an unknown) in the Yarra Valley. Such outbreak events however would negate any market access concessions gained. Pest incidence could lead to unavoidable losses and costs including the cost of incursion response to regain QFF-free status. Such event could also cause a serious setback on project adoption.
    - **Unknown probability distribution function that is appropriate for this analysis.** Beta probability distribution function was used as suitable way of stating the type of uncertainty in the variables including 'minimum', 'most likely' and 'maximum' value for the probabilistic model. This function was chosen only because it is readily understandable (Palisade Corp. 2010; Vose 2008).
    - **Incomplete data used in the analysis.** Estimates of project benefits were based on incomplete data on production and the number of commercial-scale businesses operating in the Yarra Valley region at the time of the survey. Because not all respondents answered each survey question completely, the collected data from the survey are likely to lead to underestimating their true quantities and values. However, had we relied solely on secondary data such as the volume and value of production and the number of commercial-scale businesses in the Melbourne Outer East statistical region to parameterise the model for the Yarra Valley, the results are likely to be not much different. This suggests that a minimum-data approach or 'back-of-the-envelope' type of analysis that mainly uses secondary data in modelling could support an informed policy decision-making process as in this case. Antle and Valdivia (2006) have demonstrated the minimum-data approach in the provision of sufficiently accurate analysis of ecosystem provision scenarios to support such a process.

3.2 Survey responses

To supplement the economic analysis, forty-five commercial-scale businesses operating in the Yarra Valley region, both participants and non-participants were invited to take part in an online survey. The survey achieved a good response rate of nearly 65 per cent, (or a total of 29 completed responses with 20 participants and nine non-participants responding). The survey's key findings are listed below.

- More than one in four (27%) of the survey respondents grew strawberry as their main QFF-host produce.
- The majority (53%) of respondents were planning to expand production in the next one to four years.
- The mean age of the main person owning or managing those businesses was fifty-six (56) years, the youngest being thirty-six years (36) and the oldest sixty-six (66) years old.
- Seventy per cent of respondents were operating under the PFPP program, being either an authorised growing property or an accredited packer (under PS-37 accreditation).
- More than half, (55%) of respondents heard about the program from *"industry presentation"* forum. Twenty-five per cent heard it from *"Packer/Agent/Wholesaler" and 20 per cent heard it from the "PFPP committee"*.
- The average total volume of QFF-host fruit produced by the 20 participant-respondents was more than 2.32 million kg in the 2015-16 seasons alone. The average total volume of QFF-host fruit produced by the nine non-participant respondents in a typical year was about 3.80 million kilograms or nearly two-thirds more than those produced by participant-respondents.
- All 20 participant-respondents agreed that *"better market access opportunities"* encouraged them to join. The majority (15 out of 20 participant-respondents) agreed that *"supporting other industries in the Yarra Valley," "preventing QFF outbreak"* and *"maintaining relationship with trading partners"* were encouraging them to take part. These forms of benefits are in the main, public or social in nature.
- Eight of 20 participant-respondents agreed that *"increased returns," "avoided losses"* and *"avoided costs"* were boosting participation.

Some inferred insights from these survey findings include:

- **There appears a sizeable volume of fruits potentially tradable through the project.** The survey revealed that the average total volume of QFF-host fruit produced by both participants and non-participant respondents was huge at around six million kilograms. This survey data suggest a potentially much higher total volume of fruits to trade in QFF-sensitive interstate and (potentially) overseas markets that the PFPP can assist under its accreditation system. Nothing was sure though as yield level may vary between seasons, for example, due to factors like rainfall damage in the case of cherries. The results of the survey appear to support a conservative view of the estimate of the net benefit.
- **Most adopters view public (or, industry-wide) benefits as their main motivating factor for joining up.** The survey revealed public or industry-wide benefits were key factors that encouraged businesses to join the PFPP program. This indicates most participant-respondents were aware that an action of one business could affect others, participant or not. For example, actions that bring in positive

spill over outcome like *better market access* negotiated through the project would be good for everyone.

- **Some adopters view private benefits as a motivating factor.** Some participant-respondents agreed that private benefits such as *"increased returns," "avoided losses"* and *"avoided costs"* were encouraging participation. These benefits were precious to an individual adopter (such as a commercial-scale grower) since she would be able to capture those gains directly and fully.
- **Many of the perceived barriers to project adoption are possible to resolve.** Three of the nine 'non-participant' survey respondents reported similar factors had deterred them from taking part in the project. These barriers include *"don't know how to participate," "not financially viable..."* and *"don't want to be accredited and use fumigation instead…"* One previous study (MacVaugh and Schiavone 2010) has identified various factors that affect a person's decision to adopt or reject a new technology. In the context of the 2016 survey responses, these personal reasons relate to: (a) ease of adoption, or as one respondent aptly put it *"reducing the length of time it takes to carry out the process"* and, (b) usefulness of the new technology like *"it must offer some value to me."* Many of these perceived barriers however could be potentially resolved through a targeted communication and engagement strategy.

4 Conclusions

The findings of this economic evaluation provide support for the continuation of the PFPP project. The evaluation results confirm PFPP as an economically efficient government-industry model for providing commercial-scale fresh fruit businesses in the Yarra valley access to lucrative interstate markets which are sensitive to QFF.

Based on these findings, the following conclusions are made:

- **PFPP provides good value for money as the participating commercial-scale producers and marketers of strawberry, cherry, rubus and pome fruits in the Yarra Valley would be financially better off if the PFPP project were to carry on over the long run.**

  This economic study justifies the PFPP project as good value for money from the viewpoint of the Victorian community as a whole. Simulation results indicate that there was a strong chance that the benefits would compensate for the project costs. The most likely value of annual net benefits was estimated to be between $0.94 and $1.22 million per year across the 20-yr evaluation period depending on the speed of adoption. These gains were in terms of cost savings and avoided losses. The fresh fruit industries would capture the bulk of benefits with the commercial-scale producers and marketers of strawberry, cherry, rubus and pome fruits in the Yarra Valley as the major beneficiaries.

- **PFPP is more likely to achieve net benefit when a relatively faster adoption occurs**

  The simulation model results provide support to the notion that the program could achieve its likely benefits when the speed of adoption of PFPP system steps up.

- **The PFFF accreditation system becomes a more attractive option for businesses as the costs associated with chemical disinfestation increase.**

  The results of this analysis indicate that the bulk of the estimated benefits were in the form of cost savings that include spraying cost, fumigation and handling cost. A more than proportional increase in these costs would make the accreditation system option more financially tempting for businesses, all else being equal.

5 Lessons identified

Based on the findings and conclusions of this economic evaluation, the following lessons identified are made with the aim of strengthening the capacity of the PFPP project to achieve its likely net benefit.

They are outlined below:

Government, community and industry continue to collaboratively engage to promote the private and public benefits of the broader adoption of the PFPP accreditation system to accelerate return on investment	Benefits of accreditation could be private in nature such as financial profits. Public benefits could be in terms of the positive impact on regional economies if the PFPP maximises its market access prospects by broadening adoption. The PFPP system adoption could be broadened, for example, by implementing targeted activities that communicate the public and private benefits of investment in the system.
Beneficiary groups to identify strategic opportunities for investment to improve management and fruit marketing arrangements	To encourage and sustain a high level of PFPP adoption, beneficiaries are encouraged to explore innovative options for strategic investment to ultimately enhance trade outcomes. This could include engagement with: • research and development institutions to identify, trial and test improved management and market approaches • industry funding bodies to ensure regional alignment with national investment strategies • community and government agencies in the design, delivery and evaluation of these programs.

Streamline government regulatory processes to reduce compliance costs to beneficiary groups	The survey results revealed that some potential participants were not familiar with the accreditation system and process. Ensuring information about the application process and compliance requirements are easily accessible and not administratively burdensome, could assist in getting more businesses to adopt PFPP.
Adopt a long-term funding arrangement between AgVic and the beneficiary industries to ensure compliance with the phytosanitary standards set by different markets.	Finding ways to make the best use of the existing cost-sharing deal is vital. It is crucial for the project to design a funding model that would help PFPP maintain the integrity of the system. For instance, the project could assign industry's share of the total budget just to cover the costs of trapping. Routine AgVic audit of QFF trapping and review of project actions which are key to maintaining the validity of the PFPP system should be sustained.
Allow for flexibility in setting the geographical coverage of production areas, and the type of produce to include in the project.	Greater flexibility in geographical scope would help PFPP comply with its future market demands or better manage project risks. An increase in area coverage and the type of produce to include could raise the capacity of the project to trade beyond its current markets. Such action could enable more businesses to benefit from PFPP over time. The survey results suggest that the project has what it takes to increase markedly the level of fruits offered now for the interstate markets. Current non-participants can move an extra three thousand tons of QFF-host fruits to these markets.
Work collaboratively with relevant federal and State Government agencies to explore export market opportunities.	The project was originally designed to restore domestic market access. For international export aspirations, key beneficiaries need to consider the scope (or areas) of the program that need enhancement to meet all requirements of ISPM-10 including fruit movement controls. Having these agencies as partners could help PFPP capture gains, such as through value adding to suit the changing market demands.

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Lilydale
Croydon Hills
Wandin North
Mount Evelyn

Appendices

Appendix 1

Outline of the benefit-cost analysis procedure used in this report

DEDJTR's economic assessment guidelines suggest that the cost and time involved in undertaking a BCA should be proportional to the size of the investment and/or its expected impact on the economy and community. A full-blown BCA of the Pest Free Place of Production (PFPP) Project would be appropriate considering the potential expansion and up-scaling of the project to include future access to international export markets.

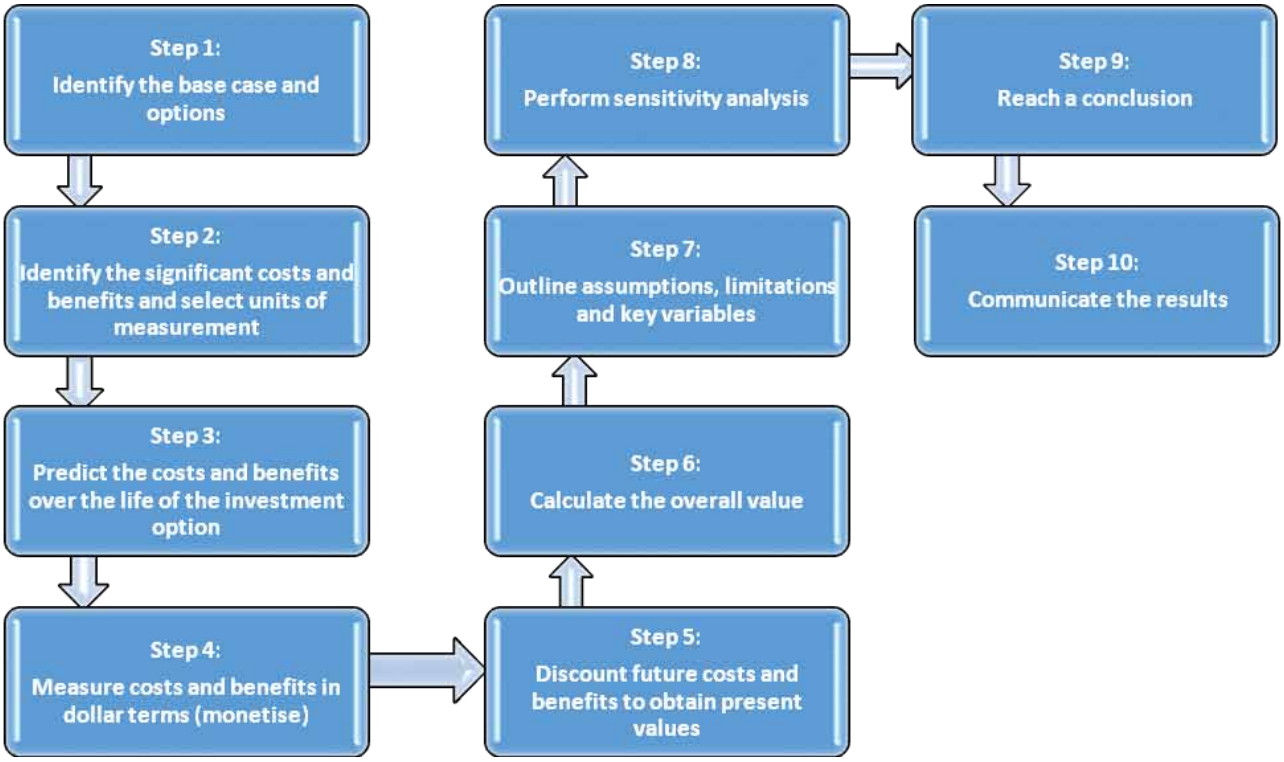

Figure A1 Steps in conducting this benefit-cost analysis (based on DEDJTR 2016 'Guidance on how to undertake economic assessment' document)

Appendix 2

Timeframe for the three adoption speed scenarios used in the benefit-cost analysis

Footnote The time lag between categories were based on Rogers (1983, p. 205). For example, a 'slow' pace of adoption ( ) assumes that the use of PFPP innovation within the Yarra Valley region is either negatively accepted or misunderstood or not enough information about how to participate being provided by the project; once these barriers to adoption are overcome, the adoption speed could be expected to be relatively much quicker ( ). Y0 refers to Year 0 of PFPP or the start of 2016 with around thirty adopters; Y1 refers to end of Year 1, Y2 refers to end of Year 2, and so on.

Adoption Speed Scenario	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20
Slow		Early majority				Late majority					Laggards										
Average		Early majority			Late majority					Laggards											
Rapid																					

Appendix 3
Selected survey questions relevant to the benefit-cost analysis

Please select the one that applies to you.

	Grower
	Packer / Agent/ Wholesaler

What is the main Queensland fruit fly (QFF)-host produce that you grow or trade?

	Cherry
	Strawberry
	Rubus or Berries
	Pome (apple, pear, etc.)
	Blueberry
	Citrus
	Fruit vegetables (capsicum, chilli, eggplant, tomato, etc.)
	Other QFF-host fruit (please specify_____)

Do you operate under the PFPP program, such as being an authorised growing property or an accredited packer (under PS-37 accreditation)?

	Yes
	No

What is your average total volume (kg) of QFF-host fruit or vegetable you produce or trade in a typical year?

_____ kg

Do you consign QFF-host produce to interstate markets?

	No
	Yes, although the state does not require certification for QFF
	Yes, and the state requires certification for QFF

Appendix 4

Total volume and gross value of production, and number of businesses in the Yarra Valley, 2016 survey results

All respondents
(participants and non-participants)

Item	Description	Estimates		
	Variable			
A	Commodity	Total volume of production (kg million)	Gross value of production ($ million)[a]	No. of respondents reporting
1	Cherry	0.92	10.70	6
2	Strawberry	1.37	9.18	10
3	Rubus or Berries	0.24	7.10	10
4	Others such as apples, pears, etc.	3.32	8.56	3
5	All fruits	5.84	35.55	29

PFPP participant-respondents

B	Commodity	Total volume of production (kg million)	Gross value of production ($ million[a]	No. of respondents reporting
6	Cherry	0.92	10.70	6
7	Strawberry	1.17	6.36	6
8	Rubus or Berries	0.23	6.77	8
9	Others such as apples, pears, etc.	0.00	0.00	0
10	All fruits	2.32	23.84	20

PFPP non-participant respondents

C	Commodity	Total volume of production (kg million)	Gross value of production ($ million[a]	No. of respondents reporting
11	Cherry	0.00	0.00	0
12	Strawberry	0.52	2.82	4
13	Rubus or Berries	0.01	0.32	2
14	Others such as apples, pears, etc.	3.32	8.56	3
15	All fruits	3.85	11.71	9

No. of businesses operating in the PFPP project region[b]

D	Commodity	Participants	Non-participants	Total
16	Cherry	10	1	11
17	Strawberry	5	7	12
18	Rubus or Berries	17	5	22
19	Others such as apples, pears, etc.	1	11	12
20	All fruits	33	24	57

Footnote:

a The average prices ($/kg) at interstate markets used to calculate the gross value of production GVP have been sourced from various sources including industry estimates and ABS statistics. The assumed unit wholesale price for cherry was at $11.70 a kilo, strawberry at $5.43, rubus/berries at $24.20 and apples at $2.58.

b The total number of participants was based on a list of growers for the first and second seasons of the PFPP project in Yarra Valley. Note that of the total 57 businesses in the region, only 45 had valid email address. The number of non-participants was based on a list available from the PFPP project at the time of project survey preparation. The estimates consider only one main fruit commodity per respondent. These estimates therefore did not capture the possibility that some businesses produce or trade other types of fruit as well.

Appendix 5

Estimates of total volume and value of QFF-host fruits produced and, number of producers in the Melbourne Outer East statistical region, Victoria.

QFF-host fruit	Volume of production[a]	Value of production[b]	Number of producers[c]
	(million kg) ($ million) (no.)		
Cherry	1.12	13.42	32
Strawberry	9.34	62.00	44
Berries/Rubus	0.46	13.25	20
Others (apple)	7.25	13.50	14
TOTAL	**18.17**	**102.17**	**110**

Footnote: Only a fraction of the above estimates would represent the figures appropriate for the Yarra Valley. All estimates are average values and may be subject to rounding-off error.

a Volume estimates based on ABS (2016a) No. 71210 Agricultural Commodities, Australia 2014/15 for Melbourne Outer East region except for berries which was sourced from ABS (2008) No. 71250 Agricultural Commodities: Small Area Data, Australia, 2006/07 for Melbourne Statistical Division

b Value estimates based on ABS (2016b) No. 75030 Value of Agricultural Commodities Produced, Australia, 2014/15 for Melbourne Outer East region except for berries what was calculated by multiplying the ABS (2008) volume of production by industry estimated price per kg

c Estimates of total number of businesses for each commodity were based on ABS (2016a) No. 71210 Agricultural Commodities, Australia 2014/15 for Melbourne Outer East region except for berries which was derived by averaging ABS (2012/13-2014/15) 7121.0 Agricultural Commodities, Australia data series

Appendix 6a

Basic model estimate of the present value of project benefit, under an 'average' adoption speed scenario(million discounted dollars, $m)

	'Without PFPP' Costs				'With PFPP' Costs				Project benefit[a] (PVB)
Year	Fumigation CF0,t	Spraying CG0,t	Handling CH0,t	Quality loss D0,t	Accreditation CA1,t	Spraying and fumigation CFG1,t	Handling CH1,t	Quality loss D1,t	Cost savings & avoided loss
0	0.02	0.02	0.02	0.01	0	0	0.01	0	0.06
1	0.56	0.40	0.45	0.26	0.01	0	0.27	0	1.39
2	0.52	0.37	0.42	0.24	0.01	0	0.25	0	1.30
3	0.49	0.35	0.40	0.23	0.01	0	0.24	0	1.22
4	0.76	0.54	0.62	0.36	0.01	0	0.37	0	1.91
5	0.71	0.51	0.58	0.34	0.01	0	0.35	0	1.79
6	0.67	0.48	0.54	0.32	0.01	0	0.32	0	1.67
7	0.62	0.44	0.51	0.30	0.01	0	0.30	0	1.56
8	0.58	0.42	0.48	0.28	0.01	0	0.28	0	1.46
9	0.65	0.46	0.53	0.30	0.01	0	0.31	0	1.62
10	0.61	0.43	0.49	0.28	0.01	0	0.29	0	1.52
11	0.57	0.40	0.46	0.26	0.01	0	0.27	0	1.42
12	0.53	0.38	0.43	0.25	0.01	0	0.26	0	1.33
13	0.49	0.35	0.40	0.24	0.01	0	0.24	0	1.24
14	0.46	0.33	0.38	0.22	0.01	0	0.22	0	1.16
15	0.43	0.31	0.35	0.20	0.01	0	0.21	0	1.08
16	0.40	0.29	0.33	0.19	0.01	0	0.20	0	1.01
17	0.38	0.27	0.31	0.18	0.00	0	0.18	0	0.95
18	0.35	0.25	0.29	0.16	0.00	0	0.17	0	0.88
19	0.33	0.24	0.27	0.16	0.00	0	0.16	0	0.83
20	0.31	0.22	0.25	0.14	0.00	0	0.15	0	0.77
Total	**10.44**	**7,454,894**	**8.52**	**4.96**	**0.15**	**0**	**5.07**	**0**	**26.16**

Footnote: 0 and 1, the first subscripts refer to 'without PFPP' and 'with PFPP' case, respectively;

a Project benefit Bt was calculated as (CF0,t + CG0,t + CH0,t + D0,t) – (CA1,t + CFG1,t + CH1,t + D1,t) where 0 and 1:the first subscripts refer to 'without PFPP' and 'with PFPP' case, respectively, CF0,t :fumigation cost, CG0,t :spraying cost, CH0,t :handling cost, D0,t :damage due to fumigation, CA1,t :accreditation cost, CFG1,t :fumigation & spraying cost, CH1,t :handling cost, D1,t :damage due to fumigation.

Appendix 6b

Basic model estimate of PFPP project net benefit (NPV) and its annual equivalent value (AEV), under an 'average' adoption speed scenario (million discounted dollars, $m)

Year	Cost savings Cs	Avoided losses Al	Total Project Benefit PVB = Cs + Al	Total Project Cost PVC	Total NPV = PVB-PVC	Annual equivalent value of net benefit AEV
0	0.05	0.01	0.06	0.14	-0.08	-0.01
1	1.12	0.26	1.39	0.13	1.26	0.10
2	1.06	0.25	1.30	0.13	1.18	0.09
3	0.98	0.23	1.22	0.12	1.10	0.09
4	1.54	0.36	1.91	0.08	1.83	0.14
5	1.44	0.34	1.79	0.07	1.71	0.14
6	1.35	0.32	1.67	0.07	1.60	0.13
7	1.26	0.30	1.56	0.07	1.50	0.12
8	1.18	0.28	1.46	0.06	1.40	0.11
9	1.31	0.31	1.62	0.06	1.57	0.12
10	1.22	0.29	1.52	0.05	1.46	0.12
11	1.14	0.27	1.42	0.05	1.37	0.11
12	1.07	0.25	1.33	0.05	1.28	0.10
13	1.00	0.24	1.24	0.04	1.20	0.09
14	0.94	0.22	1.16	0.04	1.12	0.09
15	0.88	0.21	1.08	0.04	1.04	0.08
16	0.82	0.19	1.01	0.04	0.98	0.08
17	0.76	0.18	0.95	0.03	0.91	0.07
18	0.72	0.17	0.88	0.03	0.85	0.07
19	0.66	0.16	0.83	0.03	0.80	0.06
20	0.62	0.15	0.77	0.03	0.74	0.06
Total	**21.19 (81%)**	**4.97 (19%)**	**26.16 (100%)**	**1.35**	**24.81**	**1.96**

Footnote Here, a seven per cent discount rate was applied. Based on the above estimates, the proportion of the total discounted value between the two forms of PFPP benefit, that is, cost savings (fumigation, spraying, handling) and avoided losses was about 80:20. All estimates are average values and may be subject to rounding-off error.


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