



Papaya

Strategic Agrichemical Review Process
(SARP)

October 2020

Hort Innovation
Project – MT19008

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SARP Service Provider:

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Purpose of the report:

This report was funded by Hort Innovation to investigate the pest problem, agrichemical usage and pest management alternatives for the papaya industry across Australia. The information in this report will assist the industry with its agrichemical selection and usage into the future.

Date of report:

October 2020

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**Hort
Innovation**
Strategic levy investment

**PAPAYA
FUND**

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Table of Contents

1. Summary	4
1.1 Diseases	5
1.2 Insects and mites	5
1.3 Weeds	5
1.4 Plant Growth Regulators	5
2. The Australian Papaya Industry	6
3. Introduction	7
3.1 Background.....	7
3.2 Minor use permits and registration	8
3.3 Methods	8
3.4 Results and discussions	9
3.4.1 Detail.....	9
3.4.2 Appendices	9
4. Diseases, pests and weeds of papaya	10
4.1 Diseases of papaya.....	10
4.1.1 Disease priorities	10
4.1.2 Available and potential products for priority diseases	12
4.2 Insect and mite pests of papaya.....	20
4.2.1 Insect and mite pest priorities	20
4.2.2 Available and potential products for priority insect and mite pests	21
4.3 Weeds in papaya.....	29
4.3.1 Weed priorities	29
4.3.2 Available and potential products for weed control.....	30
4.4 Plant Growth Regulators in papaya	34
4.4.1 Plant Growth Regulator Priorities	34
4.4.2 Available and Potential Plant Growth Regulators	35
5. References.....	36
5.1 Information:	36
5.2 Abbreviations and Definitions:	36
5.3 Acknowledgements:	36
6. Appendices	37
Appendix 1. Products available for disease control in papaya	38
Appendix 2. Products available for control of insects and mites in papaya.....	40
Appendix 3. Products available for weed control in papaya	43
Appendix 4. Plant Growth Regulators available in papaya	44
Appendix 5. Current permits for use in papaya.....	45
Appendix 6. Papaya Maximum Residue Limits (MRLs).....	45
Appendix 7. Papaya Agrichemical Regulatory Risk Assessment.....	49

1. Summary

The Strategic Agrichemical Review Process (SARP) - Updates (MT19008) project is a strategic levy investment of the Hort Innovation Papaya Fund. A Strategic Agrichemical Review Process (SARP), through the process of a desktop audit and industry liaison;

- (i) Assesses the importance of the diseases, insects and weeds (plant pests) that can affect a horticultural industry;
- (ii) Evaluates the availability and effectiveness of fungicides, insecticides and herbicides (pesticides) to control the plant pests;
- (iii) Determines any gaps in the pest control strategy and
- (iv) Identifies suitable new or alternatives pesticides to address the gaps.

Alternative pesticides should ideally be selected for benefits of:

- Integrated Pest Management (IPM) compatibility
- Improved scope for resistance management
- Sound biological profile
- Residue and trade acceptance domestically and for export

The results of this process will provide the papaya industry with sound pesticide usage for the future that the industry can pursue for registration with the manufacturer, or minor-use permits with the Australian Pesticide and Veterinary Medicines Authority (APVMA).

1.1 Diseases

The high priority diseases of papaya are:

Common name	Scientific name
Phytophthora Root Rot	<i>Phytophthora palmivora</i>
Phytophthora Fruit Rot	<i>Phytophthora</i> spp.
Black Spot	<i>Asperisporium caricae</i>
Brown Spot	<i>Corynespora cassiicola</i>
Anthracoise	<i>Colletotrichum gloeosporioides</i>

1.2 Insects and mites

The high priority insect and mite pests of papaya are:

Common name	Scientific name
Fruit Spotting Bug	<i>Amblypelta nitida</i>
Banana Spotting Bug	<i>Amblypelta lutescens</i>
Two Spotted Mite	<i>Tetranychus urticae</i>

1.3 Weeds

The high priority weeds of papaya are:

Common Name	Scientific Name
Nutgrass	<i>Cyperus rotundus</i>

1.4 Plant Growth Regulators

The high priority Plant Growth Regulator issues are:

Issue
Post-harvest ripening

2. The Australian Papaya Industry

The Australian papaya industry has growers across Northern Australia from Queensland to Western Australian with production of 14,921 tonnes for the year ending June 2019 with a value of production of \$27.5 million while the wholesale value of fresh supply was \$32.3 million.

Over 90 per cent of production comes from Queensland with growers spread between Bundaberg and Lakeland, located in the Shire of Cook. Almost all papaya goes to the fresh domestic market, with very small quantities going to fresh export and processing markets.

Product is either yellow, referred to as papaw, or red fleshed, known as papaya. Papaya grows all year round and because of this the industry has the capacity to provide consistent supply of fruit to consumers and year-round income to growers.

There are over 130 growers in Australia, but production is dominated by several large producers.

Fresh Papaya Seasonality by State¹

State	18/19 Tonnes	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Queensland	12,683												
Western Australia	1,194												
Northern Territory	1,044												
Imported	40												
Availability Legend			High		Medium		Low					None	

¹ Hort Innovation (2020). Australian Horticulture Statistics Handbook 2018/19. [online] Available at: <https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/australian-horticulture-statistics-handbook/>

3. Introduction

3.1 Background

Growers of some horticultural crops suffer from a lack of legal access to crop protection products (pesticides). The problem may be that whilst a relatively small crop area is valuable in an agricultural sense, it may not be of sufficient size for Agrichemical companies to justify the expense of registering a product use on that crop. Alternately, the disease, pest, or weed problem may be regional or spasmodic, making Agrichemical companies unwilling to bear the initial high cost of registering suitable pesticides.

Growers may face severe losses from diseases, pests and weeds due to a lack of registered or approved (via a permit) chemical control tools.

Environmental concerns, consumer demands, and public opinion are also significant influences in the marketplace related to pest management practices. Industry IPM practitioners must strive to implement best management practices and tools to incorporate a pest management regime where strategies work in harmony with each other to achieve the desired effects while posing the least risks.

In combination with cultural practices, pesticides are important tools in papaya production and respective IPM programs. They control the various diseases, insects and weeds that affect the crop and can cause severe economic loss in modern high intensity growing operations. Pesticides are utilised during establishment and development, and to maximise quality and customer appeal.

As a consequence of the issues facing the papaya industry regarding pesticide access, Hort Innovation undertook a review of the pesticide requirements via a Strategic Agrichemical Review Process (SARP) in 2014. The current project is to update the SARP with the latest information and progress.

The SARP process identifies diseases, insect pests and weeds of major concern to the papaya industry. Against these threats, available registered or permitted pesticides are evaluated for overall suitability in terms of IPM, resistance, efficacy, trade, human safety and environmental issues. Where tools are unavailable or unsuitable the process aims to identify potential future solutions. Potential new risks to the industry are also identified.

The results will provide the papaya industry with a clear outlook of gaps in existing pest control options. This report is not a comprehensive assessment of ALL pests and control methods used in papaya but attempts to prioritise the major problems.

Exotic plant pests, not present in Australia, are not addressed in this document. A biosecurity plan has been developed for the papaya industry in consultation with industry, government and scientists. The Biosecurity Plan outlines key threats to the industry, risk mitigation plans, identification and categorisation of exotic pests and contingency plans. High priority exotic pests have been assessed based on their potential to enter, establish, and spread in Australia (e.g. environmental factors, host range, vectors) and the cost to industry of control measures.

https://australianpapaya.com.au/images/papaya/biosecurity/110915%20papaya%20ibp%20v1%200%20final_web.pdf

3.2 Minor use permits and registration

From a pesticide access perspective, the APVMA classifies papaya as a minor crop. The crop fits within the APVMA crop group Crop Group 006: Assorted tropical and sub-tropical fruits – inedible peel, within the Subgroup 006B, Assorted tropical and sub-tropical, Inedible Peel, Large. Therefore, access to minor use permits can be relatively straight forward as long as a reasonable justification is provided in accordance to the APVMA’s minor use guidance (<https://apvma.gov.au/node/10931>).

Possible justification for future permit applications could be based on:

- New disease, insect or weed identified as a cropping issue
- No pesticide approved for the problem
- Insufficient options for resistance management
- Current pesticides ineffective due to resistance
- Trade risk - current pesticides unsuitable where crop commodities will be exported
- IPM, environment or OH&S issues
- Loss of pesticides due to removal from market or chemical review restrictions
- Opportunity to extrapolate a use pattern when a new, effective pesticide is registered in another crop
- Alternate pesticide has overseas registration or minor use permit
- Market failure – insufficient return on investment for registrant.

With each of these options, sound, scientific argument is required to justify any new permit applications. Another option for the papaya industry is for manufacturers to register new pesticides uses in the crop.

3.3 Methods

The current update of the Papaya Strategic Agrichemical Review Process (SARP), which was last updated in 2014, was conducted by desktop audit and included an online industry survey. The process included gathering, collating and confirming information. The steps in the process were:

Process of Review	Activity / Date
Industry survey	Preparation and circulation of online industry survey to update priority pests and identify priority control gaps. Survey released: 14 January 2020 Survey closed: 31 March 2020
SARP data updated via a desktop audit	Updated registrations and permits Updated MRL tables Updated available and potential pesticides against low, moderate and high priority pests, including an assessment of their suitability Included information on regulatory risks from MT17019
Captured industry input	Collated and analysed survey results Consolidated and incorporated industry needs and insights

3.4 Results and discussions

3.4.1 Detail

Results and discussions are presented in the body of this document.

3.4.2 Appendices

Refer to additional information in the appendices:

- Appendix 1. Products available for disease control in papaya
- Appendix 2. Products available for control of insects and mites in papaya
- Appendix 3. Products available for weed control in papaya
- Appendix 4. Plant Growth Regulators available in papaya
- Appendix 5. Current permits for use in papaya
- Appendix 6. Papaya Maximum Residue Limits (MRLs)
- Appendix 7. Papaya Agrichemical Regulatory Risk Assessment

4. Diseases, pests and weeds of papaya

Resistance management: To manage the risk of resistance development, integrated disease/pest/weed management (IDM/IPM/IWM) strategies should be adopted. The general principle is to integrate diverse chemical and non-chemical strategies; maximise efficacy; not rely on singular tools and rotate between different modes of action. It is always essential to follow all the label instructions. Specific resistance management strategies may apply. These can be found, along with other useful information, on the CropLife Australia website².

Information on regulatory risk derived from project MT17019 (Chapter 4) - Regulatory support and coordination (Appendix 7) has been incorporated.

Some of the suggested options have no overseas MRLs (see Appendix 6). If treated fruit is to be exported nil residues at harvest would be needed for these options.

While care has been taken to ensure the accuracy of the information provided in this document the APVMA registered label and where relevant the APVMA approved permit must always be followed.

4.1 Diseases of papaya

4.1.1 Disease priorities

Common name	Scientific name
High	
Phytophthora Root Rot	<i>Phytophthora palmivora</i>
Phytophthora Fruit Disease	<i>Phytophthora</i> spp.
Black Spot	<i>Asperisporium caricae</i>
Brown Spot	<i>Corynespora cassiicola</i>
Anthraxnose	<i>Colletotrichum gloeosporioides</i>
Moderate	
Papaya Sticky Disease / Papaya Meleira Virus	<i>Meleira Virus</i>
Powdery Mildew	<i>Sphaerotheca humuli</i>
Low	
Damping Off	<i>Pythium</i> spp.
Rhizoctonia	<i>Rhizoctonia</i> spp.

The disease priorities identified in this report are similar to those named in the 2014 SARP for the papaya industry.

² <https://www.croplife.org.au/resources/programs/resistance-management/>

In controlling fungal and bacterial diseases, the industry should be mindful of resistance management. CropLife Australia has a resistance management strategy and users must refer to it before using any product³

CropLife Australia recommends that in the absence of a specific resistance management strategy the use of fungicides from a specific mode of action be limited to a maximum of one-third of the total. The number of consecutive applications of the same group should also be limited by rotating/alternating between products from different activity groups. An exception is the use of Group M fungicides as they have a low risk of resistance development.

³ <https://www.croplife.org.au/resources/programs/resistance-management/fungicide-resistance-management-strategies1/fungicide-resistance-management-strategies1-draft/>

4.1.2 Available and potential products for priority diseases

TABLE KEY: Note that blank fields in the table indicate no information has been provided.

Availability		Regulatory risk (refer to Appendix 6)	
A	Available via either registration or permit approval	R1	Short-term: Critical concern over retaining access
P	Potential - a possible candidate to pursue for registration or permit	R2	Medium-term: Maintaining access of significant concern
P-A	Potential, already approved in the crop for another use	R3	Long-term: Potential issues associated with use - Monitoring required
Withholding Period (WHP) – Number of days from last treatment to harvest (H) or Grazing (G)			
Harvest	H	Not Required when used as directed	NR
Grazing	G	No Grazing Permitted	NG

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Phytophthora Root Rot (<i>Phytophthora palmivora</i>)							
Priority: High							
Phytophthora Root Rot is rated as a high priority. Infections can significantly affect tree health and severe cases can lead to tree death. The key cultural control is to ensure good drainage and maintain general tree health.							
Metalaxyl-M (Ridomil Gold) Syngenta, Phosphorous Acid present as Mono-Di Potassium Phosphite PER14490	4+33	Protectant & Curative	NR	A	QLD	Permitted in pawpaw for control of Phytophthora Root Rot and Pythium. Irrigation (fertigation) - Apply Metalaxyl-M through irrigation system followed by phosphorous acid. Foliar Application – Apply phosphorous acid only, ensuring thorough foliar coverage and using spray intervals of 14 days when conditions favour disease. Treatments per season not limited.	-
<i>Bacillus amyloliquefaciens</i> Strain QST 713 (Serenade Prime) Bayer	BM 02	Biological	NR	P-A	ALL	Registered in tree crops for application to soil to improve bioavailability of soil resources to horticultural crops. Provides suppression of soil-borne diseases such as Black Scurf in potatoes and Pineapple Disease in sugarcane.	-
Copper	M1	Protectant	1	P-A	ALL	Registered in papaya for control of Phytophthora Stem Canker.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Mandipropamid (Revus) Syngenta	40	Protectant & Curative		P		US registrations for Phytophthora in various crops, including as a foliar application for protection of citrus from Phytophthora Root Rot .	-
Oxathiopiprolin (Zorvec Enicade) Corteva	49	Protectant & Curative		P		Current AU registrations only for Downy Mildew but known to have broad activity in the oomycete group. US registration for control of Phytophthora Canker and Brown Rot in citrus.	-
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Biological	NR	P		Registered in strawberries for the suppression of Powdery Mildew and Phytophthora . No MRLs required for biological product.	-
Phytophthora Fruit Rot (<i>Phytophthora</i> spp.)							
Priority: High							
Phytophthora Fruit Rot is rated as a high priority. It is favoured by warm, wet weather and leads to a surface rot that will progress into the flesh of the fruit. Affected fruit are firm initially and soften at the late stage of the infection. Cultural controls include removing potential sources of infection (fallen fruit and infected plants) and ensuring good drainage and general tree health.							
Copper (Cu) present as cupric hydroxide PER14417	M1	Protectant	1	A	ALL	Permitted in papaya for control of Papaya Fruit Rot . Apply as a preventative cover spray and repeat as required while conditions favour disease development with a minimum spray interval of 10-14 days. Treatments per season not limited.	-
Metalaxyl-M (Ridomil Gold) Syngenta PER14490	4	Protectant	NR	P-A	QLD	Permitted in papaya for control of Phytophthora Root Rot.	-
Phosphorous Acid PER14490	33	Curative	NR	P-A	QLD	Permitted in papaya for control of Phytophthora Root Rot.	-
Mandipropamid (Revus) Syngenta	40	Protectant & Curative		P		US registrations for Phytophthora in various crops, including as a foliar application for protection of citrus from Phytophthora Brown Rot and Phytophthora Blight in cucurbits and fruiting vegetables.	-
Oxathiopiprolin (Zorvec Enicade) Corteva	49	Protectant & Curative		P		Current AU registrations only for Downy Mildew but known to have broad activity in the oomycete group. US registration for control of Phytophthora Canker and Brown Rot in citrus.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Biological	NR	P		Registered in strawberries for the suppression of Powdery Mildew and Phytophthora . No MRLs required for biological product.	-
Black Spot (<i>Asperisporium caricae</i>)							
Priority: High							
Black Spot is rated as a high priority. It leads to reduced yield and sunburn on fruit as it causes premature death of leaves.							
Chlorothalonil (Bravo) PER12592	M5	Protectant	3	A	ALL (excl. VIC)	Permitted in papaya for control of Black Spot and Brown Spot. Apply as a cover spray every 10-14 days when conditions favour disease as new growth of damaged trees develops. Treatments per season not limited.	R3
Difenoconazole (Score) Syngenta PER12592	3	Protectant & Curative	3	A	ALL (excl. VIC)	Permitted in papaya for control of Black Spot . Commence spraying during the cooler months of the year (Mar-Oct). When disease potential is high, apply 2 consecutive sprays at 14-21 day interval before applying further treatments of protectant fungicide from a different activity group. Do not apply more than 2 consecutive applications, and do not exceed 6 applications per season.	R3
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Protectant & Curative	3	A	ALL	Registered in papaya for control of Black Spot and Brown Spot. Begin applications when crop development reaches susceptible stages for disease to occur. Use in a preventative fungicide program with 14-21 day intervals between treatments. Apply a maximum of 3 applications per season.	-
Mancozeb	M3	Protectant	1	A	ALL	Registered in papaya for control of Black Spot . Apply at 10-14 day intervals during periods conducive to disease. Treatments per season not limited.	R2
Tebuconazole	3	Protectant & Curative	3	A	ALL	Registered in papaya for control of Black Spot . Apply as a cover spray at 14 day intervals. Alternate with sprays of a protectant fungicide. Do not use more than 6 applications of Group 3 fungicides in any 12 month period.	R3
Florypicoxamid (Adavelt) Corteva	21	Protectant & Curative		P		New Mode of Action fungicide being developed for AU, with activity on a broad range of foliar diseases. Due for registration in 2023.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fluopyram + Tebuconazole (Luna Experience) Bayer	7+3	Protectant & Curative		P		Hort Innovation project ST16006 generating data to register in Tropical & Subtropical Fruit (inedible peel) for control of Alternaria, Anthracnose and Septoria. Submission expected in November 2020 and registration in mid to late 2021. Fluopyram: AU MRL T2 mg/kg. Tebuconazole: AU MRL 0.2 mg/kg. Codex MRL 2 mg/kg.	R3
Brown Spot (<i>Corynespora cassiicola</i>) Priority: High							
Brown Spot is rated as a high priority. Outbreaks can occur during extended periods of warm, humid weather. Damage is usually confined to the foliage but can affect the fruit in some seasons.							
Chlorothalonil (Bravo) PER12592	M5	Protectant	3	A	ALL (excl. VIC)	Permitted in papaya for control of Black Spot and Brown Spot . Apply as a cover spray every 10-14 days when conditions favour disease as new growth of damaged trees develops. Treatments per season not limited.	R3
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Protectant & Curative	3	A	ALL	Registered in papaya for control of Black Spot and Brown Spot . Begin applications when crop development reaches susceptible stages for disease to occur. Use in a preventative fungicide program with 14-21 day intervals between treatments. Apply a maximum of 3 applications per season.	-
Florylpicoxamid (Adavelt) Corteva	21	Protectant & Curative		P		New Mode of Action fungicide being developed for AU, with activity on a broad range of foliar diseases. Due for registration in 2023.	-
Fluopyram + Tebuconazole (Luna Experience) Bayer	7+3	Protectant & Curative		P		Hort Innovation project ST16006 generating data to register in Tropical & Subtropical Fruit (inedible peel) for control of Alternaria, Anthracnose and Septoria. Submission expected in November 2020 and registration in mid to late 2021. Fluopyram: AU MRL T2 mg/kg. Tebuconazole: AU MRL 0.2 mg/kg. Codex MRL 2 mg/kg.	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Anthracnose (<i>Colletotrichum gloeosporioides</i>)							
Priority: High							
Anthracnose is rated as a high priority. It is the most important post-harvest disease of papaya. The fruit develops brown sunken spots on the surface which can enlarge into unsightly water-soaked areas. Crop hygiene is important to reduce infection during fruit set and ripening. Post-harvest fungicide treatments are required to maintain fruit quality. The use of post-harvest hot water dips (50-52 deg C) have also proven effective.							
Chlorine		Post-harvest Spray	NR	A	ALL	Registered in fruit for post-harvest control of bacteria and fungi . Chlorinated water needs to make contact with produce for at least 30 seconds.	-
Didecyl Dimethyl Ammonium Chloride (Sporekill)		Post-Harvest Treatment	NR	A	ALL	Registered in tropical and sub-tropical fruit (inedible peel) for control of post-harvest decay and diseases caused by relevant micro-organisms. Dip fruit for 3 minutes.	-
Fludioxonil (Scholar) Syngenta PER89170	12	Post-Harvest Treatment	NR	A	NSW, NT, QLD & WA	Permitted in papaya for post-harvest control of Anthracnose and Stem End Rot. Apply as a post-harvest dip or flood spray. Maximum 1 application per crop. Dip fruit in prepared solution for 30- 60 seconds and allow to drain or treat with flood spray for 30-60 seconds. Hort Innovation project ST17000 generating data for a label registration to control Anthracnose in papaya. Due for completion November 2020.	-
Iodine	M	Post-Harvest Sanitation	NR	A	ALL	Registered in Tropical & Sub-Tropical Fruit (Inedible Peel) for sanitation of post-harvest decay and diseases . Dip fruit for a minimum of 1 minute.	-
Prochloraz (Sportak)	3	Post-Harvest Spray Treatment	NR	A	QLD, NSW & WA	Registered in papaya for post-harvest control of Anthracnose and Stem End Rot. Fruit should be treated as soon as possible after harvest. Spray fruit for at least 1 minute.	R3
Florypicoxamid (Adavelt) Corteva	21	Protectant & Curative		P		New Mode of Action fungicide being developed AU, activity claimed on Anthracnose . Due for registration in 2023.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Papaya Sticky Disease / Papaya Meleira Virus							
Priority: Moderate							
Papaya Sticky Disease is rated as a moderate priority. It causes a sticky exudate on the fruit, making it unsaleable. The disease is not well understood and there are no chemical control options. No insect vectors have been identified and removal of infected plants is the only control strategy currently being used.							
No control options available.							
Powdery Mildew (<i>Sphaerotheca humuli</i>)							
Priority: Moderate							
Powdery Mildew is rated as a moderate priority. It usually infects immature leaves but can also attack unripe fruit. Affected fruit can be deformed and unable to be sold. Orchard hygiene and other cultural controls to reduce humidity in the canopy will assist in reducing incidence.							
Sulfur	M2	Protectant	NR	A	QLD	Registered in papaya for control of Powdery Mildew . Apply from flowering onwards every 7-14 days. Treatments per season not limited.	-
Triadimenol (Bayfidan) Bayer	3	Protectant & Curative	7	A	QLD, NSW & WA	Registered in papaya for control of Powdery Mildew . Apply as a cover spray when powdery mildew infection begins or when conditions favour the disease. Repeat application every 14 days while conditions favour the disease. Treatments per season not limited.	R3
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Protectant & Curative	3	P-A	ALL	Registered in papaya for control of Black Spot and Brown Spot. Registered in apples for control of Powdery Mildew .	-
ADM1700F Adama	TBC			P		Fungicide in development from Adama with Powdery Mildew activity	-
Cyflufenamid (Flute) AgNova	U6	Protectant & Curative		P		Registered for control of Powdery Mildew in cucurbits, grapes and strawberries.	-
Florypicoxamid (Adavelt) Corteva	21	Protectant & Curative		P		New Mode of Action fungicide being developed AU, activity claimed on Powdery Mildew . Due for registration in 2023.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fluopyram + Tebuconazole (Luna Experience) Bayer	7+3	Protectant & Curative		P		Hort Innovation project ST16006 generating data to register in Tropical & Subtropical Fruit (inedible peel) for control of Alternaria, Anthracnose and Septoria. Submission expected in November 2020 and registration in mid to late 2021. Fluopyram: AU MRL T2 mg/kg. Tebuconazole: AU MRL 0.2 mg/kg. Codex MRL 2 mg/kg.	R3
NUL3195 Nufarm	TBC			P		Fungicide in development from Nufarm with activity on Powdery Mildew and Botrytis.	-
Pyriofenone (Kusabi) ISK	50			P		Registered for control of Powdery Mildew in cucurbits and grapes. Registered in the US for control of Powdery Mildew in berry fruit on the US label. AU MRL 0.05 mg/kg.	-
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Biological	NR	P		Registered in strawberries for the suppression of Powdery Mildew and Phytophthora. No MRLs required for biological product.	-
Damping Off (<i>Pythium</i> spp.)							
Priority: Low							
Damping Off is rated as a low priority. Infections can impact young seedlings. Current cultural controls (disease free stock, drainage, hygiene) and fungicide treatments are effective at keeping the disease in check.							
Metalaxyl-M (Ridomil Gold) Syngenta, Phosphorous Acid present as Mono-Di Potassium Phosphite PER14490	4 33	Protectant & Curative	NR	A	QLD	Permitted in pawpaw for control of Phytophthora Root Rot and Pythium . Irrigation (fertigation) - Apply Metalaxyl-M through irrigation system followed by phosphorous acid. Foliar Application – Apply phosphorous acid only, ensuring thorough foliar coverage and using spray intervals of 14 days when conditions favour disease. Treatments per season not limited.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Bacillus amyloliquefaciens</i> Strain QST 713 (Serenade Prime Soil Ameliorant and Biofungicide) Bayer	BM 02	Biological Soil Ameliorant	NR	P-A	ALL	Available in tree crops for application to soil to improve bioavailability of soil resources to horticultural crops. No MRLs required for biological product.	-
NUL3163 Nufarm	TBC			P		New fungicide in development from Nufarm with activity on <i>Pythium spp.</i>	-
Rhizoctonia (<i>Rhizoctonia spp.</i>)							
Priority: Low							
Rhizoctonia is rated as a low priority. It is a soil-borne disease that can affect seedlings, but older trees are resistant. Cultural controls such as planting into well-drained sites and ensuring planting materials are free of disease.							
<i>Bacillus amyloliquefaciens</i> Strain QST 713 (Serenade Prime Soil Ameliorant and Biofungicide) Bayer	BM 02	Biological Soil Ameliorant	NR	P-A	ALL	Available in tree crops for application to soil to improve bioavailability of soil resources to horticultural crops. No MRLs required for biological product.	-
NUL3163 Nufarm	TBC			P		New fungicide in development from Nufarm with activity on <i>Rhizoctonia spp.</i>	-

4.2 Insect and mite pests of papaya

4.2.1 Insect and mite pest priorities

Common name	Scientific name
High	
Fruit Spotting Bug	<i>Amblypelta nitida</i>
Banana Spotting Bug	<i>Amblypelta lutescens</i>
Two Spotted Mite	<i>Tetranychus urticae</i>
Moderate	
Queensland Fruit Fly	<i>Bactrocera tryoni</i>
Low	
Cutworms	<i>Agrostis</i> spp.
Scale	<i>Coccidae</i>
Mealybugs	<i>Planococcus</i> spp.

Exotic pests and new incursions which could be potential threats are listed below:

Common Name	Scientific name
Fall Armyworm	<i>Spodoptera frugiperda</i>

Fruit Spotting Bug, Banana Spotting Bug and Two Spotted Mite are rated as a high priority. These priorities have not changed since the 2014 SARP.

It is important to take an Integrated Pest Management (IPM) Approach to pest control in papaya. The diversity of insects that will attack the crop means that a planned, strategic approach is required. A range of control measures should be used, including cultural controls, biological controls and insecticides. Beneficial insects such as predators, parasitoids and pollinators should be encouraged and can be introduced artificially if required. Insecticide choice should be made with regard to preserving the beneficial insects that play an important role in the crop.

Bees also play an important role as pollinators of papaya. Extra care should be taken with insect control measures used at flowering time, to avoid impacting on pollinators. Always refer to the pesticide label for guidance about preserving bees.

The diverse range of invertebrate pests in papaya necessitates careful planning with resistance management. Pest strategies are available on the CropLife website⁴.

⁴ www.croplife.org.au/resources/programs/resistance-management/

4.2.2 Available and potential products for priority insect and mite pests

TABLE KEY: Note that blank fields in the table indicate no information has been provided.

Availability		Regulatory risk (refer to Appendix 6)	
A	Available via either registration or permit approval	R1	Short-term: Critical concern over retaining access
P	Potential - a possible candidate to pursue for registration or permit	R2	Medium-term: Maintaining access of significant concern
P-A	Potential, already approved in the crop for another use	R3	Long-term: Potential issues associated with use - Monitoring required
Withholding Period (WHP) – Number of days from last treatment to harvest (H) or Grazing (G)			
Harvest	H	Not Required when used as directed	NR
Grazing	G	No Grazing Permitted	NG
IPM – indicative overall impact on beneficials (based on the Cotton Pest Management Guide 2018-19 and cotton use patterns)			
VL – Very low; L – Low; M – Moderate; H – High; VH – Very High; - not specified			

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Fruit Spotting Bug (<i>Amblypelta nitida</i>) Banana Spotting Bug (<i>Amblypelta lutescens</i>) Priority: High Fruit Spotting Bug and Banana Spotting Bug are rated as a high priority. They are particularly prevalent in coastal and tableland areas. Adults and nymphs feed by piercing fruit and sucking the juice from the tissue. This causes extensive tissue damage and can lead to fruit drop.								
Beta-cyfluthrin (Bulldock) PER13671	3A	Contact	3	A	NSW, QLD, NT & WA	Permitted in papaya for control of Fruit Spotting Bug and Banana Spotting Bug . Apply as foliar spray during January to May when monitoring indicates that <i>Amblypelta</i> species are present in sufficient numbers to cause economic damage. Repeat treatment if re-infestation occurs. Apply a maximum of only two (2) applications during January to May, with a minimum of 21 days between sprays.	VH Bee H	R3

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Sulfoxaflor (Transform) Corteva PER85397	4C	Contact & Ingestion	7	A	NSW, NT, QLD & WA	Permitted in papaya for control of Fruit Spotting Bug and Banana Spotting Bug . Apply only when monitoring of the crop indicates that the pest is present and active in sufficient numbers to cause economic damage. DO NOT apply more than two (2) applications per year with a minimum of 14 days between consecutive sprays. Hort Innovation project ST17000 is generating residue data to gain a label registration in Tropical & Sub-Tropical Fruit (inedible peel) for control of Spotting Bugs. Due for completion Nov 2020.	M Bee VH	-
Trichlorfon (Lepidex)	1B	Contact	2	A	QLD, NSW & NT	Registered in papaya for control of Fruit Spotting Bug and Banana Spotting Bug . Apply when premature fruit fall is evident. A second application may be required 2 weeks later. Treatments per season not limited.	H Bee H	R2
Acetamiprid + Pyriproxyfen (Trivor) Adama	4A+7C	Ingestion / IGR		P		Hort Innovation project ST16006 generating data to enable registration in Tropical and Sub-Tropical Fruits (inedible peel) for control of Spotting Bugs , Hoppers, Scale and Mealybug. Pyriproxyfen: Codex MRL 0.3 mg/kg.	M Bee H	R2
Flupyradifurone (Sivanto Prime) Bayer	4D	Ingestion		P		ST19020 data generation (AgVet Grant) for label registration to control Fruit Spotting Bugs in Tropical & Sub-Tropical Fruits (inedible peel). Registered for control of Fruit Spotting Bugs in macadamia.	L Bee L	-
NUL3445	TBC			P		New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and Thrips.		-
SYNFOI21 Syngenta	New			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for various pests including Thrips, Bugs, Mites and Caterpillars.		-
Two-Spotted Mite (<i>Tetranychus urticae</i>)								
Priority: High								
Two Spotted Mite is rated as a high priority. They damage the foliage and fruit by direct feeding damage. An integrated approach to managing the pest includes minimising the use of broad-spectrum insecticides, release of predatory mites and the use of targeted miticides to control outbreaks when necessary.								
Abamectin	6	Ingestion	H:7 NG	A	ALL	Registered in papaya for control of Two Spotted Mite . Apply as soon as mites appear. One application only per season.	M Bee H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Bifenazate (Acramite) UPL	20D	Contact & Ingestion	7	A	ALL	Registered in papaya for control of Two Spotted Mite . Apply as soon as mites appear. One application only per season.	L Bee H	-
Etoxazole (Paramite) Sumitomo PER14098	10B	Contact & Ingestion	H:7 NG	A	WA, NT, QLD & NSW	Permitted in papaya for control of Two Spotted Mite . Apply as soon as mites appear. One application only per season.	L Bee VL	R3
Fenbutatin Oxide (Torque) BASF PER14097	12B	Contact	H:7 NG	A	ALL (excl. VIC)	Permitted in papaya for control of Two Spotted Mite . Apply as soon as mites appear. DO NOT make more than two applications per season. Repeat after at least 14 days depending on infestation.	L Bee L	R3
Potassium Salts of Fatty Acid (Natrasoap)		Contact	NR	A	ALL	Registered in fruit trees for control of Aphids, Thrips, Mealybug, Two Spotted Mite , Spider Mite and Whitefly. Apply as a cover spray. Treatments per season not limited.	L Bee L	-
<i>Beauveria bassiana</i> (Velifer) BASF	UN	Biological	NR	P		Registered for suppression of Onion Thrips and Western Flower Thrips in protected vegetables and ornamentals and has activity on Thrips, Aphids, Whitefly and Mites. No MRLs required for a biological product.	L Bee L	-
Cyflumetofen (Danisaraba) BASF	25A	Contact		P		BASF is seeking registration in Australia for the control of Spider Mites in various crops. Will not control mite species other than Spider Mites.	L Bee L	-
Spiromesifen (Oberon) Bayer	23			P		No registration in AU but studies underway with Hort Innovation in various crops. US registrations for Mites in various crops.	M Bee VL	-
SYNFOI21 Syngenta	New			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for various pests including Thrips, Bugs, Mites and Caterpillars.		-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Queensland Fruit Fly (<i>Bactrocera tryoni</i>)								
Priority: Moderate								
Queensland fruit Fly is rated as a moderate priority. They are a frequent pest although the damage caused to fruit is not always easy to detect. Fruit exported or sent interstate from Queensland must be treated post-harvest to ensure fruit is not infested.								
4-(P-Acetoxyphenyl)-2-Butanone + Maldison	1B	Contact	NR	A	ALL	Registered in fruit trees for use as a trap for Queensland Fruit Fly . Used to detect the presence of Fruit Fly in the orchard to assist with making decisions about control.	H Bee H	R3
4-(P-Acetoxyphenyl)-2-Butanone + Fipronil	2B	Contact	NR	A	ALL	Registered in fruit crops for population reduction and population monitoring of Queensland Fruit Fly and Lesser Queensland Fruit Fly. Single stations can be used for population monitoring. Control of fruit fly required placement of 16 stations per hectare and should be used in conjunction with regular insecticide cover sprays.	M Bee VH	R3
Dimethoate	1B	Post-Harvest Dip	NR	A	NSW, WA	Registered in papaya as a post-harvest dip treatment for Queensland Fruit Fly . Dip the fruit for one minute.	H Bee H	R1
Dimethoate PER87164	1B	Post-Harvest Treatment	NR	A	ALL	Permitted in papaya for post-harvest control of Queensland Fruit Fly , Lesser Queensland Fruit Fly, Northern Territory or Darwin Fruit Fly and Mediterranean Fly . Dip the fruit for one minute.	H Bee H	R1
Maldison (Fyfanon)	1B	Fruit Tree / Fruit Fly Bait	3	A	ALL	Registered in fruit trees for control of Fruit Fly . Mix with a protein lure and apply to the foliage, starting 6 weeks before normal ripening of the tree and repeat at 4-10 day intervals while fruit remains on the tree. Avoid contact of the bait with the fruit. Treatments per season not limited.	H Bee H	R3
Spinosad (Naturalure) Corteva	5	Fruit Fly Bait Concentrate	NR	A	ALL	Registered in fruit for control of Fruit Flies including Queensland Fruit Fly and Mediterranean Fruit Fly . Apply as either a band or a spot spray to the lower canopy of fruiting plants. Begin applications as soon as monitoring traps indicate flies are present and fruit is at a susceptible stage. Repeat applications every 7 days, re-applying sooner if rain washes off the deposit. Avoid spraying the fruit as phytotoxicity may occur.	L Bee H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Acetamiprid + Pyriproxyfen (Trivor) Adama	4A+7C	Ingestion/ IGR		P		Hort Innovation project ST16006 generating data to enable registration in Tropical and Sub-Tropical Fruits (inedible peel) for control of Spotting Bugs, Hoppers, Scale and Mealybug. Registered for suppression of Queensland Fruit Fly in avocado, citrus and mango. Pyriproxifen: Codex MRL 0.3 mg/kg.	M Bee H	R2
NUL3445 (Nufarm)	TBC			P		New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and Thrips.		-
Cutworms (Agrostis spp.)								
Priority: Low								
Cutworms are rated as a low priority. They are soil-dwelling insects that can damage trees during seedling and early vegetative stages. The larvae feed on the foliage either by climbing the plant or cut the stem at ground level and feeding on the plant tops. No chemical controls are available.								
NUL3445	TBC			P		New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and Thrips.		-
SYNFOI21 Syngenta	New			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for various pests including Thrips, Bugs, Mites and Caterpillars.		-
Tetraniliprole (Vayego 200SC) Bayer	28	Ingestion		P		Registered for control of various weevils, beetles and Lepidoptera in almonds, macadamias, pome and stone fruit. Hort Innovation has several projects underway towards assisting registration in minor crops.	L-M Bee VH	-
Scale (Coccidae)								
Priority: Low								
Scale are rated as a low priority. Severe infestations can lead to sugary excretions on the foliage, which can promote development of sooty mould. No chemical controls are available.								
Sulfoxaflor (Transform) Corteva PER85397	4C	Contact & Ingestion	7	P-A	NSW, NT, QLD & WA	Permitted in papaya for control of Fruit Spotting Bug and Banana Spotting Bug. Registered for control of Scale Insects in citrus.	M Bee VH	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Acetamiprid + Pyriproxyfen (Trivor) Adama	4A+7C	Ingestion/ IGR		P		Hort Innovation project ST16006 generating data to enable registration in Tropical and Sub-Tropical Fruits (inedible peel) for control of Spotting Bugs, Hoppers, Scale and Mealybug. Pyriproxifen: Codex MRL 0.3 mg/kg.	M Bee H	R2
Buprofezin (Applaud) Corteva	16	Contact & Ingestion		P		Registered for the control of Scale Insects in citrus and various tropical tree crops.	M Bee L	-
NUL3145 Nufarm	TBC			P		New product in development from Nufarm with activity on Scale, Nematodes, Mealybug and Whitefly.		-
Paraffinic Oil		Contact		P		Registered for control of Scale Insects in various tree crops and ornamentals.	L Bee L	-
Spirotetramat (Movento) Bayer	23	Ingestion		P		Registered for control of Scale in various crops. Codex MRL 0.4 mg/kg.	M Bee L	-
Mealybugs (<i>Planococcus</i> spp.)								
Priority: Low								
Mealybugs are rated as a low priority. They usually feed on leaves but can also damage fruit.								
Potassium Salts of Fatty Acid (Natrasoap)		Contact	NR	A	ALL	Registered in fruit trees for control of Aphids, Thrips, Mealybug , Two Spotted Mite, Spider Mite and Whitefly. Apply as a cover spray. Treatments per season not limited.	L Bee L	-
Sulfoxaflor (Transform) Corteva PER85397	4C	Contact & Ingestion	7	P-A	NSW, NT, QLD & WA	Permitted in papaya for control of Fruit Spotting Bug and Banana Spotting Bug. Registered for control of Mealybug in citrus, grapes and pome fruit.	M Bee VH	-
Acetamiprid + Pyriproxyfen (Trivor) Adama	4A+7C	Ingestion/ IGR		P		Hort Innovation project ST16006 generating data to enable registration in Tropical and Sub-Tropical Fruits (inedible peel) for control of Spotting Bugs, Hoppers, Scale and Mealybug. Pyriproxifen: Codex MRL 0.3 mg/kg.	M Bee H	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Buprofezin (Applaud) Corteva	16	Contact & Ingestion		P		Registered for the control of Mealybugs in passionfruit, custard apple, persimmon, pear and citrus.	M Bee L	-
Flonicamid (Mainman) ISK, UPL	29			P		Registered for control of Longtailed Mealy Bug in pears.	M Bee VL	-
Flupyradifurone (Sivanto Prime) Bayer	4D	Ingestion		P		ST19020 data generation (AgVet Grant) for label registration to control Fruit Spotting Bugs in Tropical & Sub-Tropical Fruits (inedible peel). Will also have activity on Mealybug . Registered for control of Fruit Spotting Bugs in macadamia.	L Bee L	-
NUL3145 Nufarm	TBC			P		New product in development from Nufarm with activity on Scale, Nematodes, Mealybug and Whitefly.		-
Paraffinic Oil		Contact		P		Registered for control of Mealybug in various ornamentals.	L Bee L	-
Spirotetramat (Movento) Bayer	23	Ingestion		P		Registered for control of Mealybug in passionfruit, mango, citrus, cotton, grapes, pome fruit and stone fruit. Codex MRL 0.4 mg/kg.	M Bee L	-
SYNFOI21 Syngenta	New			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for various pests including Thrips, Bugs, Mites and Caterpillars.		-
Fall Armyworm (<i>Spodoptera frugiperda</i>)								
Priority: Unknown								
Fall Armyworm has recently been detected in Australia for the first time. It has not been seen in papaya and the potential impact is currently unknown.								
Spinetoram (Success Neo) Corteva PER89241	5	Ingestion	NR	A	ALL (excl. VIC)	Permitted in Tropical & Sub-Tropical Fruit (Inedible Peel) for control of Fall Armyworm . Target sprays against mature eggs and newly-hatched larvae when numbers exceed spray threshold. Apply repeat applications at 7-14 day intervals as new infestations occur. Do not use more than 4 applications per season.	M Bee VH	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva PER89870	5	Ingestion	NR	A	ALL (excl. VIC)	Permitted in Tropical & Sub-Tropical Fruit (Inedible Peel) for control of Fall Armyworm . Target sprays against mature eggs and newly-hatched larvae when numbers exceed spray threshold. Apply repeat applications at 7-14 day intervals as new infestations occur. Do not use more than 4 applications per season.	L Bee H	-
NUL3445 Nufarm	TBC			P		New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and Thrips.		-
SYNFOI21 Syngenta	New			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for various pests including Thrips, Bugs, Mites and Caterpillars.		-
Tetraniliprole (Vayego 200SC) Bayer	28	Ingestion		P		Registered for control of various weevils, beetles and Lepidoptera in almonds, macadamias, pome and stone fruit. Hort Innovation has several projects underway towards assisting registration in minor crops.	L-M Bee VH	-

4.3 Weeds in papaya

4.3.1 Weed priorities

Common Name	Scientific Name
High	
Nutgrass	<i>Cyperus rotundus</i>
Moderate	
Bellvine	<i>Ipomoea plebeia</i>
Flaxleaf Fleabane	<i>Conyza bonariensis</i>
Couch Grass	<i>Cynodon dactylon</i>

Nutgrass was the only high priority weed nominated by growers for this report. Bellvine, Flaxleaf Fleabane and Couch Grass were identified as moderate priority.

The 2014 SARP named Fleabane and Mexican Clover as Low-Moderate Priority. This suggests that Fleabane has been a consistent challenge for papaya growers in recent years.

Given the small number of respondents it is difficult to assess how broadly these weed issues are impacting across the industry.

Specific resistance management strategies for high resistance risk (A and B) and moderate resistance risk (C, D, F, G, I, J, K, L, M, N, Q and Z) herbicide modes of action are available on the CropLife Australia webpage.

<https://www.croplife.org.au/resources/programs/resistance-management/herbicide-resistance-management-strategies-2/>

4.3.2 Available and potential products for weed control

TABLE KEY: Note that blank fields in the table indicate no information has been provided.

Availability			
A	Available via either registration or permit approval		
P	Potential – a possible candidate to pursue for registration or permit		
P-A	Potential, already approved in the crop for another use		
Resistance risk		Regulatory risk (refer to Appendix 6)	
		R1	Short-term: Critical concern over retaining access
**	Moderate resistance risk	R2	Medium-term: Maintaining access of significant concern
***	High resistance risk	R3	Long-term: Potential issues associated with use - Monitoring required
Withholding Period (WHP) – Number of days from last treatment to harvest (H) or Grazing (G)			
Harvest	H	Not Required when used as directed	NR
Grazing	G	No Grazing Permitted	NG

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Nutgrass (<i>Cyperus rotunda</i>)							
Priority: High							
Nutgrass is rated as a high priority. Few options are available for controlling nutgrass. Keep good ground cover and improve drainage.							
Glyphosate (Roundup)	M**	Papaya / Directed Spray, Shielded Spray or Wick Wiper	Registered in papaya for control of various grass and broadleaf weeds and nutgrass. Do not allow spray to contact any part of the tree. Time application to flowering nutgrass. Multiple applications will be required.	NR	A	ALL	R3
Bellvine (<i>Ipomoea plebeia</i>)							
Priority: Moderate							
Bellvine is rated as a moderate priority. It is a rapid growing weed that can be difficult to remove once it is established.							
Glufosinate (Basta)	N**	Papaya / Directed or Shielded Spray	Registered in papaya for control of Grass and Broadleaf Weeds, including Bellvine . Apply as a directed or shielded spray. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	NSW, QLD, NT, VIC, SA & WA	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Oxyflourfen (Goal)	G**	Papaya / Directed Spray	Registered in papaya for control of Broadleaf Weeds, including Bellvine . If weeds are already present, use as a spike in a mixture with glyphosate or paraquat.	H:NR NG	A	ALL	-
Paraquat (Gramoxone)	L**	Orchards / Directed Spray or Spot Spray	Registered in orchards for control of Annual Grass and Broadleaf Weeds, including seedling Bellvine . Apply as a directed spray or spot spray. Do not allow spray to contact any part of the tree, including the trunk.	H:1 G:7	A	ALL	R3
Paraquat + Diquat (SpraySeed)	L**	Orchards / Directed Spray or Spot Spray	Registered in orchards for control of Annual Grass and Broadleaf Weeds, including seedling Bellvine . Apply as a directed spray or spot spray. Do not allow spray to contact any part of the tree, including the trunk.	H:NR G:7	A	ALL	R3
Flaxleaf Fleabane (<i>Conyza bonariensis</i>) Priority: Moderate							
Flaxleaf Fleabane is rated as a moderate priority. It seeds prolifically and can germinate year-round. It is difficult to control with herbicides and a continuous program is required to manage it in the orchard.							
Glufosinate (Basta)	N**	Papaya / Directed or Shielded Spray	Registered in papaya for control of Grass and Broadleaf Weeds, including Flaxleaf Fleabane . Apply as a directed or shielded spray. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	NSW, QLD, NT, VIC, SA & WA	R3
Paraquat + Diquat (SpraySeed)	L**	Orchards / Directed Spray or Spot Spray	Registered in orchards for control of Annual Grass and Broadleaf Weeds, including Flaxleaf Fleabane . Apply as a directed spray or spot spray. Do not allow spray to contact any part of the tree, including the trunk.	H:NR G:7	A	ALL	R3
Couch Grass (<i>Cynodon dactylon</i>) Priority: Moderate							
Couch Grass is rated as a moderate priority. It is a widespread, perennial weed that grows year-round in most areas. Herbicide control is effectively provided it is targeted to young, actively growing weeds. Multiple applications are usually required.							
Glufosinate (Basta)	N**	Papaya / Directed or Shielded Spray	Registered in papaya for control of Grass and Broadleaf Weeds, including Couch Grass . Apply as a directed or shielded spray. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	NSW, QLD, NT, VIC, SA & WA	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Glyphosate (Roundup)	M**	Papaya / Directed Spray, Shielded Spray or Wick Wiper	Registered in papaya for control of Grass and Broadleaf Weeds, including Couch Grass . Apply as a directed spray, shielded spray or wick wiper. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	ALL	R3
Haloxypop (Verdict)	A***	Papaya / Directed Spray or Spot Spray	Registered in papaya for control of Grass Weeds, including Couch Grass . Apply as a directed spray or spot spray.	NR	A	ALL	-
Grass and Broadleaf Weeds							
Priority: Low							
The key to weed management in orchards is maintaining ground cover in the inter-row with grass and mulch.							
Glufosinate (Basta)	N**	Papaya / Directed or Shielded Spray	Registered in papaya for control of Grass and Broadleaf Weeds. Apply as a directed or shielded spray. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	NSW, QLD, NT, VIC, SA & WA	R3
Glyphosate (Roundup)	M**	Papaya / Directed Spray, Shielded Spray or Wick Wiper	Registered in papaya for control of Grass and Broadleaf Weeds. Apply as a directed spray, shielded spray or wick wiper. Do not allow spray to contact any part of the tree, including the trunk.	NR	A	ALL	R3
Fluazifop-P (Fusilade)	A***	Papaya / Directed Spray	Registered in papaya for control of Grass Weeds. Apply as a directed spray.	14	A	NSW, QLD, NT & WA	-
Haloxypop (Verdict)	A***	Papaya / Directed Spray or Spot Spray	Registered in papaya for control of Grass Weeds. Apply as a directed spray or spot spray.	NR	A	ALL	-
Oryzalin	D**	Papaya / Non-Bearing Trees Only / Directed Spray	Registered in papaya for control of Grass and Broadleaf Weeds. Apply as a directed spray to non-bearing trees only.	NR	A	ALL	-
Oxyflourfen (Goal)	G**	Papaya / Directed Spray	Registered in papaya for control of Broadleaf Weeds. If weeds are already present, use as a spike in a mixture with glyphosate or paraquat.	H:NR NG	A	ALL	-
Paraquat (Gramoxone)	L**	Orchards / Directed Spray or Spot Spray	Registered in orchards for control of Annual Grass and Broadleaf Weeds. Apply as a directed spray or spot spray. Do not allow spray to contact any part of the tree, including the trunk.	H:1 G:7	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Paraquat + Diquat (SpraySeed)	L**	Orchards / Directed Spray or Spot Spray	Registered in orchards for control of Annual Grass and Broadleaf Weeds. Apply as a directed spray or spot spray. Do not allow spray to contact any part of the tree, including the trunk.	H:NR G:7	A	ALL	R3

4.4 Plant Growth Regulators in papaya

4.4.1 Plant Growth Regulator Priorities

Priority
High
Post-harvest ripening
Moderate
Restriction of vegetative growth
Low
Promote vegetative growth
Promote fruit ripening

Plant Growth Regulators (PGRs) play a minor role in managing papaya orchards. Post-harvest ripening is rated as a high priority.

4.4.2 Available and Potential Plant Growth Regulators

Active ingredient (Trade Name)	Chemical Group	Crop/ Situation	Comment / Use	WHP (days)	Availability	States	Regulatory risk
Post-harvest ripening							
Priority: High							
Post-harvest ripening is rated as a high priority. Harvest timing should aim to achieve a balance between maintaining shelf life and producing high quality fruit with a favourable taste. The use of ethephon as a post-harvest treatment will promote ripening of the fruit.							
1-Methylcyclopropene (Smartfresh)	Plant Growth Regulator	Papaya / Post-Harvest Treatment	Registered in papaya as a post-harvest treatment for improved quality after shipping, storage and handling . Apply as soon after harvest as possible using a Smartfresh delivery system in an enclosed (gas-tight) area.	NR	A	ALL	-
Ethephon PER80746	Plant Growth Regulator	Papaya / Post Harvest Dip	Permitted in papaya as a post-harvest treatment for fruit de-greening (post-harvest ripening) . Apply 1 treatment only as a post-harvest dip. Immerse the fruit for 1 minute and allow to drain prior to packing.	NR	A	NSW, NT, QLD & WA	-

5. References

5.1 Information:

AgChem Access Priority Access Forum	https://www.agrifutures.com.au/national-rural-issues/agvet-chemicals/
Australian Pesticide and Veterinary Medicines Authority	www.apvma.gov.au
APVMA Chemical review	https://apvma.gov.au/chemicals-and-products/chemical-review/listing
APVMA MRLs	www.legislation.gov.au/Details/F2020C00713
APVMA Permit search	https://productsearch.apvma.gov.au/permits
APVMA Product search	https://productsearch.apvma.gov.au/products
Codex MRL database	http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/
Cotton Pest Management Guide 2020-21	https://www.cottoninfo.com.au/publications/cotton-pest-management-guide
CropLife Australia	https://www.croplife.org.au/
Growcom – Infopest Database	www.infopest.com.au
Hort Innovation	www.horticulture.com.au
Ausveg	https://ausveg.com.au/
Agriculture and Food - WA	https://www.agric.wa.gov.au

5.2 Abbreviations and Definitions:

APVMA	Australian Pesticides and Veterinary Medicines Authority
IPM	Integrated pest management
LOQ	Limit of quantification
MRL	Maximum residue limit (mg/kg or ppm)
Pesticides	Plant protection products (fungicide, insecticide, herbicide, nematocides, rodenticides, etc.).
Plant pests	Diseases, insects, nematodes, rodents, viruses, weeds, etc.
SARP	Strategic Agrichemical Review Process
TBC	To be confirmed
WHP	Withholding Period

5.3 Acknowledgements:

Thanks go to the many industry people who contributed information and collaborated on the review of this report.

6. Appendices

- Appendix 1. Products available for disease control in papaya
- Appendix 2. Products available for control of insects and mites in papaya
- Appendix 3. Products available for weed control in papaya
- Appendix 4. Plant Growth Regulators available in papaya
- Appendix 5. Current permits for use in papaya
- Appendix 6. Papaya Maximum Residue Limits (MRLs)
- Appendix 7. Papaya Agrichemical Regulatory Risk Assessment

Appendix 1. Products available for disease control in papaya

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
<i>Bacillus amyloliquefaciens</i> Strain QST 713 (Serenade Prime) Bayer	BM 02	Tree Crops	For soil application to improve bioavailability of soil resources for horticultural crops	ALL	NR	-
Chlorine		Fruit / Post-Harvest Sanitation	Bacteria Fungi	ALL	NR	-
Chlorothalonil (Bravo) PER12592	M5	Papaya / Pawpaw	Black Spot (<i>Asperisporium caricae</i>) Brown Spot (<i>Corynespora cassicola</i>)	ALL (excl. VIC)	3	R3
Copper (Cu) present as cupric ammonium complex	M1	Tropical Fruit	Phytophthora Stem Canker	ALL	1	-
Copper (Cu) present as cupric hydroxide	M1	Tropical Fruit	Phytophthora Stem Canker	QLD, NSW	1	-
Copper (Cu) present as cupric hydroxide PER14417	M1	Papaya / Pawpaw	Papaya Fruit Rot (<i>Phytophthora palmivora</i>)	ALL (excl. VIC)	1	-
Copper (Cu) present as cuprous oxide	M1	Tropical Fruit	Phytophthora Stem Canker	ALL	1	-
Copper (Cu) Present as Tribasic Copper Sulphate	M1	Tropical Fruit	Phytophthora Stem Canker	ALL	1	-
Didecyl Dimethyl Ammonium Chloride (Sporekill)		Tropical & Sub-Tropical Fruit (Inedible Peel) / Post-Harvest Sanitation	Post-Harvest Decay and Diseases	ALL	NR	-
Difenoconazole (Score) Syngenta PER12592	3	Papaya / Pawpaw	Black Spot (<i>Asperisporium caricae</i>)	ALL (excl. VIC)	3	R3

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
Fludioxonil (Scholar) Syngenta PER89170	12	Papaya	Anthracnose (<i>Colletotrichum gloeosporioides</i>) Stem End Rot (<i>Botrosphaeria</i> family, including <i>Lasiodiplodia</i> and <i>Dothiorella</i>)	NSW, NT, QLD & WA	NR	-
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Papaya	Black Spot (<i>Asperisporium caricae</i>) Brown Spot (<i>Corynespora cassicola</i>)	ALL	3	-
Iodine		Tropical & Sub-Tropical Fruit (Inedible Peel) / Post-Harvest Sanitation	Bacteria & Fungi	ALL	NR	-
Mancozeb	M3	Papaya / Pawpaw	Black Spot	ALL	1	R2
Metalaxyl-M (Ridomil Gold) Syngenta Phosphorous Acid present as Mono-Di Potassium Phosphite PER14490	4 33	Papaya / Pawpaw	Phytophthora Root Rot (<i>Phytophthora palmivora</i>) Pythium (<i>Pythium spp</i>)	QLD only	NR	-
Prochloraz (Sportak)	3	Papaya / Pawpaw / Post-Harvest	Anthracnose (<i>Colletotrichum spp</i>) Stem End Rot	QLD, NSW & WA	NR	R3
Propamocarb PER13076	28	Papaya / Pawpaw Seedlings (Nurseries only)	Damping Off (<i>Pythium spp</i>)	NSW, QLD, NT & WA	NR	-
Sulfur	M2	Pawpaw	Powdery Mildew	QLD	NR	-
Tebuconazole	3	Papaya / Pawpaw	Black Spot	ALL	3	R3
Triadimenol (Bayfidan) Bayer	3	Papaya / Pawpaw	Powdery Mildew	QLD, NSW & WA	7	R3

Appendix 2. Products available for control of insects and mites in papaya

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
4-(P-Acetoxyphenyl) -2- Butanone + Maldison	1B	Fruit Trees / Fruit Fly Trap	Queensland Fruit Fly	ALL	NR	R3
4-(P-Acetoxyphenyl) -2- Butanone + Fipronil	2B	Fruit Trees / Fruit Fly Trap	Queensland Fruit Fly Lesser Queensland Fruit Fly	ALL	NR	R3
Abamectin	6	Papaya / Pawpaw	Two Spotted Mite (<i>Tetranychus urticae</i>)	ALL	H:7 NG	-
Abamectin PER14097	6	Papaya / Pawpaw	Two Spotted Mite	ALL (excl. VIC)	H:7 NG	-
Beta-Cyfluthrin (Bulldock) Bayer PER13671	3A	Papaya / Pawpaw	Fruit Spotting Bug Banana Spotting Bug	NSW, QLD, NT & WA	3	R3
Bifenazate (Acramite) UPL	20D	Papaya / Pawpaw	Two Spotted Mite	ALL	7	-
Dimethoate	1B	Papaya / Pawpaw Post-Harvest Dip	Queensland Fruit Fly	NSW, WA	NR	R1
Dimethoate PER87164	1B	Papaya / Post-Harvest Dip or Flood Spray	Queensland Fruit Fly Lesser Queensland Fruit Fly Northern Territory or Darwin Fruit Fly Mediterranean Fly	ALL	NR	R1
Etoxazole (Paramite) Sumitomo PER14098	10B	Papaya / Pawpaw	Two Spotted Mite	WA, NT, QLD & NSW	H:7 NG	R3

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Fenbutatin Oxide (Torque) BASF PER14097	12B	Papaya / Pawpaw	Two Spotted Mite	ALL (excl. VIC)	H:7 NG	R3
Maldison (Fyfanon)	1B	Fruit Tree / Fruit Fly Bait	Fruit Fly	ALL	3	-
Potassium Salts of Fatty Acid (Natrasoap)		Fruit Trees	Aphids Thrips Mealybug Two-Spotted Mite Spider Mite Whitefly	ALL	NR	-
Pyriproxyfen (Distance Ant Bait) Sumitomo	7C	Tropical Fruit Plantation	Invasive & Nuisance Ants	ALL	NR	-
Spinetoram (Success Neo) Corteva	5	Tropical & Sub-Tropical Fruits (inedible peel)	Flower-Eating Caterpillar Leafrollers Loopers Yellow Peach Moth Red-Banded Thrips Sorghum Head Caterpillar	ALL	NR	-
Spinetoram (Success Neo) Corteva PER89241	5	Tropical & Sub-Tropical Fruits (inedible peel)	Fall Armyworm	ALL (excl. VIC)	NR	-
Spinosad (Naturalure) Corteva	5	Tree, Fruit, Nut, Vine & Vegetable Crops / Fruit Fly Bait	Fruit Flies including Queensland Fruit Fly Mediterranean Fruit Fly	ALL	NR	-

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Tropical & Sub-Tropical Fruits (inedible peel)	Flower-Eating Caterpillar Leafrollers Loopers Yellow Peach Moth Red-Banded Thrips Sorghum Head Caterpillar	ALL	NR	-
Spinosad (Entrust Organic) Corteva PER89870	5	Tropical & Sub-Tropical Fruits (inedible peel)	Fall Armyworm	ALL (excl. VIC)	NR	-
Sulfoxaflor (Transform) Corteva PER85397	4C	Papaya / Pawpaw	Fruit Spotting Bug Banana Spotting Bug	NSW, NT, QLD & WA	7	-
Trichlorfon (Lepidex)	1B	Papaya / Pawpaw	Fruit Spotting Bug Banana Spotting Bug	QLD, NSW & NT	2	R2

Appendix 3. Products available for weed control in papaya

Active ingredient (Trade Name)	Chem. Group	Situation	Comment / Use / Weed	WHP (days)	States	Regulatory risk
Carfentrazone (Spotlight Plus)	G**	Tropical and Sub-Tropical Fruit	Broadleaf Weeds	NR	ALL	-
Fluazifop-P (Fusilade)	A***	Papaya / Directed Spray	Grass weeds	14	NSW, QLD, NT & WA	-
Glufosinate (Basta)	N**	Tropical Fruit (Inedible Peel) / Directed or Shielded Spray	Do not allow spray to contact any part of the tree, including the trunk. Grass and broadleaf weeds	NR	NSW, QLD, NT, VIC, SA & WA	R3
Glyphosate (Roundup)	M**	Papaya / Directed Spray, Shielded Spray or Wick Wiper	Do not allow spray to contact any part of the tree, including the trunk. Grass and broadleaf weeds.	NR	ALL	R3
Haloxfop (Verdict)	A***	Papaya / Directed Spray or Spot Spray	Grass weeds	NR	ALL	-
Oryzalin	D**	Papaya / Non-Bearing Trees Only / Directed Spray	Grass and broadleaf weeds	NR	ALL	-
Oxyfluorfen (Goal)	G**	Papaya / Directed Spray	Grass and broadleaf weeds. If weeds are already present, use as a spike in a mixture with glyphosate or paraquat.	H:NR NG	ALL	-
Metham		Pawpaw / Fumigant	Germinating Weed Seeds including Winter Grass, Prince of Wales Feather and Fat-Hen.	NR	ALL	-
Paraquat (Gramoxone)	L**	Orchards / Directed Spray or Spot Spray	Annual Grass and broadleaf weeds	H:1 G:7	ALL	R3
Paraquat + Diquat (SpraySeed)	L**	Orchards / Directed Spray or Spot Spray	Annual Grass and broadleaf weeds	H:NR G:7	ALL	R3

Chemical Group Resistance Risk: ** Moderate, *** High

Appendix 4. Plant Growth Regulators available in papaya

Active ingredient (Trade Name)	Chem. Group	Situation	Comment / Use	WHP (days)	States	Regulatory risk
1-Methylcyclopropene (Smartfresh)	Plant Growth Regulator	Papaya / Post-Harvest Treatment	Post-Harvest Treatment for improved quality after shipping, storage and handling	NR	ALL	-
Ethephon PER80746	Plant Growth Regulator	Papaya / Post-Harvest Dip	Fruit De-Greening (Post-Harvest Ripening)	NR	NSW, NT, QLD & WA	-

Appendix 5. Current permits for use in papaya

Permit No.	Description	Issued Date	Expiry Date	Permit Holder
PER12592 Version 2	Chlorothalonil & Difenconazole / Papaya / Black Spot & Brown Spot	14-Aug-11	30-Apr-25	Hort Innovation
PER13076 Version 2	Propamocarb / Papaw or Papaya (Seedlings) / Damping Off (NSW, QLD, NT, WA)	5-Apr-12	31-Mar-22	Papaya Australia c/- Hort Innovation
PER13671 Version 3	Beta-Cyfluthrin (Bulldock) / Papaya / Fruit-Spotting Bug & Banana-Spotting Bug (NSW, QLD, NT, WA)	28-Nov-12	28-Feb-23	Papaya Australia c/- Hort Innovation
PER14097 Version 3	Abamectin & Fenbutatin oxide / Papaya (Pawpaw) / Two-Spotted Mite	31-Oct-13	30-Jun-23	Papaya Australia
PER14098 Version 2	Etoxazole (Paramite) / Papaya / Two-Spotted Mite (WA, NT, QLD, NSW)	3-Oct-13	30-Jun-23	Papaya Australia
PER14417 Version 2	Copper (Cupric) Hydroxide / Papaya/ Phytophthora Fruit Rot	28-Feb-14	31-Dec-24	Hort Innovation
PER14490 Version 2	Metalaxyl-M (Ridomil Gold 25G), Metalaxyl (Zee-mil 50G) + Phosphorous Acid / Papaya (Pawpaw) / Phytophthora Root Rot & Pythium (QLD)	4-Apr-14	31-Mar-22	Papaya Australia c/- Hort Innovation
PER80746 Version 2	Ethephon / Papaya / Crop Ripening (NSW, NT, QLD, WA)	18-Aug-15	31-Aug-25	Hort Innovation
PER85397	Sulfoxaflor / Lychee, Mango, Papaya & Passionfruit / Fruit Spotting Bug & Banana Spotting Bug (NSW, QLD, NT, WA)	17-Apr-18	30-Apr-23	Hort Innovation
PER87164 Version 2	Dimethoate / Specified Citrus, Tropical Fruit Commodities / Various Fruit Fly Species	1-Mar-19	31-Mar-24	Hort Innovation
PER89170	Fludioxonil (Scholar) / Papaya / Anthracnose & Stem End Rot (NSW, NT, QLD, WA) Emergency Use Permit	12-Feb-20	28-Feb-21	Hort Innovation
PER89241	Spinetoram (Success Neo) / Various Crops / Fall Armyworm Emergency Use Permit	6-Mar-20	31-Mar-23	Hort Innovation
PER89870	Spinosad (Entrust Organic) / Various Crops / Fall Armyworm Emergency Use Permit	21-Jul-20	31-Jul-23	Hort Innovation

Appendix 6. Papaya Maximum Residue Limits (MRLs)

CODEX commodity groupings of tropical fruits and subgroups:

FI0030 Assorted Tropical and Sub-Tropical Fruit - Inedible Peel

FI0350 Papaya

AO2 0002 Fruits

Note: Export quantities of papaya are very small and of that most goes to New Zealand. Available information indicates that in the absence of specific limits in legislation, that some countries defer to Codex, followed by EU MRL standards, or apply a 0.01ppm default value. Food exported to New Zealand from Australia may be legally sold if it complies with Australian requirements. MRLs and legislation are subject to change; the values presented should not be relied on.

Chemical	Codex Code	Description (Commodity)	APVMA MRL mg/kg	Codex MRL mg/kg
2,2-DPA	FI 0350	Papaya	*0.1	
Abamectin	FI 0350	Papaya	0.1	0.01
Aldrin and Dieldrin		Fruits	E0.05	
Amitrole	FI 0350	Papaya	*0.01	
Azoxystrobin	FI 0350	Papaya		0.3
Beta-cyfluthrin	FI 0350	Papaya	T0.2	
Bifenazate	FI 0350	Papaya	2	
Bromide Ion		Fruits		20
Carfentrazone-ethyl	FI 0030	Tropical - Inedible peel	*0.05	
Chlorfenapyr	FI 0350	Papaya		0.3
Chlorothalonil	FI 0350	Papaya	10	20
Clothianidin	FI 0350	Papaya		*0.01
Cypermethrins (including alpha- and zeta- cypermethrin)	FI 0350	Papaya		0.5
DDT		Fruits	E1	
Diazinon		Fruits	0.5	
Dicofol		Fruits	5	
Didecyldimethylammonium chloride	FI 0030	Tropical - Inedible peel	20	
Difenoconazole	FI 0350	Papaya	1	0.2
Dimethoate see also Omethoate	FI 0030	Tropical - Inedible peel	5	
Diquat		Fruits	*0.05	
Dithianon		Fruits	2	
Dithiocarbamates (mancozeb, metham, metiram, thiram, zineb and ziram)	FI 0350	Papaya		5
	FI 0350	Papaya	5	
Ethephon	FI 0350	Papaya	T1	
Etoxazole	FI 0350	Papaya	T0.1	
Fenbutatin oxide	FI 0030	Tropical - Inedible peel	5	
Fipronil	FI 0030	Tropical - Inedible peel	*T0.01	
Fluazifop-p-butyl	FI 0030	Tropical - Inedible peel	0.05	
Fludioxonil	FI 0350	Papaya	T5	
Fluopyram	FI 0030	Tropical - Inedible peel	T2	
Fluxapyroxad	FI 0350	Papaya		1
Glufosinate/Glufosinate-Ammonium	FI 0030	Tropical - Inedible peel	0.2	0.1

Chemical	Codex Code	Description (Commodity)	APVMA MRL mg/kg	Codex MRL mg/kg
Glyphosate	FI 0350	Papaya	*0.05	
Haloxypop	FI 0030	Tropical - Inedible peel	*0.05	
Inorganic bromide		Fruits	20	
Isoxaben	FI 0030	Tropical - Inedible peel	*0.01	
Lindane		Fruits	E0.5	
Maldison		Fruits	2	
Metalaxyl	FI 0350	Papaya	*0.01	
Metaldehyde		Fruits	1	
Methiocarb		Fruits	T0.1	
Methoxyfenozide	FI 0350	Papaya		1
Methyl bromide	FI 0350	Papaya	*0.05	
Omethoate		Fruits	2	
Oryzalin		Fruits	0.1	
Oxyfluorfen	FI 0030	Tropical - Inedible peel	*0.01	
Paclobutrazol	FI 0030	Tropical - Inedible peel	*0.01	
Paraquat		Fruits	*0.05	
	FI 0030	Tropical - Inedible peel		*0.01
Pendimethalin	FI 0030	Tropical - Inedible peel	*0.05	
Phosphine	FI 0030	Tropical - Inedible peel	*T0.01	
Phosphorous acid	FI 0030	Tropical - Inedible peel	T100	
Piperonyl butoxide		Fruits	8	
Pirimicarb		Fruits	0.5	
Prochloraz	FI 0350	Papaya	5	
	FI 0030	Tropical - Inedible peel		Po7
Pyraclostrobin	FI 0350	Papaya	T0.5	0.15
Pyrethrins		Fruits	1	
Pyriproxyfen	FI 0350	Papaya		0.3
Simazine		Fruits	*0.1	
Spinetoram	FI 0030	Tropical - Inedible peel	0.3	
Spinosad	FI 0030	Tropical - Inedible peel	0.3	
Spirodiclofen	FI 0350	Papaya		*0.03
Spirotetramat	FI 0350	Papaya		0.4
Sulfoxaflor	FI 0350	Papaya	T0.7	
Tebuconazole	FI 0350	Papaya	0.2	2
Teflubenzuron	FI 0350	Papaya		0.4
Thiabendazole	FI 0350	Papaya		Po10
Thiamethoxam	FI 0350	Papaya		*0.01
Triadimenol	FI 0350	Papaya	0.2	
Trichlorfon	FI 0030	Tropical - Inedible peel	T3	
Trifloxystrobin	FI 0030	Tropical - Inedible peel	T2	
	FI 0350	Papaya		0.6
Triflumizole	FI 0350	Papaya		2
Trifluralin		Fruits	*0.05	

NOTE: MRLs are constantly under review and subject to change. Check for current MRLs and do not rely on the values stated above.

* Indicates that an MRL is at the Limit of Quantitation (LOQ)

NR - Uses of substances where MRLs are not necessary / required.

T =Temporary MRL

E = The MRL is based on extraneous residues

Sources: APVMA MRLs: Agricultural and Veterinary Chemicals Code (MRL Standard) Instrument 2019. Compilation 4. Prepared 15 January 2020.

CODEX MRLs: CODEX Alimentarius International Food Standards database (February 2020),

<http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/>

Appendix 7. Papaya Agrichemical Regulatory Risk Assessment

Papaya Agrichemical Regulatory Risk Assessment

September 2020

Regulatory pressures on agrichemicals are increasing globally, with many being either restricted or withdrawn from use. For older agrichemicals these pressures are often the result of reconsiderations involving new or refined risk assessment methodologies with changed data requirements. A consequence of which can be that many agrichemicals are not meeting contemporary risk assessment standards as the necessary data is unavailable, or where data is available, the refined risk posed is considered unacceptable.

The use of agrichemicals can also be impacted through differences in standards between trading partners. The lack of an appropriate pesticide maximum residue limit (MRL) in an importing country can, for practical purposes, effectively prohibit use in the exporting country so as to ensure compliance, as a MRL breach would adversely affect market access.

The effects of the above are greater regulatory pressure placed on the use of individual agrichemicals or chemical groups. As a consequence it is possible that the number of approved agrichemical options could be adversely impacted.

To assist strategic planning, with respect to future pest management options, the following tables have been developed to highlight the regulatory threats to agrichemicals currently approved for the management of the pests and diseases in papaya as well as current initiatives aimed at addressing identified pest management deficiencies.

Papaya Agrichemical Regulatory Risk Assessment

R1	Short-term: Critical concern over retaining access
R2	Medium-term: Maintaining access of significant concern
R3	Long-term: Potential issues associated with use - Monitoring required

Problem	Active Constituents	Chemical Group	Comment	Activities
INSECT AND MITE PESTS				
Ants	Pyriproxyfen	7C	EU: Authorisation renewal process underway	
Red imported fire ant	Pyriproxyfen (PER85163 & PER87728 Qld only)	7C	EU: Authorisation renewal process underway	
	S-methoprene (PER14093 & PER85308 Qld only)	7A		
Tropical fire ant	Indoxacarb	22A	EU: No authorisations	
Caterpillars/Lepidoptera				
Fall armyworm	Spinetoram (PER89241)	5		
	Spinosad (PER89870)	5		
Flower eating caterpillars	Spinetoram	5		
	Spinosad	5		
Leafroller moths	Spinetoram	5		
	Spinosad	5		
Loopers	<i>B thuringiensis</i>	11A		
	Spinetoram	5		
	Spinosad	5		
Native budworm	<i>B thuringiensis</i>	11A		
Sorghum head caterpillar	Spinetoram	5		
	Spinosad	5		
Yellow peach moth	Spinetoram	5		
	Spinosad	5		

Papaya Agrichemical Regulatory Risk Assessment

Problem	Active Constituents	Chemical Group	Comment	Activities
Fruit fly				
Fruit flies	Maldison + attractant	1B	APVMA: Under review – chemistry Codex: Re-evaluation scheduled for 2022/23	
	Spinosad	5		
	Trichlorfon	1B	APVMA – nominated for review Codex – No MRLs Europe – deregistered US – No MRLs	
Lesser Queensland fruit fly	Dimethoate (Po) (PER87164)	1B	Codex: MRL deletion recommended.	
Mediterranean fruit fly	Dimethoate (Po) (PER87164)	1B	EU proposing to set all MRLs to < 0.01 mg/kg	
	Dichlorvos (PER6338)	1B	EU: No authorisation in place	
	Spinosad	5		
	Trichlorfon	1B	APVMA – nominated for review Codex – No MRLs Europe – deregistered US – No MRLs	
Northern Territory fruit fly	Dimethoate (Po) (PER87164)	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
Papaya fruit fly	Maldison (PER1205 Qld only)	1B	APVMA: Under review – chemistry	
	Maldison (PER80877 SA only)	1B	Codex: Re-evaluation scheduled for 2022/23	
Queensland fruit fly	Fipronil (PER81366 Trapping)	2B	APVMA – Under review Codex: Re-evaluation scheduled for 2021/22 EU: No authorisation in place	
	Dichlorvos + maldison (PER83258)	1B	EU: No authorisation in place	
	Dimethoate (Po)	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
	Maldison	1B	APVMA: Under review – chemistry	
	Maldison (PER80877 SA only)	1B	Codex: Re-evaluation scheduled for 2022/23	
	Spinosad	5		
Queensland fruit fly	Trichlorfon	1B	APVMA – nominated for review Codex – No MRLs Europe – deregistered US – No MRLs	

Papaya Agrichemical Regulatory Risk Assessment

Problem	Active Constituents	Chemical Group	Comment	Activities
Plant bugs				
Banana-spotting bug / Fruit spotting bug	Beta-cyfluthrin (PER13671)	3A	EU: Non-renewal of approval	Data generation projects ST16006 for Trivor® (acetamiprid + pyriproxyfen) ST17000 - Sulfoxaflor (Transform) ST19020 – Sivanto (Flupyradiforone)
	Sulfoxaflor (PER85397)	4C	USA – Pollinator concerns	
	Trichlorfon	1B	APVMA – nominated for review Codex – No MRLs Europe – deregistered US – No MRLs	
Mites				
Two-spotted (Red spider) mite	Abamectin	6		Data generation project ST19020 - Bayer Spiromesifen (Oberon 240 SC) Group 23 Label Registration
	Bifenazate	20D	EU: Proposed non-renewal	
	Etoxazole (PER14098)	10B	EU: Being phased-out	
	Fenbutatin oxide (PER14097)	12B	APVMA – Nominated for review Codex - To be reviewed 2021/22. No supporting registrant EU: No authorisation in place	
Thrips				
Red banded thrips	Spinetoram	5		
	Spinosad	5		

Papaya Agrichemical Regulatory Risk Assessment

Problem	Active Constituents	Chemical Group	Comment	Activities
DISEASES				
Anthracnose	<i>Bacillus amyloliquefaciens</i>	BM02		Luna Experience (7+3) Pending Label Registration for Assorted tropical and sub-tropical fruits - inedible peel crop group ST17000 Data generation for Syngenta Fludioxonil (Scholar) Label registration
	Fludioxonil (PER89170)	9	EU – Under review & Candidate for substitution	
	Fluopyram + trifloxystrobin	7 + 11		
	Prochloraz (Post-harvest)	3	Codex - To be reviewed 2021	
Bactericide	Iodine	M		
Black spot	Chlorothalonil (PER12592)	M5	APVMA - Nominated for review Canada – Review recently completed, continued use considered acceptable Europe - Deregistration proposed.	
	Difenoconazole (PER12592)	3	APVMA - Nominated for review	
	Mancozeb	M3	APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022	
	Tebuconazole	3	APVMA - Nominated for review	
Brown spot (Corynespora leafspot)	Chlorothalonil (PER12592)	M5	APVMA - Nominated for review Canada – Review recently completed, continued use considered acceptable Europe - Deregistration proposed.	
	Difenoconazole (PER12592)	3	APVMA - Nominated for review	
Phytophthora fruit rot	Copper (PER14417)	M1	EU: Candidate for substitution	
Phytophthora stem/root rot	Copper	M1	EU: Candidate for substitution	
	Metalaxyl-M/Metalaxyl (PER14490)	4	Metalaxyl EU: Candidate for substitution Metalaxyl-M EU: Restricted use approval	
	Phosphorous acid (PER14490)	33		

Papaya Agrichemical Regulatory Risk Assessment

Problem	Active Constituents	Chemical Group	Comment	Activities
Powdery mildew	Sulfur	M2		
	Triadimenol	3		
Pythium	Metalaxyl-M/Metalaxyl (PER14490)	4	Metalaxyl EU: Candidate for substitution Metalaxyl-M EU: Restricted use approval	
	Phosphorous acid (PER14490)	33		
	Propamocarb HCl (PER13076)	28		
Stem end rot	<i>Bacillus amyloliquefaciens</i>	BM02		
	Fludioxonil (PER89170)	9	EU: Under review & Candidate for substitution	
	Fluopyram + trifloxystrobin	7 + 11		
	Prochloraz (Post-harvest)	3	Codex: Periodic re-evaluation scheduled for 2021/22 EU: Candidate for substitution	

Papaya Agrichemical Regulatory Risk Assessment

Problem	Active Constituents	Chemical Group	Comment	Activities
WEEDS				
Broadleaf weeds and grasses	Carfentrazone-ethyl	G		
	Diquat	L	APVMA - Currently under review EU: No authorisation in place	
	Fluazifop-P	A		
	Glufosinate-ammonium	N	EU: No authorisation in place	
	Glyphosate	M	Ongoing issues internationally	
	Haloxifop	A		
	Oryzalin (non-bearing)	D		
	Oxyfluorfen	G	EU: Candidate for substitution	
	Paraquat	L	APVMA - Currently under review EU: No authorisation in place Rotterdam Convention - nomination	
Plant growth regulators				
Ripening	Ethephon (PER80746)			

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