



Artichoke

Strategic Agrichemical Review Process
(SARP)

June 2021

Hort Innovation
Project – VG18004

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VG18004 – Vegetable Strategic Agrichemical Review Process (SARP) Report Updates

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 Artichoke industry across Australia. The information in this report will assist the industry with its agrichemical selection and usage into the future.

Date of report:

June 2021

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**Hort
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Strategic levy investment

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1. Summary

The strategic levy investment project Vegetable Industry SARP Report Updates (VG18004) is part of the Hort Innovation Vegetable 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 Artichoke 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 moderate priority disease is:

Common name	Scientific name
Powdery Mildew	<i>Leveillula taurica</i>

1.2 Insects and Other Pests

The high priority insect and other pests are:

Common name	Scientific name
Green Peach Aphid	<i>Myzus persicae</i>

1.3 Weeds

The feedback received from the different States did not rank any weeds for the Artichoke industry.

2. The Australian Artichoke Industry

The Australian Artichoke industry is a minor horticultural industry. This report covers only Globe Artichokes and does not cover Jerusalem Artichokes.

Artichoke occurs predominantly in Werribee (Victoria), with other states producing smaller quantities. Perth (WA) is also a significant producer.

Production¹ for the year ending June 2020 was 452 tonnes with a value of \$ 1.0m. Ninety-eight percent was sent to the fresh market and two percent was exported.

Fresh Artichoke Seasonality by State

State	19/20 t	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
New South Wales (3%)	14												
Victoria (78%)	355												
Western Australia (17%)	75												
South Australia (<1%)	9												
Availability legend			High		Medium		Low					None	

Australia is a net exporter of Artichokes, and for the year ending in June 2020, Australia exported a total of 9 tonnes. Of this export, 26% was destined for New Caledonia, followed by Thailand (23%), Hong Kong (22%), Malaysia (9%) and Indonesia (7%).

¹ Hort Innovation (2020). Australian Horticulture Statistics Handbook 2019/20. [online] Available at: <https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/ha18002-australian-horticulture-statistics-handbook-2019-20-vegetables.pdf>

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 Artichoke 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 Artichoke industry regarding pesticide access, Hort Innovation has undertaken a review of the pesticide requirements via a Strategic Agrichemical Review Process (SARP) and its current position is outlined here.

The SARP process identifies diseases, insect pests and weeds of major concern to the Artichoke 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 Artichoke 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 Artichoke 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 Vegetable Industry in consultation with industry, government and scientists. The Biosecurity Plan² for the Vegetable Industry which covers Artichoke 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.

² <https://ausveg.com.au/app/uploads/2018/06/Industry-Biosecurity-Plan-for-the-Vegetable-Industry.pdf>

3.2 Minor use permits and registration

From a pesticide access perspective, the APVMA classifies Artichoke as a minor crop. The crop fits within the APVMA crop group Crop Group 017: Stalk and Stem vegetables. Therefore, access to minor use permits can be relatively straight forward as long as a reasonable justification is provided in accordance with the APVMA's minor use guidance³.

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 Artichoke industry is for manufacturers to register new pesticides uses in the crop.

³ <https://apvma.gov.au/node/10931>

3.3 Methods

The current version of the Artichoke Strategic Agrichemical Review Process (SARP) was conducted by desktop audit using industry information gathered during 2011-2014 under MT10029 – Managing pesticide access in horticulture and finalised under VG12081 - Review of vegetable SARP reports. The process included gathering, collating and confirming information:

Hort Innovation Project Reference	Process of Review - Activity
VG16060 - Vegetable Agrichemical Pest Management Needs and Priorities (AUSVEG) - Commenced: 2 May 2017	<p>Engagement and consultation with growers and other relevant stakeholders; Including; Online crop specific surveys, workshops and one on one consultation Nationally.</p> <p>Collation of information collected by commodity on applicable pests, diseases and weeds in order of priority.</p>
MT17019 – Regulatory Support & Co-ordination (AKC)	<p>Artichoke Agrichemical Regulatory Risk Assessment Document</p> <p>To assist strategic planning, with respect to future pest management options, this document was developed as part of the Hort Innovation funded project MT17019 to highlight the regulatory threats to agrichemicals currently approved for the management of the pests and diseases in Artichoke as well as current initiatives aimed at addressing identified pest management deficiencies.</p>
VG18004 – Vegetable Strategic Agrichemical Review Process (SARP) Report Updates	<p>SARP updated via a desktop audit:</p> <p>Review list of priorities ranked as high, moderate and low for each plant pest groups (disease, insects and weeds) – provided by VG16060</p> <p>Identify industries pest priority gaps in order of importance</p> <p>Update current pesticides available via label registrations or minor use permits.</p> <p>Update available pesticide use patterns, IPM ranking/compatibility, mode of action and chemical group.</p> <p>Identify pesticides at risk (under review and/or limited uses) via MT17019 Regulatory Support & Co-ordination – AKC consulting.</p> <p>Identify any appropriate solutions through the outcomes of the AgChem Forum’s or similar market intelligence and their overall suitability (IPM compatibility, Chemical group to manage resistance, risk profile, existing domestic MRL’s or global MRL’s including any potential trade barriers, efficacy, OH&S, environmental safety and sustainability).</p> <p>Include known pesticide solutions that are currently under development with registrants for new uses in the nominated crops or in current Hort Innovation projects.</p> <p>Update MRL tables to include Australian MRL’s, Codex and any applicable export market MRL’s</p>

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 artichoke

Appendix 2. Products available for control of insects and other pests in artichoke

Appendix 3. Products available for weed control in artichoke

Appendix 4. Current permits for use in artichoke

Appendix 5. Artichoke Maximum Residue Limits (MRLs)

Appendix 6. Artichoke Agrichemical Regulatory Risk Assessment

4. Diseases, Pests and Weeds of Artichoke

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 website⁴.

In chapter 4, information on regulatory risk derived from project MT17019 - Regulatory support and coordination (Appendix 6) has been incorporated.

Some of the suggested options have no overseas MRLs (see Appendix 5). 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 <https://www.croplife.org.au/resources/programs/resistance-management/>

4.1 Diseases of artichoke

4.1.1 Disease priorities

Common name	Scientific name
Moderate	
Powdery Mildew	<i>Leveillula taurica</i>
Low	
Crown Rot	<i>Rhizoctonia</i> spp., <i>Phytophthora</i> spp.
Downy Mildew	<i>Pseudoperonospora</i> spp.
Grey Mould	<i>Botrytis cinerea</i>

The moderately important disease issue based on the feedback received was Powdery mildew. Available and potential products for all these diseases are in Section 4.1.2.

Some of the diseases that have received moderate to low priority have few fungicide options available to suppress or control but should be supplemented by management practices that would increase airflow and minimise moisture in the plant canopy. Soil fumigation also helps in preventing some diseases.

Management methods that promote clean seeds and transplant material, early detection and disposal of infected seedlings would keep most of diseases in check whilst eliminating alternative hosts, crop rotation, cover crops and farm hygiene are also important to prevent spread of these between sites as well as taking precautions to prevent spread of disease from nursery to field.

Resistance Management

Powdery Mildew and Downy Mildew are both considered to have a high risk of resistance development. In Australia there are confirmed cases of Powdery Mildew resistance to Group 8 Bupirimate, Group 11 Strobilurins and Group 3 Triadimenol.

There are several disease strategies that apply to various vegetables on the Croplife website⁵, including Powdery Mildew and Downy Mildew.

⁵ www.croplife.org.au/resources/programs/resistance-management/

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
Powdery Mildew (<i>Leveillula taurica</i>)							
Priority: Moderate							
Powdery Mildew was ranked as a moderate priority in VIC. Powdery Mildew causes a characteristic white, powdery growth on infected plants. Photosynthetic efficiency is reduced in affected leaves and fruit can be scarred and damaged, causing produce to be downgraded. Severe outbreaks can cause defoliation, exposing fruit to sunburn and predisposing them to secondary rots.							
Sulphur	UN	Contact	NR	A	ALL	Registered in vegetables for control of Powdery Mildew , Rust, Black Spot and Mites. [Max no. of applications not specified; re-treatment interval 14-21 d]	-
ADM1700F Adama	TBC			P		Fungicide in development from Adama with Powdery Mildew activity	-
<i>Bacillus amyloliquefaciens</i> (Serenade Opti) Bayer	BM 02	Biological	NR	P		Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. Permitted for control of Powdery Mildew in eggplant. US registration for control of Powdery Mildew in cucurbits, grapes, pome fruit, stone fruit and strawberries.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Bacillus amyloliquefaciens</i> strain MBI 600 (Serifel) BASF	BM 02	Biological	NR	P		Registered for control of Botrytis in grapevines and strawberries. Permitted for suppression of Powdery Mildew in nursery stock. US registration for control of Powdery Mildew in artichoke, berries, brassica leafy vegetables, bulb vegetables, cucurbits, fruiting vegetables, grapes, hops, leafy vegetables, legume vegetables, pome fruit, stone fruit, sugar beet and tobacco.	-
BLAD (ProBlad Plus)	BM 01	Biological	NR	P		Registered for control of Brown Rot and Blossom Blight in stone fruit. US registration for control of Powdery Mildew in cucurbits, fruiting vegetables, grapes, hops, pome fruit and strawberries.	-
Boscalid + Kresoxim-Methyl (Colliss) BASF	7+11	Protectant & Curative		P		Registered for control of Powdery Mildew in cucurbits.	-
Bupirimate (Nimrod)	8	Protectant & Curative		P		Registered for control of Powdery Mildew in apple, cucurbits, cut flowers, eggplant, nursery stock, ornamentals, peppers and strawberries.	-
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 active in development from Corteva with activity on Septoria, Powdery Mildew , Botrytis, Anthracnose, Alternaria, Scab, Monilinia, Rust and <i>Mycosphaerella</i> spp. Scheduled for JMPR evaluation in 2023.	-
Fluopyram + Tebuconazole (Luna Experience) Bayer	7+3	Protectant & Curative		P		Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas. US registration for control of Powdery Mildew in almond, Brassica leafy vegetables, cucurbits, grapes, hops, dry and succulent beans, stone fruit and sunflower.	R3
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Protectant & Curative		P		Registered for control of Powdery Mildew in apples. US registration for control of Powdery Mildew in artichoke, almond, low growing berry except cranberry, Brassica vegetables, Brassica leafy vegetables, carrot cherry, dill seed, pome fruit, small vine climbing fruit except kiwi fruit, ginseng, herbs, hops, leafy greens, cucurbits, pecan, leafy petioles (including celery, fennel (bulb) & rhubarb) fruiting vegetables & root vegetables except sugar beet.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fluxapyroxad + Pyraclostrobin (Merivon) BASF	7+11	Protectant & Curative		P		Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of Alternaria Leaf Blight, Powdery Mildew , Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits.	-
Hydrogen Peroxide + Peroxyacetic Acid (Peratec Plus)	M	Protectant		P		Registered for control of Powdery Mildew in peppers, eggplant, grapes, tomatoes and cucurbits.	-
Isofetamid (Kenja) ISK / AgNova	7	Protective & Curative		P		Registered for control of Botrytis Grey Mould in berries. US registration for control of Grey Mould, Powdery Mildew and Anthracnose in low-growing berries.	-
Metrafenone (Vivando) BASF	U8	Protectant		P		Registered for control of Powdery Mildew in cucurbits and grapes.	-
NUL3195 Nufarm	TBC			P		Fungicide in development from Nufarm with activity on Powdery Mildew and <i>Botrytis</i> .	-
Penthiopyrad (Fontelis) Corteva	7	Protectant		P		Registered for control of Powdery Mildew in pome fruit, beetroot, brassica vegetables, peppers, carrot, celeriac, chilli, brassica leafy vegetables, fruiting vegetables, cucurbits, endive, fennel, galangal, gherkin, leafy vegetables, root vegetables, silver beet, spinach and strawberries.	-
Proquinazid (Talendo) Corteva	13	Protectant		P		Registered for control of Powdery Mildew in fruiting vegetables, cucurbits, grapes and pome fruit.	-
Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta	7+12	Protectant & Curative		P		Registered for control of Botrytis in berries and grapes, and Botrytis and Sclerotinia in leafy vegetables and potato. US registration for control of Powdery Mildew in brassica vegetables cucurbits, fruiting vegetables, grapes, specific leaf petioles, leafy greens, root and tuber vegetables, mustard greens, potato, root vegetables. strawberry and tuberous and corm vegetables.	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Pyriofenone (Kusabi) AgNova	50	Protectant & Curative		P		Registered for control of Powdery Mildew in cucurbits and grapes.	-
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Biological	NR	P		Registered for suppression of Powdery Mildew in strawberries, carrots, cucurbits, fruiting vegetables and verbena.	-
Tea Tree Oil (Timorex)	46	Protectant		P		Registered for control of Powdery Mildew in fruiting vegetables, cucurbits and grapes.	-
Crown Rot (<i>Rhizoctonia</i> , <i>Phytophthora</i>)							
Priority: Low							
Crown Rot was ranked as a low priority in VIC. A soil-borne disease that is widespread in most regions, it enters through the roots and the leaves of affected plants show yellowing, curling and causing plants to eventually wither and decay. Cultural controls recommended including crop rotation and the use of resistant varieties.							
1,3-Dichloropropene + Chloropicrin (Telone C-35)	8B	Fumigant	NR	A	ALL	Registered in vegetables for control of plant parasitic nematodes, symphyllans, wireworms, soil borne diseases (including <i>Fusarium</i> and <i>Verticillium</i> wilts, <i>Rhizoctonia</i> , <i>Pythium</i>) and suppression of weeds. For use by professional and registered fumigators only.	-
Dazomet (Basamid)	8F	Fumigant	NR	A	ALL	Registered in broadacre seed beds for control of soil fungi (including <i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , and <i>Verticillium</i>), nematodes (cyst and non-cyst forming), soil insects and germinating seeds of weeds.	-
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Biological	NR	A	ALL	Registered in cucurbits for suppression of Powdery Mildew and as a seed treatment in vegetables for control of <i>Fusarium</i> , <i>Rhizoctonia</i> and <i>Pythium</i> .	-
<i>Bacillus amyloliquefaciens</i> Strain QST 713 (Serenade Prime Soil Ameliorant & Biofungicide) Bayer	BM 02	Biological	NR	P-A	ALL	Registered in vegetables for application to soil to improve bioavailability of soil resources to horticultural crops.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Bacillus amyloliquefaciens</i> strain MBI 600 (Serifel) BASF	BM 02	Biological	NR	P		Registered for control of Botrytis in grapevines and strawberries. US registration for control of Rhizoctonia spp. in artichoke, asparagus, brassica leafy vegetables, bulb vegetables, cucurbits, corn, fruiting vegetables, leafy vegetables, legume vegetables, oilseeds, soybean, strawberries and root and tuber vegetables.	-
Fludioxonil + Metalaxyl-M (Maxim XL) Syngenta	12+4	Protectant & Curative		P		Registered for the control of Rhizoctonia Rot in Canola seedlings.	R3
Fludioxonil + Sedaxane (Vibrance Premium Seed Treatment) Syngenta	12+7	Protectant & Curative		P		Registered in potatoes for control of Black Scurf (Rhizoctonia), Silver Surf, Black Rot, Gangrene and Fusarium Dry Rot and suppression of Scab. Hort innovation is conducting research for use in beetroot to control Rhizoctonia .	R3
Fluopyram + Tebuconazole (Luna Experience) Bayer	7+3	Protectant & Curative		P		Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas. US registration for control of Rhizoctonia in cucurbits and for suppression of Rhizoctonia in Brassica leafy vegetables.	R3
Mandipropamid (Revus) Syngenta	40	Protectant		P		Registered for control of Downy Mildew in Asian leafy vegetables, brassica leafy vegetables, grapes, leafy vegetables, poppy oilseed, rocket, silverbeet and spinach. US registration for control of Phytophthora spp. in citrus, ginseng and potatoes, and suppression of Phytophthora spp. in cucurbits and fruiting vegetables.	-
Metalaxyl-M (Ridomil Gold 25G) Syngenta	4	Protectant		P		Registered for control of Damping Off in cucurbits. Registered for control of Phytophthora Root Rot in avocado and macadamia.	-
NUL3163 Nufarm	TBC			P		New active in development from Nufarm with activity on <i>Fusarium</i> , <i>Pythium</i> & Rhizoctonia .	-
Oxathiapiprolin (Zorvec Enicade) Corteva	49	Protectant				Registered in bulb vegetables, brassica vegetables, cucurbits, leafy vegetables, brassica leafy vegetables and poppies for control of Downy Mildew. US registration for control of Phytophthora spp. in cucurbits, fruiting vegetables, ginseng, tuberous and corm vegetables and tobacco.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Penflufen+ Trifloxystrobin (Evergol Extend) Bayer	7+11	Protectant		P		Registered for control of Rhizoctonia spp. in canola, forage brassicas, pastures and cotton.	-
Thiophanate-Methyl + Etridiazole (Banrot)	1+14	Protectant		P		Registered in container grown ornamentals and in ground bedding plants as a post plant soil drench for control of <i>Pythium</i> , Phytophthora , Rhizoctonia and <i>Thielaviopsis</i> .	-
Downy Mildew (<i>Pseudoperonospora</i> spp.)							
Priority: Low							
Downy Mildew was ranked as a low priority in VIC. It is a common disease that is characterised by a white downy fungal growth that develops on the underside of the leaf and is favoured by warm, moist weather. Management options include general farm hygiene, crop rotation, planting space and the use of fungicide applications when conditions favour disease.							
Chlorothalonil (Bravo)	M5	Protectant	1	P-A	ALL	Registered in globe artichokes for control of Botrytis Grey Mould. Registered for control of Downy Mildew in cucurbits, onions (excluding spring onions), peas (processing) and grapes.	R3
Acibenzolar-S-Methyl (Actigard Plant Activator) Syngenta	P01	Protectant		P		Registered in tomatoes for the suppression of Bacterial Speck, Bacterial Spot, Bacterial Canker and Powdery Mildew. US registration for control of Downy Mildew in Brassica leafy vegetables, cucurbits, leafy vegetables, spinach, and suppression of Downy Mildew in bulb onion.	-
Copper	M1	Protectant		P		Registered for control of Downy Mildew in grapes, brassicas, cucurbits, lettuce, onions, ornamentals, beet, rhubarb, silver beet and spinach.	-
Cyazofamid (Ranman) ISK	21	Protectant		P		Registered for control of Downy Mildew in basil, brassica leafy vegetables, nursery stock and poppy.	-
Dimethomorph (Acrobat) BASF	40	Protectant		P		Registered for control of Downy Mildew in cucurbits, grapes, lettuce, onions and poppy.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Dimethomorph + Amitoctradin (Zampro) AgNova	40+45	Protectant		P		Registered for control of Downy Mildew in grapes.	-
Fluxapyroxad + Pyraclostrobin (Merivon) BASF	7+11	Protectant & Curative		P		Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for suppression of Downy Mildew in cucurbits.	-
Mandipropamid (Revus) Syngenta	40	Protectant		P		Registered for control of Downy Mildew in grapes and brassica leafy crops. US registration for suppression of Downy Mildew in cucurbits and control of Downy Mildew in basil, edible podded bean, brassica vegetables, leafy vegetables, bulb vegetables, fruiting vegetables (except tomatoes), grapes and hops.	-
Oxathiapiprolin (Zorvec Enicade) Corteva	49	Protectant		P		Registered for control of Downy Mildew in bulb vegetables, brassica vegetables, cucurbits, leafy vegetables and poppies.	-
Phosphorous Acid	33	Protectant		P		Registered for control of Downy Mildew in cucurbits, grapes and poppy.	-
Propamocarb Hydrochloride + Fluopicolide (Infinito) Bayer	28+43	Protectant		P		Registered for control of Downy Mildew in brassica vegetables, bulb vegetables, cucurbits, leafy vegetables poppy and potato.	-
Grey Mould (<i>Botrytis cinerea</i>)							
Priority: Low							
Grey Mould was ranked as a low priority in VIC. It can affect plants at most stages of production. Affected fruit become water-soaked and soft and are rapidly covered with a thick grey mould. Other plant parts such as stems can also be affected. <i>Botrytis</i> also causes secondary rots on fruit and vegetables in storage or transit and in the marketplace.							
Chlorothalonil (Bravo)	M5	Protectant	1	A	ALL	Registered in artichoke for control of Botrytis Grey Mould . [Max. no. of applications not specified; re-treatment interval: 7 - 10 d]	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Aureobasidium pullulans</i> (Botector) Nufarm	BM 02	Biological		P		Registered for control of Botrytis in berries, fruiting vegetables and grapes.	-
<i>Bacillus amyloliquefaciens</i> (Serenade Opti) Bayer	BM 02	Biological		P		Registered for control of Botrytis in grapes and strawberries. US registration for control of Grey Mould in artichoke.	-
<i>Bacillus amyloliquefaciens strain MBI 600</i> (Serifel) BASF	BM 02	Biological		P		Registered for control of Botrytis in grapes and strawberries. Registered for control of Anthracnose, Alternaria, Botrytis , Powdery Mildew and Ramularia Leaf Spot in artichoke.	-
BLAD (ProBlad Plus)	BM 01	Biological		P		Registered for control of Brown Rot and Blossom Blight in stone fruit. US registration for control of Grey Mould in fruiting vegetables, grapes, strawberries and ornamentals.	-
Cyprodinil + Fludioxonil (Switch) Syngenta	9+12	Protective & Curative		P		Registered for control of Botrytis in capsicum, cucumber, cut flowers, grapes, green beans, green peas, lettuce, nursery stock and ornamentals, onions, alliums and strawberries.	R3
Fenhexamid (Teldor) Bayer	13	Protective		P		Registered for control of Botrytis in grapes and strawberries.	-
Fenpyrazamine (Prolectus) Sumitomo	17	Protectant & Curative		P		Registered for control of Botrytis in grapes.	-
Florypicoxamid (Adavelt) Corteva	21	Protective & Curative		P		New active in development from Corteva with activity on Septoria, Powdery Mildew, Botrytis , Anthracnose, Alternaria, Scab, Monilinia, Rust and <i>Mycosphaerella</i> spp. Scheduled for JMPR evaluation 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		Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas. US registration for control of Botrytis in almond, Brassica leafy greens, bulb vegetables, grapes, hops, pistachio and stone fruit.	R3
Fluopyram + Trifloxystrobin (Luna Sensation) Bayer	7+11	Protectant & Curative		P		Registered in pome fruit, stone fruit, almonds and tropical and sub-tropical fruit for the control of various diseases, including Powdery Mildew, Anthracnose and Alternaria. US registration for control of Powdery Mildew and Botrytis and suppression of Ramularia Leaf Spot in globe artichokes.	-
Fluxapyroxad + Pyraclostrobin (Merivon) BASF	7+11	Protectant & Curative		P		Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control Botrytis spp. in bulb vegetables, leafy vegetables, pome fruit, stone fruit, strawberries and tree nuts, and for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits.	-
Isofetamid (Kenja) ISK	7	Protectant & Curative		P		Registered for control of Botrytis in berries.	-
NUL3195 Nufarm	TBC			P		Fungicide in development from Nufarm with activity on Powdery Mildew and Botrytis .	-
Penthiopyrad (Fontelis) Corteva	7	Protectant		P		Registered for control of Botrytis in bulb vegetables, cucurbits, fruiting vegetables, leafy vegetables and strawberries.	-
Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta	7+12	Protectant & Curative		P		Registered for control of Botrytis in berries, grapes and strawberries and control of Botrytis and <i>Sclerotinia</i> in leafy vegetables, lettuce and potatoes.	R3

4.2 Insect and other pests of artichoke

4.2.1 Insect and other pest priorities

Common name	Scientific name
Moderate	
Green Peach Aphid	<i>Myzus persicae</i>
Low	
African Black Beetle	<i>Heteronychus arator</i>
Cotton Bollworm / Corn Earworm	<i>Helicoverpa armigera</i>
Native Budworm	<i>Helicoverpa punctigera</i>
Jassids / Leafhoppers	Cicadellidae
Snails and Slugs	Gastropoda
Onion Thrips	<i>Thrips tabaci</i>
Plague Thrips	<i>Thrips imagines</i>
Western Flower Thrips	<i>Frankliniella occidentalis</i>
Spotted Vegetable Weevil	<i>Desiantha diversipes</i>
Vegetable Weevil	<i>Listroderes difficilis</i>

New incursion of an exotic pest which poses a potential threat.

New Pest to Australia (unknown priority)	
Fall Armyworm	<i>Spodoptera frugiperda</i>
Vegetable Leafminer	<i>Liriomyza sativae</i>
Pea Leafminer / Serpentine Leafminer	<i>Liriomyza huidobrensis</i>
American Serpentine Leafminer	<i>Liriomyza trifolii</i>

Green Peach Aphid was ranked as a high priority in the recent survey of the artichoke industry. Products available to control the pests listed are detailed in Section 4.2.2.

Resistance to some insect groups has reduced control options despite a range of actives registered. Additionally, not all actives have broad registrations across Lepidoptera. Growers should not exceed the maximum number of applications permitted on the insecticide label.

Biological control involving other insects or fungal organisms in insect pest control is another option that need to be further evaluated. There are several identified biological control agents commercially available for pests in Australia.

Resistance Management

There are several insecticide management strategies that apply to various vegetables on the CropLife website⁶, including Thrips & Aphids.

Further development and extension of IPM strategies and best management practices that can be implemented in the management of sucking insects and other pests may be warranted.

⁶ www.croplife.org.au/resources/programs/resistance-management/

4.2.2 Available and potential products for priority insects and other 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
Green Peach Aphid (<i>Myzus persicae</i>)								
Priority: Moderate								
Aphids were ranked as a moderate priority in VIC. Aphids suck on sap, causing loss of vigour, and in some cases yellowing, stunting or distortion of plant parts. Honeydew can cause sooty mould to develop on leaves. Aphids are important disease vectors in some crops.								
Afidopyropen (Versys) BASF	9D	Ingestion	1	A	ALL	Registered in rhubarb, celery & artichokes for control of Cabbage Aphid, Lettuce Aphid, Green Peach Aphid and Cotton/Melon Aphid and suppression of Silverleaf Whitefly. [Max. 2 applications per crop; re-treatment interval 14 d]	L Bee:L	-
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Biological	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including Western Flower Thrips, Onion thrips, Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-Spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d]	L Bee:L	-
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids , Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks.	VH Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Pirimicarb (Aphidex)	1A	Contact	2	A	ALL	Registered in Globe artichoke for control of Aphids . [Max. no. of applications and re-treatment interval not specified].	VL Bee:VL	R3
Potassium Salts of Fatty Acids (Natrasoap)	-	Contact	NR	A	ALL	Registered in vegetables for control of Aphids , Thrips, Mealybug, Two spotted mites, Spider mite, and White fly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d]	L Bee:L	-
Emulsifiable Botanical Oil (Eco-Oil)	-	Contact	NR	P-A	ALL	Registered in vegetables for control of Greenhouse Whitefly. Registered for control of Aphids in tomatoes, cucumbers, capsicums, strawberries and ornamentals.	L Bee:L	-
Dimpropridaz (Axalion) BASF	TBC			P		BASF has applied for registration in leafy vegetables, brassica vegetables and fruiting vegetables, including cucurbits to control Whitefly, Aphids and Thrips. Pending regulatory approvals, first market introduction in Australia is expected by late 2022 or early 2023.	-	-
Fonicamid (Mainman) UPL	9C	Ingestion		P		Registered for control of Aphids in cucurbits, potatoes, apples, pears and cotton.	M Bee:L	-
Flupyradifurone (Sivanto Prime) Bayer	4D	Contact & Ingestion		P		Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of Aphids in alfalfa, brassica leafy vegetables, berries, citrus, clover, cucurbits, fruiting vegetables, hop, leafy vegetables, legume vegetables, pome fruit, root vegetables, stone fruit, taro, tree nuts, tropical & sub-tropical fruit, tuberous and corn vegetables and turnip greens.	L Bee:VL	-
Novaluron + Acetamiprid (Cormoran) Adama	15+4A	Contact & Ingestion		P		Registered for control of Green Peach Aphid in stone fruit.	M Bee:M	R2
Petroleum Oil	UN	Contact		P		Registered for control of Aphids in cotton, tree nuts, stone fruit and ornamentals.	VL Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Pymetrozine (Chess) Syngenta	9B	Ingestion		P		Registered for control of Aphids in brassica vegetables, fruiting vegetables, sweet corn, lettuce, leafy vegetables, cucurbits, potatoes, stone fruit, almonds and pistachios, beetroot, celery, cut flowers and nursery stock.	L Bee:VL	R3
Spirotetramat (Movento 240 SC) Bayer	23	Ingestion		P		Registered for control of Aphids in beans, peas, brassica vegetables, brassica leafy vegetables, celery, rhubarb, cucurbits, eggplant, peppers, tomatoes, herbs, leafy vegetables, lettuce, chicory, endive, radicchio, bulb vegetables, potatoes, sweet corn, pome fruit, stone fruit and cotton.	M Bee:VL	-
Sulfoxaflor (Transform) Corteva	4C	Contact and Ingestion		P		Registered for control of Aphids in cucurbits, fruiting vegetables, sweet corn, leafy vegetables, root and tuber vegetables, brassica vegetables, strawberries, pome fruit, stone fruit and tree nuts.	M Bee:VH	-
African Black Beetle (<i>Heteronychus arator</i>)								
Priority: Low								
African Black Beetle was ranked as a low priority in VIC. Larvae are soil dwelling and adults have strong nocturnal flight activity. Adults chew plants at or just beneath ground level and may chew right through the stem.								
Spinosad (Entrust Organic) Corteva	5	Ingestion	1 G:14	P-A	ALL	Registered in stalk & stem vegetables including artichoke for control of Helicoverpa. US registration for control of Asparagus Beetle in asparagus, suppression of Flea Beetle in brassica leafy vegetables, fruiting vegetables, control of Flea Beetle in bulb vegetables, root and tuber vegetables, spices, Leaf Feeding Beetles in ornamentals, control of Colorado Potato Beetle in artichoke and fruiting vegetables.	L Bee:L	-
Cyantraniliprole + Thiamethoxam (Spinner) Syngenta	28+4A	Contact and Ingestion		P		Registered for control of African Black Beetle Larvae in turf.	M Bee:VH	R2
NUL3445 Nufarm	TBC			P		Product in development from Nufarm with activity on Caterpillars, Fruit Flies, Bugs, Beetles and Thrips.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Tetraniliprole (Vayego) Bayer	28	Ingestion		P		Registered in almonds, macadamias, pome fruit, and stone fruit for various insect pests such as Fruit Fly suppression, Carpophilus Beetles, Weevils & Lepidoptera. Hort Innovation project ST17000 is generating data to support a label extension for control of Lepidoptera in stalk and stem vegetables.	M Bee:VH	-
<p>Cotton Bollworm / Corn Earworm (<i>Helicoverpa armigera</i>) Native Budworm (<i>Helicoverpa punctigera</i>) Priority: Low</p> <p>Helicoverpa was ranked as a low priority in VIC. <i>Helicoverpa armigera</i> is generally regarded as the more serious pest because of its greater capacity to develop resistance to insecticides, broader host range, and persistence in cropping areas from year to year. Larvae feed on leaves but are most damaging when feeding on growing terminals, buds, flowers & fruit. Damage also occurs through bud/fruit shedding and reduced quality.</p>								
<i>Bacillus thuringiensis subsp. kurstaki</i> (DiPel)	11A	Biological	NR	A	ALL	Registered in vegetables for control of Caterpillars, including Helicoverpa . [Apply a minimum of 2 sprays, 3 d apart; re-treatment interval 3-5 d]	VL Bee:L	-
Chlorantraniliprole (Coragen) FMC	28	Ingestion	3	A	ALL	Registered in stalk and stem vegetables for control of Helicoverpa . [Max. 3 applications per season; 2 consecutive; re-treatment interval 7 d]	L Bee:VL	-
Flubendiamide (Belt) Bayer	28	Ingestion	1	A	ALL	Registered in stalk & stem vegetables for control of Helicoverpa spp. [Max. 3 applications per crop; re-treatment interval 7-14 d]	L-M Bee:L	-
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids, Caterpillars , Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks.	VH Bee:H	-
Helicoverpa NPV (Gemstar)	31	Biological	NR	A	ALL	Registered in stalk vegetables for control of Helicoverpa spp. Effective on larvae of <7 mm. [Max no. of applications not specified; re-treatment interval 2-3 d]	VL Bee:L	-
Spinetoram (Success Neo) Corteva	5	Ingestion	1	A	ALL	Registered in stalk & stem vegetables for control of Helicoverpa spp. [Max no. of applications not specified; re-treatment interval 7-14 d]	M Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Ingestion	1 G:14	A	ALL	Registered in stalk & stem vegetables including artichoke for control of Helicoverpa . [Max. 4 applications per season; re-treatment interval 7-14 d]	L Bee:L	-
Broflanilide (Vedira) BASF	30	Contact & Ingestion		P		Pending registration as an ant bait. It also has potential uses as a seed treatment for the control of Wireworms, and a foliar treatment for the control of chewing pests in various crops.	-	-
<i>Clitoria ternatea</i> Extract (Sero-X) Growth Agriculture	-	Biological		P		Registered for control of Helicoverpa spp. , Green Mirids and Silverleaf Whitefly in cotton and for control of Diamondback Moth in brassica leafy vegetables.	L Bee:VL	-
Emamectin (Proclaim Opti) Syngenta	6	Ingestion		P		Registered for control of Helicoverpa spp. in brassica vegetables, fruiting vegetables, leafy vegetables, brassica leafy vegetables, legume vegetables, lettuce, root and tuber vegetables, strawberries and sweet corn.	M Bee:H	-
Indoxacarb (Avatar eVo) FMC	22A	Ingestion		P		Registered for control of Helicoverpa spp. in brassica vegetables, celery, Chinese leafy vegetables, leafy vegetables, solanaceous fruit and sweet corn.	M Bee:H	R3
NUL3445 Nufarm	TBC			P		New product in development from Nufarm with activity on Lepidoptera , Bugs, Beetles/Weevils, Fruit Fly and Thrips.	-	-
SYNFOI21 Syngenta	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2023 for control of Thrips, Bugs, Mites and Caterpillars .	-	-
Jassids / Leafhoppers (Cicadellidae)								
Priority: Low								
Jassids were ranked as a low priority in VIC. Adult and nymph leafhoppers suck sap and inject toxins into the plant. Some species transmit diseases such as viruses and phytoplasmas. Perimeter sprays may be effective for minimising vector transmission.								
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips & Leafhoppers . Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks.	VH Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Buprofezin (Applaud) Corteva	16	Ingestion / IGR		P		Registered for control of Leafhopper in citrus.	L Bee:L	-
Flonicamid (Mainman) UPL	29	Ingestion		P		Registered for control of Green Mirids in cotton, Aphids in cucurbits and mealybugs in apples and pears. US registration for control of Plant Bugs in brassica vegetables, brassica leafy greens, cucurbits, fruiting vegetables, leaf petiole vegetables, leafy greens, tuberous and corm vegetables, root vegetables (except sugar beet), pome fruit, stone fruit, tree nuts, berries, legume vegetables and alfalfa.	M Bee:L	-
Flupyradifurone (Sivanto Prime) Bayer	4D	Contact & Ingestion		P		Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of Leafhoppers in alfalfa, brassica leafy vegetables, cucurbits, fruiting vegetables, leafy vegetables, legume vegetables, peanuts, small fruit vine climbing (except fuzzy kiwifruit), taro, tuberous and corm vegetables and turnip greens.	L Bee:VL	-
NUL3445 Nufarm	TBC			P		Product in development from Nufarm with activity on Caterpillars, Fruit Flies, Bugs , Beetles and Thrips.		
Petroleum Oil	UN	Contact		P		Registered for control of Mango Plant Hopper in mango.	VL Bee:L	-
Sulfoxaflor (Transform) Corteva	4C	Contact & Ingestion		P		Registered for control of Rutherglen Bug in cucurbits, fruiting vegetables, leafy vegetables, root and tuber vegetables and brassica vegetables, control of Green Mirid in strawberries, and control of Fruit-Spotting Bugs in avocado, citrus, macadamia, Lace Bug in macadamia, and Apple Dimpling Bug in pome fruit and stone fruit. US registration for control of Leafhoppers in berries, pome fruit and root and tuber vegetables.	M Bee:VH	-
SYNFOI21 Syngenta	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs , Mites and Caterpillars.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Slugs and Snails (Gastropoda)								
Priority: Low								
Slugs and Snails were ranked as a low priority in VIC. They are active after dusk when chemical treatments can be most effective.								
Iron EDTA Complex	-	Contact & Ingestion	NR	A	ALL	Registered in all plants for the control of Snails and Slugs . Spread pellets evenly on ground. [Max no. of applications and re-treatment not specified]	-	-
Metaldehyde	-	Contact & Ingestion	7	A	ALL	Registered in vegetables for the control of Snails and Slugs . Spread pellets evenly on ground. [Max no. of applications and re-treatment not specified]	-	-
Methiocarb (Mesurol) Bayer	1A	Contact & Ingestion	NR	A	ALL	Registered in artichoke for control of common garden Snail, Slugs, White Italian Snail & White Snail . [Max no. of applications and re-treatment not specified]	-	R2
Onion Thrips (<i>Thrips tabaci</i>)								
Plague Thrips (<i>Thrips Imaginis</i>)								
Western Flower Thrips (<i>Frankliniella occidentalis</i>)								
Priority: Low								
Thrips were ranked as a low priority in VIC. It can be difficult to distinguish between thrips species in the field. Thrips cause direct feeding damage to foliage by piercing and rasping leaves. Western Flower Thrips develop resistance more easily than other thrips species. MT16009 IPM Project Recommends: The use of predatory thrips, mites & bug releases, control flowering weeds, mulch and use of certified seed.								
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Biological	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion Thrips , Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-Spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d]	L Bee:L	-
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips & Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks.	VH Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Potassium Salts of Fatty Acids (Natrasoap)	-	Contact	NR	A	ALL	Registered in vegetables for control of Aphids, Thrips , Mealybug, Two Spotted Mites, Spider Mite, and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d]	L Bee:L	-
Spinetoram (Success Neo) Corteva	5	Ingestion	1	P-A	ALL	Registered in stalk & stem vegetables for control of <i>Helicoverpa</i> spp. Registered for control of Thrips in brassica vegetables, cucurbits, fruiting vegetables, leafy vegetables, legume vegetables, ornamentals and berries.	M Bee:H	-
Spinosad (Entrust Organic) Corteva	5	Ingestion	1	P-A	ALL	Registered in stalk & stem vegetables including artichoke for control of Helicoverpa. Registered for control of Thrips in brassica vegetables, cucurbits, fruiting vegetables, leafy vegetables, legume vegetables, ornamentals, berries, pome fruit, stone fruit and tropical and sub-tropical fruit.	L Bee:L	-
Cyantraniliprole (Benevia) FMC	28	Ingestion		P		Registered for suppression of Thrips in bulb vegetables, fruiting vegetables, cucurbits, potatoes and strawberries.	M Bee:VH	-
Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta	12A+28	Contact & Ingestion		P		Registered for suppression of Thrips in cucurbits and fruiting vegetables.	M Bee:VH	-
Dimpropridaz (Axalion) BASF	TBC			P		BASF has applied for registration in leafy vegetables, brassica vegetables and fruiting vegetables, including cucurbits to control Whitefly, Aphids and Thrips . Pending regulatory approvals, first market introduction in Australia is expected by late 2022 or early 2023.	-	-
Flonicamid (Mainman) ISK/UPL	29	Ingestion		P		Registered for control of Aphids, Mealybug and Silverleaf Whitefly in various crops including pome fruit, cucurbits and potatoes. US registration for control of Thrips in greenhouse peppers, and control of Aphids, Plant Bugs and Greenhouse Whitefly in cucurbits. ST17000 is generating data to support a minor use permit for Thrips control in bulb vegetables.	M Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Flupyradifurone (Sivanto Prime) Bayer	4D	Contact and Ingestion		P		Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for suppression of Thrips in berries, citrus, fruiting vegetables, tropical and subtropical fruit, and control of Leafhoppers, Aphids, Squash Bug and Whitefly in cucurbits.	L Bee:L	-
NUL3445 Nufarm	TBC			P		New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and Thrips .		-
Petroleum Oil	UN	Contact		P		Registered for control of Thrips in asparagus, beans, beet, corn, cucurbits, peppers, radish, squash and tomatoes.	VL Bee:L	-
Spirotetramat (Movento 240 SC) Bayer	23	Ingestion		P		Registered for control of Western Flower Thrips and Tomato Thrips in green beans, control of Western Flower Thrips , Tomato Thrips and Plague Thrips in celery and rhubarb, herbs, bulb vegetables, and control of Western Flower Thrips in lettuce.	M Bee:VL	-
SYNFOI21 Syngenta	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips , Bugs, Mites and Caterpillars.	-	-
Spotted Vegetable Weevil (<i>Desiantha diversipes</i>) Vegetable Weevil (<i>Listroderes difficilis</i>) Priority: Low Weevils were ranked as a low priority in VIC. Weevils can cause damage by tunnelling into leaves and reducing plant vigour. MT16009 IPM Project Recommends: Control broadleaf weed hosts in the season prior to planting.								
Chlorpyrifos (Lorsban)	1B	Contact	3	A	NSW & WA	Registered in vegetables for control of Vegetable Weevil . [Max no. of applications and re-treatment interval not specified].	H Bee:H	R1
Indoxacarb (Avatar eVo) FMC	22A	Ingestion		P		Registered for control of Weevils in pome and stone fruits.	M Bee:M	R3
NUL3445 Nufarm	TBC			P		Product in development from Nufarm with activity on Caterpillars, Fruit Flies, Bugs, Beetles and Thrips.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Tetraniliprole (Vayego) Bayer	28	Ingestion		P		Registered for control of various insect pests such as Fruit Fly, Carpophilus Beetles, Weevils & Lepidoptera in almonds, macadamias, pomefruit, and stonefruit. Hort Innovation project ST17000 is generating data to support a label extension for control of Lepidoptera in stalk and stem vegetables.	M Bee:VH	-
Fall Armyworm (<i>Spodoptera frugiperda</i>)								
Priority: Unknown								
Fall Armyworm was not ranked as a pest in artichoke. It is an exotic pest that is considered a potential threat that could affect most vegetable crops if allowed to spread. It is important to monitor crops for eggs and larvae of pest species by regular field scouting. Target sprays against mature eggs and newly hatched larvae before pests become entrenched.								
Chlorantraniliprole (Coragen) FMC PER89259	28	Ingestion	1	A	ALL (excl. VIC)	Permitted for use in stalk and stem vegetables (field) for control of Fall Armyworm . [Max. 3 applications per crop; 2 consecutive; re-treatment interval 7 d]	L Bee:VL	-
Spinetoram (Success Neo) Corteva PER89241	5	Ingestion	3	A	ALL (excl. VIC)	Permitted for use in stalk and stem vegetables (field & protected) for control of Fall Armyworm . [Max. 4 applications per crop; re-treatment interval 7-14 d]	M Bee:H	-
Spinosad (Entrust Organic) Corteva PER89870	5	Ingestion	1 G:14	A	ALL (excl. VIC)	Permitted for use in stalk and stem vegetables (field & protected) for control of Fall Armyworm . [Max. 4 applications per season; re-treatment interval 7-14 d]	L Bee:L	-
Amorphous Silica (Abrade) Grow Choice	-	Contact		P		Registered for control of <i>Spodoptera</i> spp. in fruiting vegetables and permitted for (PER90841) control of Fall Armyworm in sweet corn.	L Bee:L	-
Broflanilide (Vedira) BASF	30	Contact & Ingestion		P		Registration submitted concurrently in Australia, Canada, USA, and Mexico as a soil application and seed treatment against chewing insects such as ants, cockroaches and Spodoptera spp. BASF are seeking registrations in amenity turf initially, then potential horticultural crops thereafter.	H Bee:VH	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Emamectin (Proclaim Opti) Syngenta	6	Ingestion		P		Permitted for control of Fall Armyworm in brassica vegetables, root and tuber vegetables, leafy vegetables, brassica leafy vegetables, sweet corn, strawberries, lettuce, cucurbits, legume vegetables, fruiting vegetables, grapes, celery and blueberries.	M Bee:H	-
Indoxacarb (Avatar eVo) FMC	28	Ingestion		P		Permitted for control of Fall Armyworm in broccoli, brussels sprouts, cabbage (closed head varieties only), cauliflower, celery, capsicum, eggplant, peppers tomato (field or trellis), leafy vegetables and Chinese leafy vegetables.	M Bee:H	R3
Magnet Insect Attractant Technology PER89398	-	Attractant		P		Permitted for control of Fall Armyworm in cotton, cereal grains, sweet corn, pastures & oilseeds.	-	-
Methomyl (Lannate)	1A	Contact		P		Permitted for control of Fall Armyworm in pome fruit, berries, citrus, stone fruit, ornamentals, mango, persimmon, grapes, brassica vegetables, fruiting vegetables, sweet corn, legume vegetables, root and tuber vegetables, macadamia, turf, shallots, spring onions, cucurbits, lettuce, avocado and celery.	H Bee:H	R2
NUL3445 Nufarm	TBC			P		New product in development from Nufarm with activity on Lepidoptera , Bugs, Beetles/Weevils, Fruit Fly and Thrips.	-	-
<i>Spodoptera frugiperda</i> Multiple Nucleopolyhedrovirus (Fawligen) AgBiTech	31	Biological		P		Permitted for control of Fall Armyworm in legume vegetables, root & tuber vegetables & sweet corn.	VL Bee:L	-
SYNFOI21 Syngenta	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, Bugs, Mites and Caterpillars .	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Tetraniliprole (Vayego) Bayer	28	Ingestion		P		Registered in Australia in multiple crops for various insect pests such as Beetles, Weevils & Lepidoptera . Hort Innovation project ST17000 is generating data to support a label extension for control of Lepidoptera in stalk and stem vegetables. Indonesia registration for control of <i>Liriomyza</i> Leafminers and Fall Armyworm in vegetable crops.	M Bee:VH	-
Leafminers (<i>Liriomyza</i> spp.)								
Priority: Unknown								
Vegetable Leafminer was not ranked as a pest in artichoke. Dipteran Leafminers (<i>Liriomyza</i> spp.) are exotic pests that have recently been detected and become problematic in Australia. For example, the Serpentine Leafminer was first detected in the Sydney area in October 2020 and has since been found in crops in SE Qld. As a group they are destructive pests and can cause significant economic loss through reduced yields and quality when uncontrolled.								
Cyromazine (Diptex 150 WP) PER81867	17	Insect Growth Regulator	7 NG	A	ALL	Permitted for use in stalk and stem vegetables for control of <i>Liriomyza</i> species, including: Vegetable Leafminer (<i>Liriomyza sativa</i>) and Serpentine Leafminer (<i>Liriomyza huidobrensis</i>) . [Max. 6 applications per crop; re-treatment interval 7 d]	-	-
Spinetoram (Success Neo) PER91155 Corteva	5	Contact & ingestion	1	A	ALL	Permitted for use in stalk and stem vegetables for control of <i>Liriomyza</i> species, including Vegetable Leafminer (<i>Liriomyza sativa</i>) , Pea Leafminer / Serpentine Leafminer (<i>Liriomyza huidobrensis</i>) & American Serpentine Leafminer (<i>Liriomyza trifolii</i>) . [Max. 4 applications per crop; re-treatment interval 7-14 d]	M Bee:H	-
Spinosad (Entrust Organic) PER90928	5	Ingestion	1 G:14	A	ALL (excl. VIC)	Permitted for use in stalk and stem vegetables for control of <i>Liriomyza</i> species, including: Vegetable Leafminer (<i>Liriomyza sativa</i>) , Pea Leafminer / Serpentine Leafminer (<i>Liriomyza huidobrensis</i>) & American Serpentine Leafminer (<i>Liriomyza trifolii</i>) . [Max. 4 applications per crop; re-treatment interval 4 d]	L Bee:L	-
Chlorantraniliprole (Coragen) FMC	28	Systemic	3	P-A	ALL	Registered in stalk and stem vegetables for control of Helicoverpa. Permitted for use in Spinach & Silverbeet for control of Cabbage Leafminer (<i>Liriomyza</i> sp.)	L Bee:VL	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Abamectin	4C	Contact & Ingestion		P		Permitted for control of Liriomyza Leafminers in cucurbits, fruiting vegetables, leafy vegetables, legume vegetables, root and tuber vegetables, bulb onions, cabbage, celery, rhubarb and bulb vegetables.	M Bee:H	-
Cyantraniliprole (Benevia) FMC	28	Ingestion		P		Permitted for control of Liriomyza Leafminers in bulb vegetables, fruiting vegetables and potatoes.	M Bee:VH	-
Emamectin (Proclaim Opti) Syngenta	6	Ingestion		P		Permitted for control of Liriomyza species, including Vegetable Leafminer in Brassica vegetables.	M Bee:H	-
Spirotetramat (Movento 240 SC) Bayer	23	Ingestion		P		Permitted for control of Liriomyza Leafminers in snow peas, sugar snap peas, lettuce, parsley, eggplant, capsicum, chilli, tomato, green beans, celery and rhubarb.	M Bee:VL	-
Tetraniliprole (Vayego) Bayer	28	Ingestion		P		Registered in Australia in multiple crops for various insect pests such as Beetles, Weevils & Lepidoptera. Hort Innovation project ST17000 is generating data to support a label extension for control of Lepidoptera in stalk and stem vegetables. Indonesia registration for control of Liriomyza Leafminers and Fall Armyworm in vegetable crops.	M Bee:VH	-

4.3 Weeds in artichoke

4.3.1 Weed priorities

The feedback received from the different states did not rank any weeds for the Artichoke industry. However, there are potential broadleaf and grass weeds that could affect stalk and stem vegetables. Management options include the use of herbicides or fumigation prior to planting to start with a weed free seedbed, or the use of spot spraying in-crop or mechanical removal of weeds.

Some growers transplant seedlings to plastic mulch beds, in conjunction with drip irrigation to assist with weed management. Growers generally use a pre-plant weed control (general knockdown herbicides) to prepare the paddock.

Resistance management

There are confirmed cases of resistance in Australia for Awnless Barnyard Grass (Group M at more than 200 sites), Feather Top Rhodes Grass (Group M at 4 sites) and Blackberry Nightshade (Group L at 2 sites).

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 webpage⁷.

⁷ <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	Crop / Situation	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Broadleaf Weeds							
Priority: Unknown							
For weed management, some growers transplant seedlings to plastic mulch beds, with drip irrigation.							
1,3-Dichloropropene + Chloropicrin (Telone C-35)	8B	Vegetables/Soil fumigant	Registered in various crops including vegetables for control of plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases and suppression of weeds . Do not plant for 7 d after soil treatment. For use by professional and registered fumigators only.	NR	A	ALL	-
Glyphosate (Roundup)	M**	Pre-plant knockdown	Registered as a pre-plant knockdown application for control of grass and broadleaf weeds.	NR	A	ALL	R3
Paraquat + Diquat (SpraySeed)	L**	Pre-plant knockdown	Registered as a pre-plant knockdown application for control of grass and broadleaf weeds.	1 G:1	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Crop / Situation	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Aclonifen (Emerger) Bayer	H**		Bayer is expected to seek registration for pre-emergent control of grass and broadleaf weeds in various vegetable crops. Registered in Europe for use in potatoes, legume vegetables and cereals.		P		-
Chloridazon (Pyramin) BASF	C**		Registered for control of various grass and broadleaf weeds in fodder beet, red beet and silver beet.		P		-
Chlorthal-Dimethyl (Dacthal)	D**		Registered for control of various grass and broadleaf weeds in lettuce.		P		-
Dimethenamid-P (Outlook) BASF	K**		Registered for control of grass and broadleaf weeds in sweet corn, beans, peas, pumpkins and kabocha.		P		-
Glufosinate- Ammonium (Basta) BASF	N**		Registered for control of grass and broadleaf weeds in berries, tomatoes, beans and fallow.		P		R3
Norflurazon (Zoliar) Agnova Technologies	F**		Registered in asparagus, citrus, grapes, nuts, stone & pome fruits for control of grass & broadleaf weeds including Annual ryegrass, Cape weed, Chickweed, Fat hen, Milk thistle, Pigweed & Wireweed. [Max. 2 applications per year; re-treatment interval not specified]		P		-
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Oxyfluorfen (Goal)	G**		Registered for control of grass and broadleaf weeds, in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat.		P		-
Phenmedipham (Betanal) Bayer	C**		Registered for control of grass and broadleaf weeds in silverbeet and beetroot.		P		R3

Active ingredient (Trade Name)	Chemical Group	Crop / Situation	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Propachlor (Ramrod) Nufarm	K**		Registered for control of broadleaf and grass weeds in Brassica vegetables		P		R3
S-Metolachlor (Dual Gold) Syngenta	K**		Registered for control of grass and broadleaf weeds in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow.		P		-
Grass Weeds							
Priority: Unknown							
For weed management, some growers transplant seedlings to plastic mulch beds, with drip irrigation.							
1,3-Dichloropropene + Chloropicrin (Telone C-35)	8B	Vegetables/Soil fumigant	Registered in various crops including vegetables for control of plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases and suppression of weeds . Do not plant for 7 d after soil treatment. For use by professional and registered fumigators only.	NR	A	ALL	-
Aclonifen (Emerger) Bayer	H**	Pre-Emergence	Bayer is expected to seek registration for pre-emergent control of grass and broadleaf weeds in various vegetable crops. Registered in Europe for use in potatoes, legume vegetables and cereals.		P		-
Chloridazon (Pyramin) BASF	C**		Registered for control of various grass and broadleaf weeds in fodder beet, red beet and silver beet.		P		-
Chlorthal-Dimethyl (Dacthal)	D**		Registered for control of various grass and broadleaf weeds in lettuce.		P		-
Dimethenamid-P (Outlook) BASF	K**		Registered for control of grass and broadleaf weeds in sweet corn, beans, peas, pumpkins and kabocha.		P		-

Active ingredient (Trade Name)	Chemical Group	Crop / Situation	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Fluazifop-P Butyl (Fusilade)	A***		Registered for control of grass weeds in berries, hops. Legume vegetables, brassica vegetables, fruiting vegetables, root and tuber vegetables, celery, lettuce, pome fruit, grapes, citrus, tropical fruit, onions, potatoes, pineapples and cucurbits.		P		-
Glufosinate- Ammonium (Basta) BASF	N**		Registered for control of grass and broadleaf weeds in berries, tomatoes, beans and fallow.		P		R3
Norflurazon (Zoliar) Agnova Technologies	F**		Registered in asparagus, citrus, grapes, nuts, stone & pome fruits for control of grass & broadleaf weeds including Annual ryegrass, Cape weed, Chickweed, Fat hen, Milk thistle, Pigweed & Wireweed. [Max. 2 applications per year; re-treatment interval not specified]		P		-
Oxyfluorfen (Goal)	G**		Registered for control of grass and broadleaf weeds, in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat.		P		-
Phenmedipham (Betanal) Bayer	C**		Registered for control of grass and broadleaf weeds in silverbeet and beetroot.		P		R3
Propachlor (Ramrod) Nufarm	K**		Registered for control of broadleaf and grass weeds in Brassica vegetables		P		R3
Quizalofop-P-Ethyl	A***		Registered for control of grass weeds in beetroot, cabbage, carrots, cauliflower, cucumbers, honey dew melons, onions, potatoes, pumpkins, radish and tomatoes.		P		R3
S-Metolachlor (Dual Gold) Syngenta	K**		Registered for control of grass and broadleaf weeds in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow.		P		-

Active ingredient (Trade Name)	Chemical Group	Crop / Situation	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Sethoxydim (Sertin)	A***		Registered for control of grass weeds in asparagus, brassica vegetables, cucurbits, root and tuber vegetables, green peas, onions and ornamentals.		P		-

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/F2021C00380
APVMA Permit search	https://productsearch.apvma.gov.au/permits
APVMA Product search	https://productsearch.apvma.gov.au/products
AUSVEG	https://ausveg.com.au
Codex MRL database	http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/
Cotton Pest Management Guide 2018-19	https://www.cottoninfo.com.au/publications/cotton-pest-management-guide
CropLife Australia (resistance management)	https://www.croplife.org.au/resources/programs/resistance-management/
Growcom – Infopest Database	www.infopest.com.au
Hort Innovation	www.horticulture.com.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, nematicides, 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 artichoke

Appendix 2. Products available for control of insects and other pests in artichoke

Appendix 3. Products available for weed control in artichoke

Appendix 4. Current permits for use in artichoke

Appendix 5. Artichoke Maximum Residue Limits (MRLs)

Appendix 6. Artichoke Agrichemical Regulatory Risk Assessment

Appendix 1. Products available for disease control in artichoke

Active Ingredient (Trade Name)	Chemical group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
1,3-Dichloropropene + Chloropicrin (Telone C-35)	8B	General fumigant / vegetables	Plant parasitic nematodes, Symphylans, Wireworms, soil borne diseases (including Fusarium and Verticillium Wilts, Rhizoctonia, Pythium) and suppression of weeds. <i>For use by professional and registered fumigators only.</i>	ALL	NR	-
Chlorothalonil (Bravo)	M5	Globe Artichokes	Botrytis Grey Mould	ALL	1	R3
Dazomet (Basamid)	8F	Fumigant / Vegetables	Soil fungi (including <i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , and <i>Verticillium</i>), Nematodes, soil insects and weeds.	ALL	NR	-
<i>Streptomyces lydicus</i> (Actinovate)	BM 02	Vegetables / Seed Treatment	Fusarium, Rhizoctonia, Pythium	ALL	NR	-
Sulphur	UN	Vegetables	Powdery Mildew, Rust, Black Spot, Mites	ALL	NR	-

Appendix 2. Products available for control of insects and other pests in artichoke

Active Ingredient (Trade Name)	Chemical group	Situation	Pests / Comments	States	WHP	Regulatory risk
1,3-Dichloropropene + Chloropicrin (Telone C-35)	8B	General fumigant / vegetables	Plant parasitic nematodes, Symphylans, Wireworms, soil borne diseases (including Fusarium and Verticillium Wilts, Rhizoctonia, Pythium) and suppression of weeds. <i>For use by professional and registered fumigators only.</i>	ALL	NR	-
Afidopyropen (Versys) BASF	9D	Artichoke, rhubarb & celery	Cabbage Aphid, Lettuce Aphid, Green Peach Aphid, Cotton/Melon Aphid and suppression of Silverleaf Whitefly.	ALL	1	-
<i>Bacillus thuringiensis subsp. kurstaki</i> (DiPel)	11A	Vegetables	<i>Helicoverpa armigera</i> and <i>Helicoverpa punctigera</i> and various Lepidoptera.	ALL	NR	-
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Protected vegetables and ornamentals	Suppression of various pests including: Western Flower Thrips, Onion Thrips, Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-Spotted Spider Mites.	ALL	NR	-
Chlorantraniliprole (Coragen) FMC	28	Stalk & stem vegetables	Corn Earworm, Native Budworm	ALL	3	-
Chlorantraniliprole (Coragen) FMC PER89259	28	Stalk & stem vegetables	Fall Armyworm (<i>Spodoptera frugiperda</i>)	ALL (excl. VIC)	1	-
Chlorpyrifos (Lorsban)	1B	Vegetables	Wingless Grasshopper	NSW, VIC, TAS, SA & WA	14	R1
			Cutworm	ALL		
			Field Cricket, Mole Cricket	QLD & WA		
			Vegetable Weevil	NSW & WA		

Active Ingredient (Trade Name)	Chemical group	Situation	Pests / Comments	States	WHP	Regulatory risk
Cyromazine (Diptex 150 WP) PER81867	17	Stalk & stem vegetables	<i>Liriomyza</i> species, including: Vegetable Leafminer (<i>Liriomyza sativa</i>) and Serpentine Leafminer (<i>Liriomyza huidobrensis</i>).	ALL	7 NG	-
Diazinon	1B	Globe Artichoke	Webworm	ALL (excl. TAS)	14	R3
Emulsifiable Botanical Oils (Eco-Oil)	-	Vegetables	Greenhouse Whitefly	ALL	NR	-
Flubendiamide (Belt) Bayer	28	Stalk & stem vegetables	Helicoverpa	ALL	1	
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Vegetables	Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers	ALL	1	-
Helicoverpa NPV (Gemstar)	-	Stalk & stem vegetables	Corn Earworm, Native Budworm	ALL	NA	-
Iron EDTA Complex	-	All Plants	Slugs and Snails	ALL	NR	-
Metaldehyde	-	Vegetables	Snails and Slugs.	ALL	7	-
Methiocarb (Mesuro) Bayer	1A	Globe Artichoke	Common garden Snail, Slugs, White Italian snail & White snail	ALL	NR	R2
Pirimicarb (Aphidex)	1A	Globe artichoke	Aphids	ALL	2	R3
Potassium Salts of Fatty Acids (Natrasoap)	-	Vegetables	Aphids, Thrips, Mealybug, Two-Spotted Mites, Spider Mite & Whitefly	ALL	NR	-
Pyriproxyfen (Distance Ant Bait) Sumitomo	7C	Vegetables	Invasive and Nuisance Ants	ALL	NR	

Active Ingredient (Trade Name)	Chemical group	Situation	Pests / Comments	States	WHP	Regulatory risk
Spinetoram (Success Neo) Corteva	3	Stalk & stem vegetables (field & protected)	<i>Helicoverpa</i> spp.	ALL	1	-
Spinetoram (Success Neo) Corteva PER89241	5	Stalk & Stem vegetables	Fall Armyworm (<i>Spodoptera frugiperda</i>)	ALL (excl. VIC)	1	-
Spinosad (Entrust Organic) Corteva	5	Stalk & Stem vegetables (field & protected)	<i>Helicoverpa</i> spp.	ALL	1 G:14	-
Spinosad (Entrust Organic) Corteva PER89870	5	Stalk & Stem vegetables (Field & protected cropping)	Fall Armyworm (<i>Spodoptera frugiperda</i>)	ALL (excl. VIC)	1 G:14	-
Spinosad (Entrust Organic) Corteva PER90928	5	Stalk & Stem vegetables (Field & protected cropping)	<i>Liriomyza</i> species, including: Vegetable Leafminer (<i>Liriomyza sativa</i>), Pea Leafminer / Serpentine leafminer (<i>Liriomyza huidobrensis</i>) & American Serpentine Leafminer (<i>Liriomyza trifolii</i>).	ALL (excl. VIC)	1 G:14	-
Sulphur		Vegetables	Bean spider mite, Tomato russet mite, Two-spotted mite	ALL	NR	-
Trichlorfon (Lepidex)	1B	Vegetables	Cabbage White Butterfly, Cabbage Moth, Rutherglen Bug, Green Vegetable Bug	ALL	2	R2

Appendix 3. Products available for weed control in artichoke

Active ingredient (Trade Name)	Chemical Group	Situation	Comment / Use / Weed	WHP (days)	States	Regulatory risk
Glyphosate (Roundup)	M**	Field crops / General seed bed preparation and knockdown	Grass and broadleaf weeds as a pre-crop spray.	NR	ALL	R3
Paraquat + Diquat (SpraySeed)	L**	Field crops / Fallow / Direct drilling / General knockdown	Grass and broadleaf weeds as a pre-crop spray.	NR	ALL	R3

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

Appendix 4. Current permits for use in artichoke

Permit No.	Description	Issued Date	Expiry Date	Permit Holder
PER89259	Chlorantraniliprole (Coragen) / Various crops including stalk and stem vegetables / Fall Armyworm	06-Mar-20	31-Mar-23	Hort Innovation
PER81867 Version 2	Cyromazine (Diptex 150 WP) / Stalk and stem vegetables / <i>Liriomyza</i> species, including: Vegetable Leaf miner (<i>Liriomyza sativa</i>) and Serpentine Leaf miner (<i>Liriomyza huidobrensis</i>)	2-Dec-19	30-Nov-23	Hort Innovation
PER89241	Spinetoram (Success Neo and Delegate Insecticide) / Various Crops including stalk and stem vegetables / Fall Armyworm	06-Mar-20	31-Mar-23	Hort Innovation
PER89870	Spinosad (Entrust Organic) / Various Crops including stalk and stem vegetables (field & protected cropping) / Fall Armyworm	21-Jul-20	31-Jul-23	Hort Innovation
PER90928	Spinosad (Entrust Organic) / Various Crops including stalk and stem vegetables (field & protected cropping) / Vegetable Leaf miner (<i>Liriomyza sativa</i>), Serpentine Leaf miner (<i>Liriomyza huidobrensis</i>) & American serpentine leaf miner (<i>Liriomyza trifolii</i>)	23-Apr-21	30-Apr-24	Hort Innovation
PER91155	Spinetoram (Success Neo) / Various Crops including stalk and stem vegetables (field & protected cropping) / Vegetable Leaf miner (<i>Liriomyza sativa</i>), Serpentine Leaf miner (<i>Liriomyza huidobrensis</i>) & American serpentine leaf miner (<i>Liriomyza trifolii</i>)	9-Jun-21	30-Jun-24	Hort Innovation

Appendix 5. Artichoke Maximum Residue Limits (MRLs)

CODEX commodity groupings of Stalk and Stem vegetables (017):

VS0620 Artichoke, Globe
 VS0078 Stalk and stem vegetables
 Vegetables

Note: Major export markets for Artichokes include New Caledonia, Thailand, Taiwan, Hong Kong & Indonesia. Currently production of all artichoke is for the Australian market and no exports are recorded. Available information indicates that in the absence specific limits in legislation the most countries defers to Codex, followed by EU MRL standards or applies 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	Description	APVMA MRL mg/kg	Codex MRL mg/kg
1,3-dichloropropene		Soil fumigant / MRLs not required	NR	
2,4-D			NA	NA
2,2-DPA		Vegetables	*0.1	-
Acephate	VS0620	Artichoke, Globe		0.03
Afidopyropen			NA	NA
Azoxystrobin	VS0620	Artichoke, Globe	-	5
Boscalid	VS0078	Stalk and stem vegetables		30
Chlorantraniliprole	VS0620	Artichoke, Globe	T0.1	2
	-	Vegetables	E0.02	-
Chlordane	-	Vegetables	E0.02	-
Chlorthal-dimethyl	-	Vegetables	5	-
Chlorothalonil		Vegetables	T7	
Chlorpyrifos		Vegetables	T*0.01	
Clothianidin	VS0620	Artichoke, Globe	-	0.05
Copper		Vegetables	Exempt	
Cypermethrins (including alpha- & zeta- cypermethrin)	VS0620	Artichoke, Globe	-	0.1
Cyprodinil	VS0620	Artichoke, Globe	-	4
Cyromazine	VS0620	Artichoke, Globe	-	3
	VS0078	Stalk and stem vegetables	T7	
Dazomet		Soil fumigant / MRLs not required	NR	
DDT		Vegetables	E1	-
Diazinon	-	Vegetables	0.7	-
Dicofol		Vegetables	5	-
Diclofop-methyl	-	Vegetables	5	-
Difenoconazole	VS0620	Artichoke, Globe	-	1.5
Dimethoate	VS0620	Artichoke, Globe	T1	0.05
Dimethomorph	VS0620	Artichoke, Globe	-	2
Diquat	-	Vegetables	*0.05	-
Dithiocarbamates			NA	
EPTC	-	Vegetables	*0.04	-
Fenarimol	VS0620	Artichoke, Globe	-	0.1

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
Flubendiamide	VS0078	Stalk and stem vegetables	5	
Flumioxazin	VS0620	Artichoke, Globe	-	*0.02
Fluopyram	VS0620	Artichoke, Globe	-	0.4
Glyphosate	VS0078	Stalk and stem vegetables	*0.01	
Heptachlor	-	Vegetables	E0.05	-
Inorganic bromide		Vegetables	20	-
Iron-EDTA		MRLs not required	NR	
Lindane	-	Vegetables	E2	-
Linuron	-	Vegetables	*0.05	-
Mancozeb			NA	
Metalaxyl	-	Vegetables	T0.1	-
Metaldehyde		Vegetables	1	-
Methamidophos	VS0620	Artichoke, Globe	-	0.2
Methiocarb	VS0620	Artichoke, Globe	-	*0.05
	-	Vegetables	0.1	-
Methyl bromide	-	Vegetables	T*0.05	-
Paraquat	-	Vegetables	*0.05	-
Penconazole	VS0620	Artichoke, Globe	-	0.06
Piperonyl butoxide	-	Vegetables	8	-
Pirimicarb	VS0620	Artichoke, Globe	-	5
Potassium salts of fatty acids		MRLs not required	NR	
Prometryn	-	Vegetables	*0.1	-
Propargite		Vegetables	3	
Propazine	-	Vegetables	*0.1	-
Propyzamide	VS0620	Artichoke, Globe	T*0.02	-
Pyraclostrobin	VS0620	Artichoke, Globe	-	2
Pyrethrins	-	Vegetables	1	-
Rotenone		MRLs not required	NR	
Spinetoram	VS0078	Stalk and stem vegetables	2	-
Spinosad			NA	-
Spirotetramat	VS0620	Artichoke, Globe	-	1
Sulphur		MRLs not required	NR	
Tebuconazole	VS0620	Artichoke, Globe	-	0.6
Thiamethoxam	VS0620	Artichoke, Globe	-	0.5
Triadimefon	VS0620	Artichoke, Globe	-	0.7
Triadimenol	VS0620	Artichoke, Globe	-	0.7
Trichlorfon		Vegetables	0.1	
Trifluralin		Vegetables	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.

NA – MRLs are not in place.

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 26 April 2021. CODEX MRLs: CODEX Alimentarius International Food Standards database (February 2020), <http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/>

Appendix 6: Artichoke Agrichemical Regulatory Risk Assessment

Artichoke Agrichemical Regulatory Risk Assessment

October 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 the growing of artichokes, as well as current initiatives aimed at addressing identified pest management deficiencies.

Artichoke 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	Actions
INSECT AND MITE PESTS				
Ants (Invasive and nuisance)	Pyriproxyfen	7C	EU: Re-authorized ⁸	
Aphids				
Aphids	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	Afidopyropen now registered for control of Aphids in artichoke
	Malathion/Maldison	1B	APVMA: Under review: chemistry Codex: Re-evaluation scheduled for 2022/23	
	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	
	Pirimicarb	1A	Codex: JMPR Periodic re-evaluation 2022/23 EU: Candidate for substitution	
Beetles				
Spotted vegetable weevil	Chlorpyrifos	1B	APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure. Codex: Scheduled for review by JMPR in 2021	
Vegetable weevil	Chlorpyrifos	1B	Canada: Cancellation of most uses. EU: Cancellation of use USA: EPA decision to allow continued use	
Weevils	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	

⁸ Pyriproxyfen https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2020.213.01.0007.01.ENG&toc=OJ:L:2020:213:TOC

Problem	Active Constituents	Chemical Group	Comment	Actions
Caterpillars/Lepidoptera				
Armyworms	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	
Bollworm (<i>H. armigera</i>) Native budworm (<i>H. punctigera</i>) Helicoverpa spp.	Chlorantraniliprole	28		ST17000 data generation for Tetraniliprole label extension in stalk and stem vegetables
	Helicoverpa NPV	31		
	Flubendiamide	28		
	Spinetoram	5		
Cabbage moth	Malathion/Maldison	1B	APVMA: Under review: chemistry Codex: Re-evaluation scheduled for 2022/23	ST17000 data generation for Tetraniliprole label extension in stalk and stem vegetables
	Trichlorfon	1B	APVMA: nominated for review Codex: No MRLs Europe: deregistered US: No MRLs	
Cabbage white butterfly	Trichlorfon	1B	APVMA: nominated for review Codex: No MRLs Europe: deregistered US: No MRLs	ST17000 data generation for Tetraniliprole label extension in stalk and stem vegetables
Caterpillars	Diazinon	1B	EU: Deregistered Codex: To be reviewed by 2020/21. JMPPR Periodic re-evaluation 2020	ST17000 data generation for Tetraniliprole label extension in stalk and stem vegetables
	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	
	Spinetoram	5		

Problem	Active Constituents	Chemical Group	Comment	Actions
Cutworms	Chlorpyrifos	1B	APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure. Codex: Scheduled for review by JMPR in 2021 Canada: Cancellation of most uses. EU: Cancellation of use USA:EPA decision to allow continued use	
	Methodathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	
Fall armyworm	Chlorantraniliprole (PER89259)	2B		
	Spinetoram (PER89241)	5		
	Spinosad (PER89870)	5		
Leaf miner (<i>Liriomyza</i> spp.)	Cyromazine PER81867			
	Spinosad (PER90928)			
Webworms	Diazinon	1B	EU: Deregistered Codex: To be reviewed by 2020/21. JMPR Periodic re-evaluation 2020	
Grasshoppers/Locusts				
Field crickets	Chlorpyrifos	1B	APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure. Codex: Scheduled for review by JMPR in 2021 Canada: Cancellation of most uses. EU: Cancellation of use USA:EPA decision to allow continued use	
Mole crickets	Chlorpyrifos	1B		
Wingless grasshopper	Chlorpyrifos	1B		
	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	

Problem	Active Constituents	Chemical Group	Comment	Actions
Jassids/Plant bugs				
Green vegetable bug	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
	Trichlorfon	1B	APVMA: nominated for review Codex: No MRLs Europe: deregistered US: No MRLs	
Jassids	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
Leafhoppers	Dimethoate	1B		
	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	
Rutherglen bug	Trichlorfon	1B	APVMA: nominated for review Codex: No MRLs Europe: deregistered US: No MRLs	
Mites				
Mites	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	ST19020 data generation for label registration for use of Spiromesifen for control of Broad Mites in rhubarb and artichoke.
	Sulphur	M2		
Thrips				
Thrips	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
	Methidathion (vegetable seedlings)	1B	Codex: To be reviewed 2020/21. APVMA: Use will not be permitted in AU after 4 February 2021. EU: Deregistered USA: Deregistered	

Problem	Active Constituents	Chemical Group	Comment	Actions
Other				
Leafminer	Dimethoate	1B	Codex: MRL deletion recommended. EU proposing to set all MRLs to < 0.01 mg/kg	
DISEASES				
Bactericide	Hydrogen peroxide + peroxyacetic acid	M		
Damping off	Thiram	M3	APVMA: Nominated for review Canada: Proposed cancelling of all foliar uses Codex: To be reviewed 2022/23 Europe: No authorisation in place	
Grey mould	Chlorothalonil	M5	APVMA: Nominated for review Canada: Review recently completed; continued use considered acceptable Europe: Deregistration proposed.	
Leaf diseases/spots	Copper	M1	EU: Candidate for substitution	
Rust	Copper	M1	EU: Candidate for substitution	
	Sulphur	M2		
WEEDS				
Broadleaf weeds and grasses	Diquat	L	APVMA: Currently under review EU: No authorisation in place	
	Paraquat	L	APVMA: Currently under review EU: No authorisation in place Rotterdam Convention: nomination	

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