



Brassica Leafy Vegetables

Strategic Agrichemical Review Process
(SARP)

May 2020

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

Date of report:

May 2020

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**Hort
Innovation**
Strategic levy investment

**VEGETABLE
FUND**

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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;

Assesses the importance of the diseases, insects and weeds (plant pests) that can affect a horticultural industry;

- (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 Brassica leafy vegetable 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 are:

Common name	Scientific name
Downy mildew	<i>Hyaloperonospora parasitica</i>
White blister	<i>Albugo candida</i>

1.2 Insects and mites

The high priority insect and mite pests are:

Common name	Scientific name
Leafminer	<i>Liriomyza chenopodii</i>
Helicoverpa Cotton bollworm / Corn earworm Native budworm	<i>Helicoverpa</i> spp. <i>H. armigera</i> <i>H. punctigera</i>
Diamondback moth	<i>Plutella xylostella</i>

1.3 Weeds

The priority weeds are:

Common name	Scientific name
Annual rye grass	<i>Lolium rigidum</i>)
Brassica weeds	<i>Brassica</i> spp.
Capeweed	<i>Arctotheca calendula</i>
Chickweed	<i>Stellaria media</i>
Fat hen	<i>Chenopodium album</i>
Fleabane	<i>Conyza</i> spp.
Groundsel	<i>Senecio</i> spp.
Marshmallow	<i>Malva parviflora</i>
Nutgrass	<i>Cyperus rotundus</i>
Pigweed	<i>Portulaca oleracea</i>
Stinging nettle	<i>Urtica</i> spp.
Wireweed	<i>Polygonum aviculare</i>

2. The Australian Brassica Leafy Vegetable Industry

The Australian Brassica leafy vegetable industry is a minor horticultural industry. This group primarily includes vegetables classified as leafy Asian vegetables.

Crops in the Brassica leafy vegetable group include:

Name	Scientific name	Common aliases
Bok choy, Baby bok choy	<i>B. rapa</i> (Chinensis group)	Bok choy, Chinese white cabbage, Chinese chard
Choy sum, Baby choy sum	<i>B. rapa</i> (Parachinensis group)	Chinese flowering cabbage
Gai choy	<i>B. juncea</i> (many varieties)	Chinese mustard, Mustard cabbage, Swatow mustard, Mustard greens, Amsoi
Gai lan	<i>B. oleraceae</i> subsp. <i>alboglabra</i>	Chinese broccoli, Kailan, Gai lum
Kale	<i>B. oleracea</i> (Acephala group)	Kale, Collard greens
<i>Mibuna</i>	<i>B. rapa</i> subsp. <i>nipposinica</i> var. <i>laciniata</i>	
Mizuna	<i>B. rapa</i> subsp. <i>nipposinica</i>	
Pak choy	<i>B. rapa</i> subsp. <i>chinensis</i> (green stemmed variety)	Baby buk choy, Shanghai buk choy
Rutabaga leaves	<i>B. napus</i> subsp. <i>napobrassica</i>	
Siberian kale	<i>B. napus</i> subsp. <i>pabularia</i>	Hanover salad
Tatsoi	<i>B. rapa</i> (Narinosa group)	Rosette pak choi, Chinese flat cabbage, Komatsuna
Turnip greens	<i>B. rapa</i> var. <i>rapa</i>	
Wombok	<i>B. rapa</i> subsp. <i>pekinensis</i>	Chinese cabbage, Napa cabbage, Wong bok

Fresh Leafy Asian Vegetables Seasonality by State

Due to Australia's diverse weather conditions and the introduction of different varieties of Brassica leafy vegetable, the Australian industry is now able to supply the domestic market with fresh Brassica leafy vegetables throughout the year.

Fresh Leafy Asian Vegetables Seasonality by State

State	18/19 t	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
New South Wales (43%)	12,468												
Victoria (24%)	6,982												
Queensland (28%)	8,152												
Western Australia (3%)	926												
South Australia (<1%)	54												
Tasmania (<1%)	25												
Northern Territory (2%)	621												
Availability legend			High		Medium		Low					None	

2019 Crops statistics and seasonal availability of some major varieties:

State	18/19 t	Fresh Market	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Pak Choy	8,184	28%												
Bok Choy	4,384	15%												
Gai Lan	1,198	4%												
Choy Sum	1,461	5%												
Baby Choy	2,046	7%												
Wombok	11,107	38%												
Other	848	3%												
Availability legend				High		Medium		Low					None	

Currently production of all Brassica leafy vegetables is for the Australian market and no exports are recorded.

Reference: 2018/19 Australian Horticulture Statistics Handbook. [online] Available at: <https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/grower-resources/ha18002-assets/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 Brassica leafy vegetables 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 Brassica leafy vegetable 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 Brassica leafy vegetables 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 Brassica leafy vegetables 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 Brassica leafy vegetables 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 Plan for the Vegetable Industry which covers Brassica leafy vegetables 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://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 Brassica leafy vegetables as a minor crop. The crop fits within the APVMA Crop Group 013: Leafy vegetables (including Brassica leafy vegetables). Therefore, access to minor use permits can be relatively straight forward as long as a reasonable justification is provided. 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 Brassica leafy vegetable industry is for manufacturers to register new pesticides uses in the crop.

3.3 Methods

The current update of the Brassica leafy vegetable Strategic Agrichemical Review Process (SARP), which was last updated in 2014, 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>Brassica leafy vegetable 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 Brassica leafy vegetables 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 Brassica leafy vegetables

Appendix 2. Products available for control of insects, mites and other invertebrates in Brassica leafy vegetables

Appendix 3. Products available for weed control in Brassica leafy vegetables

Appendix 4. Current permits for use in Brassica leafy vegetables

Appendix 5. Brassica Leafy Vegetable Maximum Residue Limits (MRLs)

Appendix 6. Brassica Leafy Vegetable regulatory risk assessment

4. Diseases, Pests and Weeds of Brassica Leafy Vegetables

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 website.

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

Information on regulatory risk derived from project MT17019 (Chapter 4) - 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.

4.1 Diseases of Brassica leafy vegetables

4.1.1 Disease priorities

Common name	Scientific name
High	
Downy mildew	<i>Hyaloperonospora parasitica</i>
White blister	<i>Albugo candida</i>
Moderate	
Alternaria leaf spot	<i>Alternaria brassicicola</i>
Cercospora leaf spot	<i>Cercospora</i> spp.
Club root	<i>Plasmodiophora brassicae</i>
Damping off	<i>Pythium</i> spp., <i>Phytophthora</i> spp., <i>Fusarium</i> spp., <i>Rhizoctonia</i> spp.
Peppery leaf spot	<i>Pseudomonas syringae</i> pv. <i>maculicola</i>
Sclerotinia rot	<i>Sclerotinia</i> spp.
Septoria leaf spot	<i>Septoria apiicola</i>
Low	
Black rot	<i>Xanthomonas campestris</i> pv. <i>campestris</i>
Ring spot	<i>Mycosphaerella brassicicola</i>

The most important disease issues based on the feedback received were Downy mildew and White blister.

White blister is a fungal disease caused by *Albugo candida*. It affects many Brassica crops and some Brassica weeds. A temperature range of 13 to 25°C and leaf wetness for a minimum of two to three hours (from dew, fog, rain or irrigation) will be ideal for infection

to spread. Controlled watering, good farm hygiene would help control spread and should supplement fungicidal use.

Some of the fungal and bacterial diseases that have received moderate to low priority have few options 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 low priority diseases such as club root and damping off whilst seed treatment helps in the control of some others such as Rhizoctonia rot.

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

It has been identified in the survey that the plants coming out of the nursery for transplanting do not come with a paddock record sheet and often the same sprays are being used in the nursery as are in the field. As the growers are unaware of what has already been applied to the seedlings that are to be transplanted there is a risk of unwittingly exceeding the application limit for that chemical. This is a serious issue that needs to be addressed by the industry as a matter of priority.

In controlling fungal and bacterial diseases, the industry should be mindful of resistance management. 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.

<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 high 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
Downy mildew (<i>Hyaloperonospora parasitica</i>)							
Priority: High							
Downy mildew was ranked as a high priority in VIC, NSW, WA and TAS and as a moderate priority in QLD and SA. Frequently attacks seedlings; Management techniques may include cultural practices that increase airflow and minimise moisture in the plant canopy. As Downy mildew can be an issue in any stage of the crop, growers feel the importance of Agchem options having short WHP and being able to use them in protected cropping and hydroponic situations as there is a gradual shift from the field to PC systems for some Brassica leafy varieties.							
Azoxystrobin + oxathiapiprolin (Orondis)	11+49	Protective and curative	42 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew and suppression of Alternaria and Sclerotinia. Use subject to CropLife resistance management strategy. [Max 3 applications per year; re-treatment interval 7-14 d]	-
Chlorothalonil (Bravo) PER82895	M5	Protective	NG	A	ALL (excl. VIC)	PER82895 for control of Downy mildew , Alternaria leaf spot and Grey mould in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval 7-10 d]	R3
Copper oxychloride (Uniguard)	M1	Protectant	1	A	ALL	Registered in Brassicas for the control of Downy mildew plus several other diseases. [Max no. of applications not specified; re-treatment interval 10-14 d; apply when conditions favour disease development]	-
Copper products (Various) PER14038	M1	Protectant	1	A	ALL (excl. VIC)	PER14038 for control of Downy mildew in Brassica leafy vegetables. Refer to product labels for rates and frequency of application.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Cupric Hydroxide + Mancozeb) (ManKocide)	M1+M3	Protective	7 NG	A	All	Registered in Brassicas for the control of Downy mildew , Black rot, Alternaria, ring spot and Anthracnose. [Max 8 applications per season; re-treatment interval 7-10 d; subject to CropLife resistant management strategy]	R2
Cyazofamid (Ranman)	21	Protective and curative	NR NG	A	ALL	Registered in Brassica leafy vegetable seedlings for the control of Downy mildew . Apply when disease is first seen. [Max 6 applications per season; re-treatment interval 7-10 d]	-
Mandipropamid (Revus)	40	Protective	1 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew . Apply when conditions favour disease development, but before disease is evident. [Max 4 applications per crop; max 2 consecutive; re-treatment interval 7-10 d]	-
Mancozeb (Dithane) + dimethomorph (Acrobat) PER14958	M3+40	Protective	14	A	ALL	PER14958 for control of Downy mildew and White blister. [Max 4 applications per crop; 2 sequential; re-treatment interval 7-10 d]	R2
Mancozeb + Metalaxyl (Ridomil Gold) PER14045	M3+4	Systemic, protective & curative	7	A	ALL (excl. VIC)	PER14045 for control of Downy mildew and White blister. [Max 2 applications per crop; re-treatment interval 7-10 d;	R2
Metalaxyl + copper as hydroxide (Ridomil Gold Plus)	M3+M1	Systemic, protective & curative	14	A	ALL	Registered in Brassica leafy vegetables for control of White blister and Downy mildew . [Max 2 applications per year; re-treatment interval 7-14 d; subject to CropLife resistant management strategy]	-
Oxathiapiprolin (Zorvec)	49	Protective	NR	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew . Apply when conditions favour disease development, but before disease is evident. [Max 3 applications per crop; max 2 consecutive; re-treatment interval 7-10 d]	-
Phosphorous acid (various) PER14184	33	Protective & systemic	NR	A	ALL (excl. VIC)	PER14184 for control of Downy mildew and Damping off in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval 7 d]	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Propamocarb + Fluopicolide (Infinito)	28+43	Protective, curative & systemic	7 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew . Apply when conditions favour disease development. [Max 3 applications per crop; re-treatment interval 7-10 d]	-
Zineb (Barmac)	M3	Protective	7	A	ALL	Registered in Cruciferous vegetables (Brassicaceae family) for the control of Downy mildew . [Max no. of applications not specified; re-treatment interval 7-14 d]	R2
Zineb (Barmac) PER10845	M3	Protective	10	A	ALL (excl. VIC)	PER10845 for control of Cercospora leaf spot and Downy mildew in Brassica leafy vegetables. [Max 3 applications per crop; re-treatment interval 7 d]	R2
Acibenzolar S-methyl (Actigard Plant Activator) Syngenta	-	Protective		P		Registered in the USA for the control of Downy mildew in Brassica vegetables Registered in Australia for use in tomatoes for the suppression of Powdery mildew.	
Dimethomorph + Amitoctradin (Zampro) AgNova	45+40	Protective		P		Registered by AgNova in Australia for control of Downy mildew in grape vines. Registration in Brassica leafy vegetables, Cucurbits, Onions & Beetroot is being pursued by Hort Innovation under grant funded projects.	
White blister (<i>Albugo candida</i>)							
Priority: High							
White blister is considered a major problem in all states. Resistance development is an issue. Current fungicide control options are limited, and varietal tolerance varies.							
Azoxystrobin (Amistar)	11	Protective & curative	7	A	ALL	Registered in Brassica leafy vegetables for control of Alternaria leaf spot, White blister and Sclerotinia rot. Reported as effective in some areas but ineffective in others. [Max 2 applications per crop; re-treatment interval 7-14 d]	-
Azoxystrobin+ Oxythiapirolin (Orondis)	11+49	Protective & curative	3 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew and suppression of Alternaria, White blister and Sclerotinia. Use subject to CropLife resistance management strategy. [Max. 3 applications per crop; re-treatment interval 7-14 d]	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Mancozeb (Dithane) + dimethomorph (Acrobat) PER14958	M3+40	Protective	14	A	ALL	PER14958 for control of Downy mildew and White blister . [Max 4 applications per crop; 2 sequential; re-treatment interval 7-10 d]. Mixtures of Mancozeb plus Dimethomorph as a preventive treatment.	R2
Mancozeb + Metalaxyl-M (Ridomil Gold MZ) PER14045	M3+4	Systemic, protective & curative	7	A	ALL (excl. VIC)	PER14045 for control of Downy mildew and White blister . [Max 2 applications per crop; re-treatment interval 7-10 d];	R2
Metalaxyl-M + copper as hydroxide (Ridomil Gold Plus)	M3+M1	Systemic, protective & curative	14	A	ALL	Registered in Brassica leafy vegetables for control of White blister and Downy mildew. [Max 2 applications per year; re-treatment interval 7-14 d; subject to CropLife resistant management strategy]	-
Cyazofamid (Ranman) ISK	21	Protectant		P-A		Registered for control of late blight and White blister in broccoli. [Resistance management - Max 3 consecutive sprays per crop; re-treatment interval 7-10 d]. Registered in Brassica leafy vegetable seedlings for the control of Downy mildew.	-
Amisulbrom + Copper (Amicus Blue) Nufarm	21+M1	Protectant		P		Registered in Brassica vegetables for control of Downy mildew and White blister . [Max 3 sprays per crop; re-treatment interval 7-10 d]	-
Hydrogen peroxide + peroxyacetic acid (Peratec Plus) Jaegar	M	Non-selective surface sterilant		P		Registered in broccoli, cauliflower, cabbage and Brussels sprout for control of Downy mildew and White blister . [Max 4 sprays per crop; max 2 consecutive; re-treatment interval 5-7 d]	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Alternaria leaf spot (<i>Alternaria brassicicola</i>)							
Priority: Moderate							
Alternaria leaf spot was ranked as a moderate priority in VIC, QLD, NSW, WA and TAS, and as a low priority in SA. Good farm hygiene is crucial as the fungus will over-winter on plant residues and can be spread on tools and water splashes. Seed may also be a source of new infection.							
Azoxystrobin (Amistar)	11	Protective & curative	7	A	ALL	Registered in Brassica leafy vegetables for control of Alternaria leaf spot , White blister and Sclerotinia rot. Reported as effective in some areas but ineffective in others. [Max 2 applications per crop; re-treatment interval 7-14 d]	-
Azoxystrobin + oxathiapiprolin (Orondis)	11+49	Protective & curative	42 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew and suppression of Alternaria and Sclerotinia. Use subject to CropLife resistance management strategy. [Max 3 applications per year; re-treatment interval 7-14 d]	-
Chlorothalonil (Bravo) PER82895	M5	Protective	NG	A	ALL (excl. VIC)	PER82895 for control of Downy mildew, Alternaria leaf spot and Grey mould in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval 7-10 d]	R3
Cupric Hydroxide + Mancozeb (ManKocide)	M1+M3	Protectant	7 NG	A	ALL	Registered in Brassicas for the control of Downy mildew, Black rot, Alternaria , ring spot and Anthracnose. [Max 8 applications per season; re-treatment interval 7-10 d; subject to CropLife resistant management strategy]	R2
<i>Bacillus amyloliquefaciens</i> (Serenade Opti) Bayer	44	Protective Biofungicide		P		Registered for control Botrytis in strawberries and grapes, suppression of bacterial spot in tomato, chili and capsicum and control of Anthracnose and suppression of Stem end rot in tropical fruits. Registered in US for control of Alternaria leaf spot in Brassica vegetables.	
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Hort Innovation data generation project underway for a label registration in Brassica Leafy Vegetables for Sclerotinia. Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot , Gummy stem blight, Septoria, <i>Botrytis</i> , <i>Cladosporium</i> , <i>Cercospora</i> , <i>Sclerotinia</i> and Anthracnose.	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Pydiflumetofen (Miravis)	7	Protective				Registered in the USA as Miravis Neo (Pydiflumetofen + fludioxonil) for Alternaria , Cercospora, Septoria, Sclerotinia, Powdery mildew and Grey mould control. The compound is registered in Australia for use in canola, grapes and potato.	
Pyraclostrobin + Fluxapyroxad (Merivon) BASF	7+11	Protective		P		Registered in almonds for control of Alternaria leaf spot . Registrant is pursuing label extension to cover Brassica leafy vegetables.	
Cercospora leaf spot (<i>Cercospora</i> spp.)							
Priority: Moderate							
Cercospora leaf spot was ranked as a moderate priority in VIC, QLD, NSW, WA and TAS, and as a low priority in SA. The inoculum survives on crop debris and on weeds. Distributed by wind, rain splash and irrigation water. Various cultural practices are important such as crop rotation, removing crop debris and avoiding spread (e.g. via overhead irrigation, equipment, etc).							
Propiconazole (Tilt) PER14479	3	Protective and curative	14	A	ALL (excl. VIC)	PER14479 for control of Cercospora leaf spot , Rust, and Septoria leaf spot. [Max 2 applications per crop; re-treatment interval 7 d]	R3
Zineb (Barmac) PER10845	M3	Protective	10	A	ALL (excl. VIC)	PER10845 for control of Cercospora leaf spot and Downy mildew in Brassica leafy vegetables. [Max 3 applications per crop; re-treatment interval 7 d]	R2
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Hort Innovation data generation project underway for a label registration in Brassica Leafy Vegetables for Sclerotinia. Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot, Gummy stem blight, Septoria, <i>Botrytis</i> , <i>Cladosporium</i> , Cercospora , <i>Sclerotinia</i> and Anthracnose.	R3
Pydiflumetofen (Miravis)	7	Protective		P		Registered in the USA as Miravis Neo (Pydiflumetofen + fludioxonil) for Alternaria, Cercospora , Septoria, Sclerotinia, Powdery mildew and Grey mould control. The compound is registered in Australia for use in canola, grapes and potato.	

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Zineb (Barmac) Amgrow	M3	Protective		P		Registered in Cauliflower and Cabbages for the control of Cercospora leaf spot and in Crucifers for control of Downy mildew (All States). Apply when disease threatens. [Max no. of applications not specified; re-treatment interval 7 d]	R2
Club root (<i>Plasmodiophora brassicae</i>)							
Priority: Moderate							
This is a new priority ranked moderate in 2019. Farm hygiene plays an important role in controlling club root. Soil fumigation is also an option.							
1,3-dichloropropene (Tri-Form)	-	Soil fumigant	NR	A	ALL	Registered in vegetables for control of soil borne diseases. Leave soil undisturbed for 14 d after treatment.	-
Fluazinam (Surefire) PCT Holdings	29	Brassica vegetables / Fumigant		P		Registered in Brassica vegetables for the control of Club root . To be used as a seedling drench or pre-plant soil application.	-
Damping off (<i>Pythium</i> spp., <i>Phytophthora</i> spp., <i>Fusarium</i> spp., <i>Rhizoctonia</i> spp.)							
Priority: Moderate							
Damping off was ranked as a moderate priority in QLD, NSW, WA, TAS and SA, and as a low priority in VIC. Damping off is caused by several different pathogens that kill or weaken seeds or seedlings before or after they germinate. It is most prevalent in wet and cool conditions.							
1,3-dichloropropene (Tri-Form)	-	General pre-plant soil fumigation	NR	A	ALL	Registered in vegetables for control of soil borne diseases. Leave soil undisturbed for 14 d after treatment.	-
Chloropicrin (Tripicrin)	8A	General pre-plant soil fumigation	NR	A	ALL	It is registered as a general fumigant to control Nematodes, insects, <i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , and <i>Verticillium</i> . Do not plant for 10 d after soul treatment.	-
Mancozeb + Sulphur (Richgro)	M3+UN	Systemic, protective	7	A	ALL	It is registered in seedlings (general) for the control Damping off . [Max no. of applications not specified; re-treatment interval 10 d]	R2
Phosphorous acid (various) PER14184	33	Protective & systemic	NR	A	ALL (excl. VIC)	PER14184 for control of Downy mildew and Damping off in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval 7 d]	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Bacillus amyloliquefaciens</i> (Serenade Prime) Bayer	44	Biological		P		Registered as a soil ameliorant for suppression of Rhizoctonia in potatoes.	
Fludioxonil + Metalaxyl-M (Maxim) Syngenta	4+12	Protectant		P		Registered in Australia for the control of Rhizoctonia rot in Canola seedlings.	
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Hort Innovation data generation project underway for a label registration in Brassica Leafy Vegetables for Sclerotinia. Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot, Gummy stem blight, Septoria, Botrytis, Cladosporium, Cercospora, Sclerotinia, Rust and Anthracnose and suppression of Rhizoctonia .	R3
Metalaxyl (Barmac) Amgrow	4	Protectant & systemic		P		Registered in Brassica vegetables, cucurbits, Brassica leafy vegetables and tomatoes for control of Damping off (<i>Pythium</i> and <i>Phytophthora</i>). Apply along furrows and incorporate into soil.	-
Metalaxyl-M (Ridomil Gold 480 SL or Gold 480 EC or Gold 25G) Syngenta	4	Systemic		P		Registered for control of Phytophthora in pineapples, asparagus and potatoes. Ridomil Gold 25G is registered in Brassica vegetables for Damping-off (Pythium spp. and Phytophthora spp.)	-
Peppery leaf spot (<i>Pseudomonas syringae</i> pv. <i>maculicola</i>)							
Priority: Moderate							
Bacterial pathogen favoured by wet, cool conditions and is considered a low priority. Tends to be seed-borne and are dispersed between plants by rain splash. Seed and soil treatment can be options.							
Copper oxychloride (Uniguard)	M1	Protectant	1	A	ALL	Registered in Brassicas for the control of Peppery leaf spot plus several other diseases. [Max no. of applications not specified; re-treatment interval 10-14 d; apply when conditions favour disease development]	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Sclerotinia rot (<i>Sclerotinia</i> spp.)							
Priority: Moderate							
Sclerotinia rot was ranked as a moderate priority in VIC, QLD, NSW, WA, TAS, and as a high priority in SA. The plants will wilt and die following infection, with total collapse of the plant occurring as the fungus spreads through the stem. Various cultural practices such as crop rotation, removing crop debris or ploughing in diseased crops immediately after harvest can help prevent spread of disease.							
Azoxystrobin (Amistar)	11	Protective & curative	7	A	ALL	Registered in Brassica leafy vegetables for the suppression of Sclerotinia rot . [Max 2 applications per crop; re-treatment interval 7-14 d]	-
Azoxystrobin + oxathiapiprolin (Orondis)	11+49	Protective & curative	42 NG	A	ALL	Registered in Brassica leafy vegetables for the control of Downy mildew and suppression of Alternaria and Sclerotinia . Use subject to CropLife resistance management strategy. [Max 3 applications per year; re-treatment interval 7-14 d]	-
Boscalid (Filan)	7	Systemic	7	A	ALL	Registered in Brassica leafy vegetables for the control of Sclerotinia rot . [Max 4 applications per crop; re-treatment interval 7-14 d; subject to CropLife resistant management strategy]	-
Cyprodinil + fludioxonil (Switch)	9+12	Protective & curative	7	A	ALL	Registered in Asian leafy greens and Chinese cabbage for the control of Sclerotinia rot . [Max 2 applications per crop; re-treatment interval 7-14 d]	R3
Penthiopyrad (Fontelis)	7	Systemic	NR NG	A	ALL	Registered in Brassica leafy vegetables for control of Sclerotinia rot . [Max 2 sequential treatments; re-treatment interval 7-14 d]	-
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Hort Innovation data generation project underway for a label registration in Brassica Leafy Vegetables for Sclerotinia . Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot, Gummy stem blight, Septoria, <i>Botrytis</i> , <i>Cladosporium</i> , <i>Cercospora</i> , Sclerotinia and Anthracnose.	R3
Pydiflumetofen (Miravis)	7	Protective		P		Registered in the USA as Miravis Neo (Pydiflumetofen + fludioxonil) for Alternaria, Cercospora, Septoria, Sclerotinia , Powdery mildew and Grey mould control. The compound is registered in Australia for use in canola, grapes and potato.	

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Septoria leaf spot (<i>Septoria apiicola</i>)							
Priority: Moderate							
Bacterial pathogen favoured by wet, cool conditions and is considered a moderate priority in all States. Tends to be seed-borne and are dispersed between plants by rain splash. Seed and soil treatment can be options.							
1,3-dichloropropene (Tri-Form)	-	General pre-plant soil fumigation	NR	A	ALL	Soil borne diseases, plant parasitic nematodes. Restricted chemical.	-
Mancozeb (Penncozeb) PER80538	M3	Systemic & protective	14	A	ALL (excl. VIC)	For control of Anthracnose and Septoria in Brassica leafy vegetables. [Max 8 sequential treatments; re-treatment interval 7 d]	R2
Propiconazole (Tilt) PER14479	3	Protective & curative	14	A	ALL (excl. VIC)	PER14479 for control of Cercospora leaf spot, Rust, and Septoria leaf spot . [Max 2 applications per crop; re-treatment interval 7 d]	R3
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Hort Innovation data generation project underway for a label registration in Brassica Leafy Vegetables for Sclerotinia. Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot, Gummy stem blight, Septoria , <i>Botrytis</i> , <i>Cladosporium</i> , <i>Cercospora</i> , <i>Sclerotinia</i> and Anthracnose.	R3
Pydiflumetofen (Miravis)	7	Protective		P		Registered in the USA as Miravis Neo (Pydiflumetofen + fludioxonil) for Alternaria, Cercospora, Septoria , Sclerotinia, Powdery mildew and Grey mould control. The compound is registered in Australia for use in canola, grapes and potato.	
Black rot (<i>Xanthomonas campestris</i> pv. <i>Campestris</i>)							
Priority: Low							
Black rot was ranked as a moderate priority in QLD and SA, and as a low priority in VIC, NSW, WA and TAS. This is a bacterial pathogen that can damage plant leaves and is considered a low priority. Management is non-chemical; using clean seeds and transplant material; eliminating alternative hosts; and through early detection and disposal of infected seedlings.							

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
<i>Bacillus amyloliquefaciens</i> strain QST 713 (Serenade Opti) PER87630	44	Protective biofungicide	NR	A	ALL (excl. VIC)	PER87630 for suppression of Bacterial spot/blight (<i>Xanthomonas</i> spp.) in Brassica leafy vegetables. [Max. no. of applications not specified; re-treatment interval 3-7 d]	-
Copper oxychloride (Uniguard)	M1	Protectant	1	A	ALL	Registered in Brassicas for the control of Black rot plus several other diseases. [Max no. of applications not specified; re-treatment interval 10-14 d; apply when conditions favour disease development]	-
Cupric Hydroxide + Mancozeb (ManKocide)	M1+M3	Protectant	7 NG	A	ALL	Registered in Brassicas for the control of Downy mildew, Black rot , Alternaria, ring spot and Anthracnose. [Max 8 applications per season; re-treatment interval 7-10 d; subject to CropLife resistant management strategy]	R2
Acibenzolar-S-methyl (Actigard Plant Activator) Syngenta	-	Protective		P		Registered in Australia for use in tomatoes for the suppression of Bacterial spot (<i>Xanthomonas campestris</i>), Bacterial speck and Bacterial canker. Registered in the USA for the suppression of Black rot (<i>Xanthomonas campestris</i>) in Brassica vegetables.	
Ring spot (<i>Mycosphaerella brassicicola</i>)							
Priority: Low							
Ring spot was ranked as a moderate priority in WA and SA and as a low priority in VIC, QLD, NSW, and TAS. Caused by an organism that thrives under wet and cool conditions and is considered a low priority. Take precautions to prevent spread of disease from nursery to field.							
Copper oxychloride (Uniguard)	M1	Protectant	1	A	ALL	Registered in Brassicas for the control of Ring spot plus several other diseases. [Max no. of applications not specified; re-treatment interval 10-14 d; apply when conditions favour disease development]	-
Cupric Hydroxide + Mancozeb (ManKocide)	M1+M3	Protectant	7 NG	A	All	Registered in Brassicas for the control of Downy mildew, Black rot, Alternaria, Ring spot and Anthracnose. [Max 8 applications per season; re-treatment interval 7-10 d; subject to CropLife resistant management strategy]	R2
Difenoconazole (Score) PER82136	3	Non-systemic, protective	3 NG	A	ALL (excl. VIC)	PER82136 for control of Ring spot in Brassica leafy vegetables. [Max 3 applications; re-treatment interval 14-21 d]	R3
Mefentrifluconazole (Belanty) BASF	3	Protectant & Curative		P		Registered on Apples and Grapes for Black Spot and Powdery Mildew. BASF claims wide range of diseases controlled by this active. No MRLs for AU or Codex.	

4.2 Insect, mite and other invertebrate pests of Brassica leafy vegetables

4.2.1 Insect, mite and other invertebrate pest priorities

Common name	Scientific name
High	
Diamondback moth	<i>Plutella xylostella</i>
Helicoverpa Cotton bollworm / Corn earworm Native budworm	<i>Helicoverpa</i> spp. <i>H. armigera</i> <i>H. punctigera</i>
Moderate	
Cabbage aphid	<i>Brevicoryne brassicae</i>
Green peach aphid	<i>Myzus persicae</i>
Green vegetable bug	<i>Nezara viridula</i>
Looper caterpillars	<i>Chrysodeixis</i> spp.
Plague thrips	<i>Thrips imaginis</i>
Rutherglen bug	<i>Nysius vinitor</i>
Silverleaf whitefly	<i>Bemisia tabaci</i>
Low	
African black beetle	<i>Heteronychus arator</i>
Cabbage-centre grub	<i>Hellula hydralis</i>
Cabbage cluster caterpillar	<i>Crocidolomia pavonana</i>
Cabbage white butterfly	<i>Pieris rapae</i>
Redlegged earth mite	<i>Halotydeus destructor</i>
Symphyla	<i>Hanseniella</i> spp. and <i>Scutigera</i> spp.
Two-spotted mite	<i>Tetranychus urticae</i>
Western flower thrips	<i>Frankliniella occidentalis</i>

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

Priority: New Pest to Australia (unknown priority)	
Fall Armyworm	<i>Spodoptera frugiperda</i>
Vegetable leaf miner	<i>Liriomyza sativae</i>

The two highest priority insect pests identified by the survey are Diamondback moths (Lepidoptera) and Helicoverpa. Available and potential products for these high priority insects and mites are 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.

Further development and extension of IPM strategies and best management practices that can be implemented in the management of Lepidopteran pests in Brassica may be warranted. Efficacy and residues need to be evaluated before pursuing new chemistry.

Diadegma semiclausum (Diadegma) is a parasitoid wasp identified in Australia which lays its eggs into the developing larvae of the diamondback moth. Potential exists for its use in Brassica plantings where no harmful chemicals have been used.

Aphids are pests across many vegetables and specific resistance management strategies exist for aphids.

<https://www.croplife.org.au/resources/programs/resistance-management/various-cottonmelon-aphid-and-green-peach-aphid/>

Rotating crops or pastures with non-host crops can reduce pest colonisation, reproduction and survival to help reduce the risk of red legged earth mite population build up. Cultivation can also help reduce risk of red legged earth mite populations by significantly decreasing the number of over-summering eggs. Hot stubble burns or soil fumigation can provide a similar effect.

Several predators and pathogens are known to attack earth mites in eastern Australia. The most important predators of red legged earth mite appear to be other mites, although small beetles, spiders and ants also play a role in reducing populations. A predatory mite (*Anystis wallacei*) has been introduced as a means of biological control of the red legged earth mite.

Biological control involving other insects or fungal organisms in insect pest control need to be further evaluated. A good case in point is the use of lady beetles *Stethorus* spp. and other predatory mites in controlling mite populations. There are several identified biological control agents available for pests in Australia;

<http://www.goodbugs.org.au/bycrop.html#Fieldgrownvegetables>

4.2.2 Available and potential products for high priority insects and mites

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
Diamondback moth (<i>Plutella xylostella</i>)								
Priority: High								
Diamondback moth (DBM) was consistently ranked as a high priority in VIC, QLD, NSW, WA, TAS, and SA. DBM is the only pest in Brassicas leafy vegetables that was consistently ranked high priority across all consulted regions and is a priority issue for all varieties. Resistance to some insect groups has reduced control options despite a range of actives registered. Additionally, not all actives have broad registrations across Lepidoptera.								
<i>Bacillus thuringiensis</i> (Xentari WG) PER87670	11A	Protective biofungicide	NR	A	ALL (excl. VIC)	PER87670 for control of Diamondback moth , Cabbage white butterfly, <i>Helicoverpa</i> and Vegetable looper in Brassica leafy vegetables. Repeat applications as required or at regular intervals. [Max. no. of applications and re-treatment not specified]	-	-
Chlorantraniliprole (Coragen)	28	Contact & systemic	3	A	ALL	Registered in Brassicas for control of Cabbage-centre grub, Cabbage cluster caterpillar, Cabbage leafminer, Cabbage white butterfly, Cluster caterpillar, Diamondback moth , Soybean looper and <i>Helicoverpa</i> spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d]	L	-
Cypermethrin (Cyrux)	3A	Contact & systemic	1	A	ALL	Registered in Kale, Kohlrabi and Chinese cabbage for control of Diamondback moth . [Max no. of applications not specified; re-treatment interval 7-10 d]	VH H- Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Emamectin (Proclaim Opti)	6	Ingestion & contact	3 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth , <i>Helicoverpa</i> spp., Cabbage white butterfly, Cluster caterpillar and Vegetable looper. [Max 4 applications per crop; re-treatment interval 7 d; Use subject to CropLife resistant management strategy]	M H-Bees	-
Emamectin (Proclaim) PER14907	6	Ingestion & contact	1 NG	A	ALL (excl. VIC)	PER14907 for control of Diamondback moth , <i>Helicoverpa</i> , Cabbage white butterfly and Vegetable looper in Brassica leafy vegetables. [Max. 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Flubendiamide (Belt)	28	Contact & systemic	1 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth , Cabbage white butterfly, Cluster caterpillar, <i>Helicoverpa</i> spp. and Soybean looper. [Max 3 applications per crop; re-treatment interval 7-14 d]	-	-
Spinetoram (Success Neo)	5	Contact & ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth , Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips, and <i>Helicoverpa</i> spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-
Spirotetramat (Movento 240 SC)	23	Contact & systemic	3	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid, Grey cabbage aphid, Diamondback moth and Silverleaf whitefly. (field & protected cropping) Use subject to CropLife resistant management strategy. [Max. 2 sprays per crop; re-treatment interval: 7 d]	M	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth , Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
<i>Clitorea ternatia</i> extract (Sero-X)	-			P		Registered in cotton for control of <i>Helicoverpa</i> . Innovate AG is seeking to register use against Diamondback moth in edible crops.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Indoxacarb + Novaluron (Plemax) Adama	22A+15			P		Registration pending for control of Lepidoptera including <i>Helicoverpa</i> spp. Registered in South Africa on a range of crops for Lepidoptera control.	M M-Bees	R3
Methoxyfenozide (Prodigy) Corteva	18	Insect growth regulator		P		Controls a range of Lepidoptera pests. Registrations and permits to control Lepidoptera pests in various vegetables including fruiting vegetables and lettuce. IPM compatible.	L	
NUL3445 Nufarm	TBC			P		New active in development. Nufarm claim activity on Lepidoptera .		
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .		
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera . Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
Helicoverpa (<i>Helicoverpa armigera</i> [Cotton bollworm/Corn Earworm] and <i>Helicoverpa punctigera</i> [Native Budworm])								
Priority: High								
Helicoverpa was ranked as a moderate priority in VIC, WA, TAS and SA, and as a high priority in QLD and NSW. Many control options are available, but <i>H. armigera</i> resistance can be an issue.								
<i>Bacillus thuringiensis subsp. kurstaki</i> (Biocrystal)	11A	Protective Biopesticide	NR	A	ALL	Registered in vegetables for control of Armyworm, Cabbage moth, Cabbage white butterfly, Green looper, Lightbrown apple moth, Pear looper, Soybean looper, Vine moth, and Tobacco looper Helicoverpa spp. Most effective on larvae < 8 mm. [Apply a minimum of 2 sprays, 3 d apart: re-treatment interval 3-5 d]	VL	-
Chlorantraniliprole (Coragen)	28	Contact & systemic	3	A	ALL	Registered in Brassicas for control of Cabbage-centre grub, Cabbage cluster caterpillar, Cabbage leafminer, Cabbage white butterfly, Cluster caterpillar, Diamondback moth, Soybean looper and Helicoverpa spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d]	L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Cypermethrin (Cyrux)	3A	Contact & systemic	1	A	ALL	Registered in Kale, Kohlrabi and Chinese cabbage for control of Cabbage white butterfly, Cabbage moth, Cluster caterpillar, and Helicoverpa spp. [Max no. of applications not specified; re-treatment interval 7-10 d]	VH	-
Emamectin (Proclaim Opti)	6	Ingestion & contact	3 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Helicoverpa spp. , Cabbage white butterfly, Cluster caterpillar and Vegetable looper. [Max 4 applications per crop; re-treatment interval 7 d; Use subject to CropLife resistant management strategy]	M H-Bees	-
Emamectin (Proclaim) PER14907	6	Ingestion & contact	1 NG	A	ALL (excl. VIC)	Control of diamondback moth, Helicoverpa , Cabbage white butterfly and Vegetable looper in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Esfenvalerate (Flex)	3A	Contact & systemic	2			Registered in Kale and kohlrabi for control of Cabbage moth, Cabbage white butterfly, Cabbage centre grub, and Helicoverpa spp. Apply when pests first appear. [Max no. of applications not specified; re-treatment interval 7-10 d]	VH H-Bees	-
Flubendiamide (Belt)	28	Contact & systemic	1 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Cluster caterpillar, Helicoverpa spp. and Soybean looper. [Max 3 applications per crop; re-treatment interval 7-14 d]	-	-
Indoxacarb (Avatar)	22A	Contact	3	A	ALL	Registered in Brassica leafy vegetables for control of Helicoverpa spp. [Max 3 applications per crop: re-treatment interval 7 d]	L	R3
Nucleopolyhedrovirus NPV of <i>Helicoverpa armigera</i> (Vivus Max)	31	Protective Biopesticide	NR	A	ALL	Registered in leafy 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	-
Prothiofos (Tokuthion)	1B	Contact and systemic	7	A	ALL	Registered in Kale and Chinese cabbage for the control of Cabbage white butterfly, Cabbage moth, Cluster caterpillar, and Helicoverpa spp. Apply when pests are first seen. [Max no. of applications not specified; re-treatment interval: 7 d]	H H-Bees	-
Spinetoram (Success Neo)	5	Contact and ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips, and Helicoverpa spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Indoxacarb + Novaluron (Plemax) Adama	22A+15			P		Registration pending for control of Lepidoptera including <i>Helicoverpa</i> spp. Registered in South Africa on a range of crops for Lepidoptera control.		R3
NUL3445 Nufarm	TBC			P		New active in development. Nufarm claim activity on Lepidoptera .		
Spinosad (Entrust Organic) Corteva	5	Contact and ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .		
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera . Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
Aphids: Cabbage aphid (<i>Brevicoryne brassicae</i>)								
Priority: High								
Cabbage aphid was ranked as a moderate priority in VIC, QLD, NSW, TAS and SA, and as a high priority in WA. Aphids are considered a major pest across most crops. Many chemical options are available for these pests. All applications are foliar unless specified otherwise.								
Afidopyropen (Versys)	9D	Disrupts feeding	1	A	ALL	Registered in Brassica leafy vegetables for control of Cabbage aphid and suppression of Silverleaf whitefly. Field use only with ground-based spraying. [Max 4 applications per crop – only 2 consecutive; re-treatment interval 14 d]	L	-
Diazinon (Barmac)	1B	Contact & systemic	14	A	QLD, SA, WA & VIC	Registered in Kale and Kohlrabi for control of Cabbage white butterfly, Centre grub, Cluster caterpillar, Cabbage aphid , Green peach aphid, and Looper. [Max no. of applications not specified; re-treatment interval 7-10 d]	H H-Bees	R3
Imidacloprid (Confidor 200SC) PER14584	4A	Contact & systemic	3	A	ALL (excl. VIC)	PER14584 for control of Aphids , Whitefly, and Thrips (except Western flower thrips) in Brassica leafy vegetables. [Apply at first sight of infestation: max no. of applications not specified]	M M-Bees	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Maldison (Fyfanon)	1B	Contact & systemic	3	A	ALL	Registered in vegetables for control of Aphid , Green vegetable bug, Jassid, Leaf hopper, Red legged earth mite, Rutherglen bug, Twenty-eight spotted ladybirds. [Apply at first sight of infestation: max no. of applications not specified]	H H-Bees	-
Petroleum oil PER12221	-	Contact & protectant	1	A	ALL (excl. VIC)	PER12221 for control of Aphids , Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in Brassica leafy vegetables. [Max. no. of applications and re-treatment interval not specified]	-	-
Pirimicarb (Aphidex)	1A	Contact & systemic	2 NG	A	ALL	Registered in Brassica leafy vegetables for control of Cabbage aphid and Green peach aphid. [max no. of applications not specified; re-treatment interval: 10-14 d]	VL	R3
Pyrethrins + piperonyl butoxide (Kendon)	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids, Thrips, Caterpillars, Leaf hoppers, and Whitefly. [Max no. of applications not specified; re-treatment interval: 7 d]	VH H-Bees	-
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids , Cabbage white butterfly, Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Spirotetramat (Movento 240 SC)	23	Contact & systemic	3	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid, Grey Cabbage aphid , Diamondback moth and Silverleaf whitefly. (field & protected cropping) Use subject to CropLife resistant management strategy. [Max 2 sprays per crop; re-treatment interval: 7 d]	M	-
Sulfoxaflor (Transform)	4C	Systemic	3	A	ALL	Registered in leafy vegetables for control of Green peach aphid, Brown sowthistle aphid, Turnip aphid, Cabbage aphid , Rutherglen bug and Greenhouse whitefly. Field situations only. [Max no. of applications not specified; re-treatment interval 7-10 d;]	M VH-bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid , Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly, Greenhouse whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
<i>Beauveria bassiana</i> (Broadband OD, Velifer) BASF	UNF	Biological		P-A		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		
Pymetrozine (Chess)	9B	Contact & systemic		P-A		Registered in Leafy vegetables including Asian Brassica, Chinese cabbage, Kale for Green peach aphid control. [Maximum of two applications per crop]	VL	R3
Fonicamid (Mainman) ISK	9C	Systemic		P		Registered in Cucurbits for control of Aphids and Silverleaf whitefly; Aphids in potatoes; Aphids and Mealybugs in apples and pears; Aphids and Mirids in cotton. US label (Beleaf) approves use on root vegetables on Aphids , Plant bugs and Greenhouse whitefly.	M	
Flupyradifurone (Sivanto 200 SL) Bayer	4D	Contact, systemic & ingestion		P		Registered in macadamia for control of Lace bug, Banana spotting bug and suppression of Scirtothrips. [Max. 1 application per crop]. US label approves use in Brassica leafy vegetables for control of Leafhoppers, Aphids and Whiteflies.		
<p>Aphids: Green peach aphid (<i>Myzus persicae</i>) Priority: Moderate</p> <p>Green peach aphid was ranked as a moderate priority in VIC, QLD, NSW, TAS and SA, and as a high priority in WA. Aphids are considered a major pest across most crops but has ranked moderate in Brassica leafy vegetables in the current survey. Many chemical options are available for these pests. All applications are foliar unless specified otherwise.</p>								
Afidopyropen (Versys)	9D	Disrupts feeding	1	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid . Field use with ground-based spraying only. [Max 4 applications per crop – only 2 consecutive; re-treatment interval 14 d]	L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
<i>Beauveria bassiana</i> (Broadband OD / Velifer)	UNF	Protective biopesticide	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]	-	-
Diazinon (Barmac)	1B	Contact & systemic	14	A	QLD	Registered in Kale and Kohlrabi for control of Cabbage white butterfly, Centre grub, Cluster caterpillar, Cabbage aphid, Green peach aphid , and Looper. [Max no. of applications not specified; re-treatment interval 7-10 d]	H H-Bees	R3
Imidacloprid (Confidor 200SC) PER14584	4A	Contact & systemic	3	A	ALL (excl. VIC)	Control of Aphids , Whitefly, and Thrips (except Western flower thrips) in Brassica leafy vegetables. [Apply at first sight of infestation: max no. of applications not specified]	M M-Bees	R2
Maldison (Fyfanon)	1B	Contact & systemic	3	A	ALL	Registered in vegetables for control of Aphids , Green vegetable bug, Jassid, Leaf hopper, Red legged earth mite, Rutherglen bug, Twenty-eight spotted ladybirds. [Apply at first sight of infestation: max no. of applications not specified]	H H-Bees	-
Petroleum oil PER12221	-	Contact & protectant	1	A	ALL (excl. VIC)	Control of Aphids , Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in Brassica leafy vegetables. [Max. no. of applications and re-treatment interval not specified]	-	-
Pirimicarb (Aphidex)	1A	Contact & systemic	2 NG	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid . [max no. of applications not specified; field crops only; re-treatment interval: 10-14 d]	VL	R3
Pyrethrins + piperonyl butoxide (Kendon)	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids , Thrips, Caterpillars, Leaf hoppers, and Whitefly. [Max no. of applications not specified; re-treatment interval: 7 d]	VH H-Bees	-
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids , Cabbage white butterfly, Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Spirotetramat (Movento 240 SC)	23	Contact & systemic	3	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid , Grey cabbage aphid, Diamondback moth and Silverleaf whitefly. (field & protected cropping). Use subject to CropLife resistant management strategy. [Max 2 sprays per crop; re-treatment interval: 7 d]	M	-
Sulfoxaflor (Transform)	4C	Systemic	3	A	ALL	Registered in leafy vegetables for control of Green peach aphid , Brown sowthistle aphid, Turnip aphid, Cabbage aphid, Rutherglen bug and Greenhouse whitefly Field situations only. [Max no. of applications not specified; re-treatment interval 7-10 d;]	M VH-bees	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Custer caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid , Western flower thrips, Onion thrips, Silverleaf whitefly and Greenhouse whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Pymetrozine (Chess)	9B	Contact & systemic	3	A	ALL	Registered in Leafy vegetables including Asian Brassica, Chinese cabbage, Kale for Green peach aphid control. [Maximum of two applications per crop]	VL	R3
Fonicamid (Mainman) ISK	9C	Systemic		P		Registered in Cucurbits for control of Aphids and Silverleaf whitefly; Aphids in potatoes; Aphids and Mealybugs in apples and pears; Aphids and Mirids in cotton. US label (Beleaf) approves use on root vegetables on Aphids , Plant bugs and Greenhouse whitefly.	M	
Flupyradifurone (Sivanto 200 SL) Bayer	4D	Contact, systemic & ingestion		P		Registered in macadamia for control of Lace bug, Banana spotting bug and suppression of Scirtothrips. [Max. 1 application per crop]. US label approves use in Brassica leafy vegetables for control of Leafhoppers, Aphids and Whiteflies.		

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Green vegetable bug (<i>Nezara viridula</i>)								
Priority: Moderate								
Green vegetable bug was ranked as a moderate priority in VIC, QLD, NSW and WA, and as a low priority in TAS and SA. The pest can leave stink marks in some varieties.								
Maldison (Fyfanon)	1B	Contact & systemic	3	A	ALL	Registered in vegetables for control of Aphids, Green vegetable bug , Jassid, Leaf hopper, Red legged earth mite, Rutherglen bug, Twenty-eight spotted ladybirds. [Apply at first sight of infestation: max no. of applications not specified]	H H-Bees	-
Petroleum oil PER12221	-	Contact & protectant	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug , Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in Brassica leafy vegetables. [Max. no. of applications and re-treatment interval not specified]	-	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug , Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Trichlorfon (TyraneX)	1B	Contact	2	A	ALL	Registered in vegetables for control of Cabbage white butterfly, Cabbage moth, Green vegetable bug and Rutherglen bug. [Apply at first sight of infestation re-treatment interval: 7-10 d]	H VH-Bees	R1
Flonicamid (Mainman) ISK	9C	Systemic		P		Registered in Cucurbits for control of Aphids and Silverleaf whitefly; Aphids in potatoes; Aphids and Mealybugs in apples and pears; Aphids and Mirids in cotton. US label (Beleaf) approves use on legume vegetables on Aphids, Plant bugs and Greenhouse whitefly.	M	
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars.		

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Looper caterpillars (<i>Chrysodeixis spp.</i>)								
Priority: Moderate								
Looper caterpillars were ranked as a moderate priority in VIC, QLD, WA and TAS, and as a low priority in NSW and SA. It is a very seasonal issue and is considered by growers as a secondary pest that is controlled when managing Diamondback Moth (DBM).								
<i>Bacillus thuringiensis subsp. kurstaki</i> (Biocrystal)	11A	Protective biopesticide	NR	A	ALL	Registered in vegetables for control of Armyworm, Cabbage moth, Cabbage white butterfly, Green looper , Lightbrown apple moth, Pear looper , Soybean looper , Vine moth, Tobacco looper and <i>Helicoverpa</i> spp. Most effective on larvae < 8 mm. [Apply a minimum of 2 sprays, 3 d apart: re-treatment interval 3-5 d]	VL	-
Diazinon (Barmac)	1B	Contact & systemic	14	A	ALL	Registered in Kale and Kohlrabi for control of Cabbage white butterfly, Centre grub, Cluster caterpillar, Cabbage aphid, Green peach aphid, and Looper . [Max no. of applications not specified; re-treatment interval 7-1 d]	H H-Bees	R3
Emamectin (Proclaim Opti)	6	Ingestion & contact	3 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, <i>Helicoverpa</i> spp., Cabbage white butterfly, Cluster caterpillar and Vegetable looper . [Max 4 applications per crop; re-treatment interval 7 d; Use subject to CropLife resistant management strategy]	M H-Bees	-
Emamectin (Proclaim) PER14907	6	Ingestion & contact	1 NG	A	ALL (excl. VIC)	PER14907 for control of Diamondback moth, <i>Helicoverpa</i> , Cabbage white butterfly and Vegetable looper in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Spinetoram (Success Neo)	5	Contact & ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers , Cluster caterpillar, Western flower thrips, and <i>Helicoverpa</i> spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-
Indoxacarb + Novaluron (Plemax) Adama	22A+15			P		Registration pending for control of Lepidoptera including <i>Helicoverpa</i> spp. Registered in South Africa on a range of crops for Lepidoptera control.		R3

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .		
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera . Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
Thrips (<i>Thrips spp.</i>) Plague thrips (<i>T. imagines</i>)								
Priority: Moderate								
Plague thrips was ranked as a moderate priority in QLD, WA and SA, and as a low priority in VIC, NSW and TAS. The pest attack can leave marks on the leaves which can affect consumer appeal.								
Alpha-cypermethrin (various) PER81702	3A	Contact & systemic	1	A	ALL (excl. VIC)	Control of Plague thrips and Redlegged earth mite in Brassica leafy vegetables. [Max. 2 applications per crop; re-treatment interval 7 d]	VH	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max. 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Imidacloprid (Confidor 200SC) PER14584	4A	Contact & systemic	3	A	ALL (excl. VIC)	Control of Aphids, Whitefly, and Thrips (except Western flower thrips) in Brassica leafy vegetables. [Apply at first sight of infestation: max no. of applications not specified]	M M-Bees	R2
Petroleum oil PER12221	-	Contact & protectant	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in Brassica leafy vegetables. [Max. no. of applications and re-treatment interval not specified]	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly, Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips . [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Spinetoram (Success Neo)	5	Contact & ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips , and <i>Helicoverpa</i> spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-
<i>Beauveria bassiana</i> (Broadband OD / Velifer) BASF	UNF	Biological	NR	P-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]	VL	-
Spirotetramat (Movento 240 SC) Bayer	23	Contact & systemic		P-A		Registered in Brassica Leafy Vegetables for control of Green peach aphid, Grey cabbage aphid, Silverleaf whitefly & Diamondback moth. Currently registered in other vegetables for control of Plague Thrips, Western Flower Thrips and Tomato Thrips . IPM compatible.	M	
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips , bugs and caterpillars.		
Rutherglen bug (<i>Nysius vinitor</i>)								
Priority: Moderate								
Rutherglen bug (RGB) was ranked as a moderate priority in VIC, NSW, TAS and SA, and as a high priority in QLD and WA. Considered to be an issue for cabbage growers as the pest seems to hide in the crop. It is claimed to be very seasonal and fluctuates from season to season.								
Maldison (Fyfanon)	1B	Contact & systemic	3	A	ALL	Registered in vegetables for control of Aphids, Green vegetable bug, Jassid, Leaf hopper, Red legged earth mite, Rutherglen bug , Twenty-eight spotted ladybirds. [Apply at first sight of infestation: max no. of applications not specified]	H H-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Petroleum oil PER12221	-	Contact & protectant	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in Brassica vegetables. [Max. no. of applications and re-treatment interval not specified]	-	-
Pyrethrins (Pyganic)	3A	Contact	NR	A	ALL	Registered in Brassica leafy vegetables for control of Rutherglen bug . Clean-up spray prior to harvest. [Max 3 applications; re-treatment:3 d]	VH H- Bees	-
Sulfoxaflor (Transform)	4C	Systemic	3	A	ALL	Registered in leafy vegetables for control of Green peach aphid, Brown sowthistle aphid, Turnip aphid, Cabbage aphid, Rutherglen bug and Greenhouse whitefly. (Field situations only). [Max no. of applications not specified; re-treatment interval 7-10 d;]	M VH- bees	-
Trichlorfon (Tyranex)	1B	Contact	2	A	ALL	Registered in vegetables for control of Cabbage white butterfly, Cabbage moth, Green vegetable bug and Rutherglen bug . [Apply at first sight of infestation re-treatment interval: 7-10 d]	H VH- Bees	R1
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars.		
Silverleaf whitefly (<i>Bemisia tabaci</i>)								
Priority: Moderate								
Silverleaf whitefly was ranked as a moderate priority in VIC, QLD, NSW and WA, and as a low priority in TAS and SA. Considered to be a Summer issue with humidity.								
Afidopyropen (Versys)	9D	Disrupts feeding	1	A	ALL	Registered in Brassica leafy vegetables for control of Cabbage aphid and suppression of Silverleaf whitefly . Field use with ground-based spraying only. [Max 4 applications per crop – only 2 consecutive; re-treatment interval 14 d]	L	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact and systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly . [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH- Bees	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Imidacloprid (Confidor) PER14584	4A	Contact and systemic	3	A	ALL (excl. VIC)	PER14584 for control of Aphids, Whitefly and Thrips (except Western flower thrips). [Max no. of applications and re-treatment interval not specified]	M M-Bees	R2
Spirotetramat (Movento 240 SC)	23	Contact and systemic	3	A	ALL	Registered in Brassica leafy vegetables for control of Green peach aphid, Grey cabbage aphid, Diamondback moth and Silverleaf whitefly . (field & protected cropping) Use subject to CropLife resistant management strategy. [Max 2 sprays per crop; re-treatment interval: 7 d]	M	-
Fonicamid (Mainman) ISK	9C	Systemic		P		Registered in Cucurbits for control of Aphids and Silverleaf whitefly ; Aphids in potatoes; Aphids and Mealybugs in apples and pears; Aphids and Mirids in cotton. US label (Beleaf) approves use on legume vegetables on Aphids, Plant bugs and Greenhouse whitefly.	M	
African black beetle (<i>Heteronychus arator</i>)								
Priority: Low								
African black beetle was not ranked in the recent industry survey, but other industry sources indicate that it is a significant issue in Brassica leafy vegetables in certain regions.								
Chlorpyrifos (Sinon) PER14583	1B	Contact and systemic	NR	A	ALL (excl. VIC)	PER14583 for control of African black beetle and Wireworms in Brassica leafy vegetables. [Max no. of applications per crop and re-treatment interval not specified]	H H-Bees	R1
Dazomet (Cerlong)	-	Soil fumigant	NR	A	ALL	Registered in various situations for control of soil fungi, nematodes, soil insects and weeds. Soil moisture is essential for release of gas and plastic cover brings optimum results. See label for details.	-	-
Cyantraniliprole + Thiamethoxam (Spinner) Syngenta	4A+28	Systemic, contact & stomach		P		Registered in Turf for control of caterpillars including cutworms, army worms, African black beetle larvae , Argentinian scarab larvae and stem weevil larvae. US label (Minecto Duo) approves use on Brassica, cucurbits, fruiting vegetables, leafy vegetables and tuberous and corm vegetables on a range of insect pests including Army worm, Leaf hoppers, Leaf miners, Diamond back moth and Potato beetle.	M VH-Bees	R2
Imidacloprid (Various)	4A	Systemic		P		Registered in Cucurbits, capsicum and eggplant for control of Green peach aphid and in turf for control of African black beetle . Apply at peak egg hatch.	M M-Bees	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera. Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
NUL3145 Nufarm	TBC			P		New product in development. Nufarm claim activity on various Beetles.		
NUL3445 Nufarm	TBC			P		New active in development. Nufarm claim activity on Beetles.		
SYNFOI21 Syngenta	TBC			P		Product in development. Syngenta claim activity on Beetles.		
Cabbage-centre grub (<i>Hellula hydralis</i>)								
Priority: Low								
Cabbage-centre grub was ranked as a moderate priority in QLD, and as a low priority in VIC, NSW, WA, TAS and SA. Considered by growers as a secondary pest that is controlled when managing Diamondback Moth (DBM).								
<i>Bacillus Thuringiensis</i> var Kurstaki (Btk) (Biocrystal)	11A	Contact	NR	A	ALL	Registered in vegetables for control of all Lepidoptera . Very effective on small caterpillars but needs regular reapplication. UV sensitive.	VL	-
Chlorantraniliprole (Coragen)	28	Contact and systemic	3	A	ALL	Registered in Brassicas for control of Cabbage-centre grub , Cabbage cluster caterpillar, Cabbage leafminer, Cabbage white butterfly, Cluster caterpillar, Diamondback moth, Soybean looper and <i>Helicoverpa</i> spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d]	L	-
Diazinon (Barmac)	1B	Contact and systemic	14	A	QLD	Registered in Kale and Kohlrabi for control of Cabbage white butterfly, Centre grub , Cluster caterpillar, Cabbage aphid, Green peach aphid, and Looper. [Max no. of applications not specified; re-treatment interval 7-10 d]	H H-Bees	R3
Esfenvalerate (Flex)	3A	Contact and systemic	2	A	QLD, NSW & WA	Registered in Kale and kohlrabi for control of Cabbage moth, Cabbage white butterfly, Cabbage centre grub , and <i>Helicoverpa</i> spp. Apply when pests first appear. [Max no. of applications not specified; re-treatment interval 7-10 d]	VH	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly, Cabbage moth, Cabbage centre grub , Caterpillars, Potato moth and Thrips. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact and systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub , Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Methoxyfenozide (Prodigy) Corteva	18	Insect growth regulator		P		Controls a range of Lepidoptera pests. Registrations and permits to control Lepidoptera pests in various vegetables including fruiting vegetables and lettuce. IPM compatible.	L	-
Spinosad (Entrust Organic) Corteva	5	Contact and ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
Cabbage cluster caterpillar (<i>Crocidolomia pavonana</i>)								
Priority: Low								
Cabbage cluster caterpillar was ranked as a moderate priority in QLD, and as a low priority in VIC, NSW, WA, TAS and SA.								
It is also considered by growers as a secondary pest that is controlled when managing Diamondback Moth (DBM).								
Chlorantraniliprole (Coragen)	28	Contact & systemic	3	A	ALL	Registered in Brassicas for control of Cabbage-centre grub, Cabbage cluster caterpillar , Cabbage leafminer, Cabbage white butterfly, Cluster caterpillar, Diamondback moth, Soybean looper and <i>Helicoverpa</i> spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d]	L	-
Diazinon (Barmac)	1B	Contact & systemic	14	A	QLD	Registered in Kale and Kohlrabi for control of Cabbage white butterfly, Centre grub, Cluster caterpillar , Cabbage aphid, Green peach aphid, and Looper. [Max no. of applications not specified; re-treatment interval 7-10 d]	H H-Bees	R3
Prothiofos (Tokuthion)	1B	Contact & systemic	7	A	ALL	Registered in Kale and Chinese cabbage for the control of Cabbage white butterfly, Cabbage moth, Cluster caterpillar , and <i>Helicoverpa</i> spp. Apply when pests are first seen. [Max no. of applications not specified; re-treatment interval: 7 d]	H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar , Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Indoxacarb + Novaluron (Plemax) Adama	22A+15			P		Registration pending for control of Lepidoptera including <i>Helicoverpa</i> spp. Registered in South Africa on a range of crops for Lepidoptera control.		R3
Methoxyfenozide (Prodigy) Corteva	18	Insect growth regulator		P		Controls a range of Lepidoptera pests. Registrations and permits to control Lepidoptera pests in various vegetables including fruiting vegetables and lettuce. IPM compatible.	L	-
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .		
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera . Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
Cabbage white butterfly (<i>Pieris rapae</i>)								
Priority: Low								
Cabbage white butterfly was ranked as a high priority in TAS, a moderate priority in NSW, and as a low priority in VIC, QLD, WA and SA. Considered by growers as a secondary pest that is controlled when managing Diamondback Moth (DBM).								
Chlorantraniliprole (Coragen)	28	Contact and systemic	3	A	ALL	Registered in Brassicas for control of Cabbage-centre grub, Cabbage cluster caterpillar, Cabbage leafminer, Cabbage white butterfly , Cluster caterpillar, Diamondback moth, Soybean looper and <i>Helicoverpa</i> spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d]	L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Cypermethrin (CyruX)	3A	Contact and systemic	1	A	ALL	Registered in Kale, Kohlrabi and Chinese cabbage for control of Cabbage white butterfly , Cabbage moth, Cluster caterpillar, and <i>Helicoverpa</i> spp. [Max no. of applications not specified; re-treatment interval 7-10 d]	VH	-
Diazinon (Barmac)	1B	Contact and systemic	14	A	QLD, NSW, SA, WA & VIC	Registered in Kale and Kohlrabi for control of Cabbage white butterfly , Centre grub, Cluster caterpillar, Cabbage aphid, Green peach aphid, and Looper. [Max no. of applications not specified; re-treatment interval 7-10 d]	H H-Bees	R3
Emamectin (Proclaim Opti)	6	Ingestion and contact	3 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, <i>Helicoverpa</i> spp., Cabbage white butterfly , Cluster caterpillar and Vegetable looper. [Max 4 applications per crop; re-treatment interval 7 d; Use subject to CropLife resistant management strategy]	M H-Bees	-
Emamectin (Proclaim) PER14907	6	Ingestion and contact	1 NG	A	ALL (excl. VIC)	PER14907 for control of diamondback moth, <i>Helicoverpa</i> , Cabbage white butterfly and Vegetable looper in Brassica leafy vegetables. [Max 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Esfenvalerate (Flex)	3A	Contact and systemic	2	A	QLD, NSW & WA	Registered in Kale and kohlrabi for control of Cabbage moth, Cabbage white butterfly , Cabbage centre grub, and <i>Helicoverpa</i> spp. Apply when pests first appear. [Max no. of applications not specified; re-treatment interval 7-10 d]	VH	-
Flubendiamide (Belt)	28	Contact and systemic	1 NG	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly , Cluster caterpillar, <i>Helicoverpa</i> spp. and Soybean looper. [Max 3 applications per crop; re-treatment interval 7-14 d]	-	-
Prothiofos (Tokuthion)	1B	Contact and systemic	7	A	ALL	Registered in Kale and Chinese cabbage for the control of Cabbage white butterfly , Cabbage moth, Cluster caterpillar, and <i>Helicoverpa</i> spp. Apply when pests are first seen. [Max no. of applications not specified; re-treatment interval: 7 d]	H	R3
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly , Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Spinetoram (Success Neo)	5	Contact and ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly , Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips, and <i>Helicoverpa</i> spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact and systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly , Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid, Western flower thrips, Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2
Trichlorfon (TyraneX)	1B	Contact	2	A	ALL	Registered in vegetables for control of Cabbage white butterfly , Cabbage moth, Green vegetable bug and Rutherglen bug. [Apply at first sight of infestation re-treatment interval: 7-10 d]	H H-Bees	R1
Indoxacarb + Novaluron (Plemax) Adama	22A+15			P		Registration pending for control of Lepidoptera including <i>Helicoverpa</i> spp. Registered in South Africa on a range of crops for Lepidoptera control.		R3
Spinosad (Entrust Organic) Corteva	5	Contact and ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .		
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera. Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	
NUL3445 Nufarm	TBC			P		New active in development, with bananas currently in scope. Nufarm claim activity on Lepidoptera.		

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Redlegged earth mite (<i>Halotydeus destructor</i>)								
Priority: Low								
Redlegged earth mite was ranked as a moderate priority in TAS, and as a low priority in VIC, QLD, NSW, WA and SA. It is not an issue in in Wombok or in protected cropping systems.								
Alpha-cypermethrin (various) PER81702	3A	Contact & systemic	1	A	ALL (excl. VIC)	Control of Plague thrips and Redlegged earth mite in Brassica leafy vegetables. [Max. 2 applications per crop; re-treatment interval 7 d]	VH H-Bees	-
Maldison (Fyfanon)	1B	Contact & systemic	3	A	ALL	Registered in vegetables for control of Aphid, Green vegetable bug, Jassid, Leaf hopper, Redlegged earth mite , Rutherglen bug, Twenty-eight spotted ladybirds. [Apply at first sight of infestation: max no. of applications not specified]	H H-Bees	-
Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta	12A+28			P		Registration is progressing (Syngenta) for control of Heliothis, Potato moth, Cucumber moth, Cluster caterpillar, Aphids and Mites in fruiting vegetables and Cucurbits.	M VH-Bees	
Esfenvalerate (Sumi-Alpha Flex) Sumitomo	3A	Contact & ingestion		P		Registered in Faba beans and broad beans for control of Thrips, Redlegged earth mite , Blue oat mite and Helicoverpa. Repeat if necessary. [Max no. of applications and re-treatment interval not specified]	VH H-Bees	-
Lambda-Cyhalothrin (Indogulf) Indogulf Cropsciences	3A	Contact & systemic		P		Registered in Faba beans for control of Redlegged earth mite and Blue oat mite, Cutworms and Helicoverpa. Repeat if necessary. [Max no. of applications and re-treatment interval not specified]	VH H-Bees	-
Symphyla (<i>Hanseniella</i> spp. and <i>Scutigerella immaculate</i>)								
Priority: Low								
Symphyla were not ranked in the industry survey, but other industry sources indicate that it is a significant issue in Brassica leafy vegetable crops in some States.								
Chloropicrin + 1,3-dichloropropene (Tri-Form)	-	Soil fumigant	NR	A	ALL Restricted use TAS, VIC & SA	Registered in vegetable crops for control of plant parasitic nematodes, Symphyla , Wireworms, soil borne diseases (including <i>Fusarium</i> and <i>Verticillium</i> wilts, <i>Rhizoctonia</i> , <i>Pythium</i>) and suppression of weeds. Restricted chemical. [Users may require fumigator licence]	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Bifenthrin (Talstar) FMC	3A	Contact & ingestion		P		PER82039 is approved for control of Symphyla in Cabbage, Cauliflower and Chinese cabbage. [Max. 1 application per crop].	VH H- Bees	R3
Two-spotted mite (<i>Tetranychus urticae</i>)								
Priority: Low								
Two-spotted mite was consistently ranked as a low priority in VIC, QLD, NSW, WA, TAS, and SA. Some kale growers in QLD have ranked it as a high priority issue.								
<i>Beauveria bassiana</i> (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	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]	VL	-
Abamectin (Various)	6	Contact		P		Registered in apples and pears for control of Two-spotted mite and European red mite. [Max. no. of applications and re-treatment interval not specified]	M H- Bees	-
Acequinocyl (Kenemite) Arysta	20B	Contact & ingestion		P		Registration is progressing (Arysta) for use in pome and stone fruit for control of mites. Registered in Canada for control of Two-spotted, spider mite and Spruce spider mites in greenhouse ornamentals, and Two-spotted spider mite in greenhouse tomato, pepper, eggplant and cucumber.		
Etoxazole (Paramite) Sumitomo	10B	Contact & translaminar		P		Registered in stone fruit, pome fruit, tomato, capsicum etc. for control of Two-spotted mites .		
Hexythiazox (Calibre) Nippon Soda	10A	Contact & stomach		P		Registered in stone fruit, pome fruit and strawberries for control of Two-spotted mites .		
Spiromesifen (Oberon) Bayer	23	Non-systemic		P		Australian Registration pending for control of Mites . Hort Innovation is undertaking data generation projects across multiple commodities for a new label registration in Australia.		

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Vegetable leaf miner (<i>Liriomyza sativae</i>)								
Priority: Low								
Liriomyza leafminers are serious horticultural pests, causing severe yield losses and quality downgrades. The Vegetable leafminer (<i>Liriomyza sativae</i>) is currently confined to the northern tip of Cape York Peninsula. Future outbreaks of Vegetable leafminer or other exotic Liriomyza species could potentially occur in any jurisdiction.								
Rotenone (Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly, Cabbage moth, Cabbage-centre grub, Caterpillars, Potato moth (Leaf miner) and Thrips. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Abamectin (Vertimec) PER81876 Syngenta	6	Contact		P		PER81876 for control of Vegetable leaf miner (<i>Liriomyza</i> spp.) in leafy vegetables (except lettuce). [max 2 application per crop; re-treatment interval: 7-14 d]	M	-
Chlorantraniliprole (Coragen) FMC	28	Contact & systemic		P		Registered in Brassica leafy vegetables for control of Cabbage-centre grub, Cabbage cluster caterpillar, Cabbage leafminer (<i>Liriomiza brassicae</i>), Cabbage white butterfly, Cluster caterpillar, Diamondback moth, Soybean looper and <i>Helicoverpa</i> spp. [Max of 3 sprays per crop; max 2 consecutive; Re-treatment interval 7 d].	L	-
Cyantraniliprole + Thiamethoxam (Spinner) Syngenta	4A+28	Systemic, contact & stomach		P		Registered in Turf for control of Caterpillars including Cutworms and Army worms, African black beetle larvae, Argentinian scarab larvae and stem weevil larvae. US label (Minecto Duo) approves use on Brassica, cucurbits, fruiting vegetables, leafy vegetables and tuberous and corm vegetables on a range of insect pests including Army worm, Leaf hoppers, Leaf miners , Diamond back moth and Potato beetle.	M VH-Bees	R2
Cyromazine (Diptex) PER81867 Agrocare	17	Contact		P		PER81867 for control of Leafminer (<i>Liriomyza sativae</i>) in broccoli, fruiting vegetables, legume vegetables, root and tuber vegetables and stalk and stem vegetables (field & protected cropping). [Max. 6 applications per crop; re-treatment interval: 7 d]. Cyromazine is registered for control of Sciarid and Phorid fly larvae in mushroom compost.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Emamectin (Proclaim Opti) PER87563 Syngenta	6	Contact & systemic		P		PER87563 for control of Vegetable leaf miner (<i>Liriomyza</i> spp.) in Brassica vegetables. [Max. 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Spinosad (Entrust Organic) Corteva	5	Systemic		P		Pending re-registering for control of various Lepidoptera species.		
Spinetoram (Delegate) PER87878	5	Contact and ingestion		P		PER87878 for control of Vegetable leaf miner in snow and sugar snap peas. [Max 3 applications per crop; re-treatment interval: 7-14 d]	M	-
Spirotetramat (Movento) Bayer	23	Contact and systemic		P		Permit pending for control of Vegetable leaf miner in various vegetables other than Brassica Leafy Vegetables.	M	-
Western flower thrips (<i>Frankliniella occidentalis</i>)								
Priority: Low								
Western flower thrips was ranked as a moderate priority in VIC and SA, and as a low priority in QLD, NSW, WA and TAS. Some kale growers in (QLD have ranked it as a high priority issue.								
Abamectin (Vantal)	6	Contact	21	A	ALL	Registered in Brassica leafy vegetables for control of Western flower thrips . [max 2 application per crop; re-treatment interval: 28 d]	M	-
<i>Beauveria bassiana</i> (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	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]	VL	-
Thiamethoxam + Chlorantraniliprole (Durivo)	4A+28	Contact & systemic	42	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Green vegetable bug, Cabbage aphid, Green peach aphid Western flower thrips , Onion thrips and Silverleaf whitefly. [max 1 application per crop; seedlings should be transplanted within 48 h of application]	L-H VH-Bees	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly, Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips . [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Spinetoram (Success Neo)	5	Contact and ingestion	3	A	ALL	Registered in Brassica leafy vegetables for control of Diamondback moth, Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips , and <i>Helicoverpa</i> spp. [Max 2 applications per crop; re-treatment interval: 7-14 d]	M	-
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Pending re-registering for control of various Lepidoptera species.	L	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips , Bugs and Caterpillars.		
Fall Armyworm (<i>Spodoptera frugiperda</i>)								
Priority: New Pest to Australia (unknown priority)								
Fall army worm was not ranked as a pest in Brassica leafy vegetables. It is an exotic pest that is considered a potential threat that could affect most vegetable crops if allowed to spread. If incursions occur, valid permits are in place for its control.								
Chlorantraniliprole (Coragen) PER89259	28	Systemic	1	A	ALL (excl. VIC)	PER89259 for control of Fall Armyworm in Field peas, Faba beans, Brassica vegetables, Brassica leafy vegetables, Stalk and stem vegetables, Leafy vegetables, Fruiting vegetables (including cucurbits), Legume vegetables, Potatoes Sweet corn and Lettuce. [Max. 3 applications per crop; 2 consecutive; re-treatment interval 7 d]	L	-
Chlorantraniliprole + Thiamethoxam (Durivo) PER89280	28+4A	Contact and systemic	42	A	ALL (excl. VIC)	PER89280 for control of Fall Armyworm in Brassica vegetables, Brassica leafy vegetables and Fruiting vegetables excluding cucurbits. Do not transplant seedlings treated by seedling drench into hydroponic production systems. [max 1 application per crop]	L-H H-Bees	R2
Emamectin (Proclaim Opti) PER89263	6	Contact and systemic	3 NG	A	ALL (excl. VIC)	PER8963 for control of Fall Armyworm in Brassica vegetables, Root and tuber vegetables, (except potato) Leafy vegetables, Brassica leafy vegetables, (field only); Fruiting vegetables, sweet corn, legume vegetables and fruiting vegetables (field grown and protected cropping). [Max. 4 applications per crop; re-treatment interval 7-14 d]	M H-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on Beneficials	Regulatory risk
Emamectin (Proclaim Opti) PER89285	6	Contact and systemic	3 NG	A	ALL (excl. VIC)	PER89285 for control of Fall Armyworm in Brassica vegetables, Root and tuber vegetables, (except potato) Leafy vegetables, Brassica leafy vegetables, Sweet Corn, Lettuce, Cucurbits, Legume vegetables and Fruiting vegetables (protected cropping). [Max 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-
Indoxacarb (Avatar) PER89278	22A	Contact	3	A	ALL (excl. VIC)	PER89278 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. [Max. 4 applications per crop; re-treatment interval 7 d]	L H-Bees	R3
Methomyl (Lannate) PER89293	1A	Contact and systemic	14	A	ALL	PER89293 for control of Fall Armyworm in Spinach, Fennel, Brassica leafy vegetables, Bulb onions, Fennel bulb, Leeks & turf. Field grown only. [Max. 3 application per crop; re-treatment interval not specified]	H H-Bees	R2
Spinetoram (Delegate & Success Neo) PER89241	5	Contact and ingestion	3	A	ALL (excl. VIC)	PER89241 for control of Fall Armyworm in Sweet corn, Brassica vegetables, Brassica leafy vegetables, Stalk and stem vegetables, Leafy vegetables, Fruiting vegetables (including cucurbits), Legume vegetables, Stalk and stem vegetables, Culinary herbs, Root and tuber vegetables and several fruits. [Max. 4 applications per crop; re-treatment interval 7-14 d]	M	-
Broflanilide (Vedira) BASF	30	Contact and 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 <i>Spodoptera</i> spp. BASF are seeking registrations in amenity turf initially, then potential horticultural crops thereafter.	H VH-Bees	-
Spinosad (Entrust Organic) Corteva	5	Contact and ingestion		P		Pending re-registering for control of various Lepidoptera species.	L H-Bees	-
SYNFOI21 (Syngenta)	TBC			P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars .	-	
Tetranilprole (Vayego) Bayer	28	Disrupts feeding		P		Bayer is proceeding with registration in Australia in multiple crops for various insect pests such as beetles, weevils & Lepidoptera. Hort Innovation has several projects underway towards assisting registration in minor crops.	M VH-Bees	-

4.3 Weeds in Brassica leafy vegetables

4.3.1 Weed priorities

There were no weeds ranked as priorities in the most recent survey (2019).

Other weeds nominated	State
Annual rye grass (<i>Lolium rigidum</i>)	VIC
Brassica weeds (<i>Brassica</i> spp.)	QLD
Capeweed (<i>Arctotheca calendula</i>)	VIC
Chickweed (<i>Stellaria media</i>)	VIC & QLD
Fat hen (<i>Chenopodium album</i>)	QLD
Fleabane (<i>Conyza</i> spp.)	QLD
Groundsel (<i>Senecio</i> spp.)	VIC
Marshmallow (<i>Malva parviflora</i>)	QLD
Nutgrass (<i>Cyperus rotundus</i>)	VIC & QLD
Pigweed (<i>Portulaca oleracea</i>)	LD
Stinging nettle (<i>Urtica</i> spp.)	VIC
Wireweed (<i>Polygonum aviculare</i>)	VIC

These weeds can be controlled with currently available herbicides as identified in section 4.3.2. Whilst there are options available for general weed knockdown during ground preparation and pre-emergent control prior to transplanting, post-emergent options in general and options available for direct seeded Brassica leafy vegetable crops are extremely rare.

Growing weed resistance is a problem. For example, wild radish populations have developed resistance to herbicides in the mode-of-action (MOA) Groups B, C, F and I. Group B resistance is the most common, followed by Group F.

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		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) – days from last treatment		Resistance risk	
Harvest	H	**	Moderate resistance risk
Not Required when used as directed	NR	***	High resistance risk

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Chlorthal-dimethyl (Pterodactyl)	D**	Asian brassicas, kale and Brassica leafy vegetables / Pre-emergent	Registered in Brassica leafy vegetables for control of many broadleaf weeds and some grass weeds. Spray at time of seeding or transplanting. [Max. no. of applications and re-treatment interval not specified]	NR NG	A	ALL	-
Clethodim (Arysta) PER82459	A***	Brassica leafy vegetables, Field and protected/post-emergent	PER82459 for use in Brassica leafy vegetables for control of various grass weeds. [Max. 1 application per crop].	14	A	ALL	R3
Fluazifop-P-Butyl (Fusilade) PER81244	A***	Brassica leafy vegetables/field only/post-emergent	PER81244 for use in Brassica leafy vegetables for control of various grass weeds as specified on the approved label. Spray at 3-leaf stage of crop. [Max. 1 application per crop].	H:28 G:28	A	ALL (excl. VIC)	-
Glyphosate (various)	M**	General knockdown. Pre-crop spray	Registered for control of general weeds as a pre-crop spray	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Paraquat +/- diquat (Agro-Essence)	L**	Vegetables/General seed bed preparation / Post-emergence inter-row weed control	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no. of applications not specified]	H:1 G:1	A	ALL	R3
Pendimethalin (various) PER14127	D**	Brassica leafy vegetables/ (various varieties, refer to permit)	PER14127 for use in Brassica leafy vegetables for control of weeds as listed on table D of the product labels. Make one application per crop. Apply 2-7 days before transplanting. [Max. 1 application per crop].	NR	A	ALL (excl. VIC)	-
Propachlor (Ramrod) PER12008	K**	Brassica leafy vegetables/pre-emergent	PER12008 for use in Brassica leafy vegetables for control of annual grasses and broadleaf weeds as per product label. Spray immediately after seeding or transplanting. [Max no. of applications not specified]	NR	A	ALL (excl. VIC)	-
S-Metolachlor (Dual Gold) PER13154	K**	Brassica leafy vegetables/ pre-emergent	PER13154 for use in Brassica leafy vegetables for control of selected grasses and broadleaf weeds as per the label for Brassicas. Apply immediately after transplanting. [Max. 1 application per crop]	NR	A	ALL	-
Pendimethalin (Stark) PER14127	D**	Brassica leafy vegetables/ pre-emergent / grass and broadleaf	PER14127 for use in Brassica leafy vegetables for control of selected grasses and broadleaf weeds as per the label for Brassicas. Apply 2-7 d before transplanting. [Max. 1 application per crop]	NR	A	ALL (excl. VIC)	-
Pyraflufen-ethyl (Sledge)	G**	General pre-plant fallowing agent/post-emergent	Registered for control of number of broadleaf and grass weeds. Apply prior to sowing winter crops or starting a winter fallow. Apply to growing weeds at 2-6 leaf stage. Do not sow crops for a minimum of 1 hour after application.	7	A	ALL	-
S-Metolachlor (Dual Gold) Syngenta	K**	Brassica vegetables/ pre-emergent	Registered in Brassica vegetables for control of several grass and broadleaf weeds. PER13154 allows use in Brassica leafy vegetables for control of selected grasses and broadleaf weeds as per the label for Brassicas.		P-A		

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Pendimethalin (Stark) Ruralco Holdings	D**	Brassica leafy vegetables/ pre-emergent / grass and broadleaf	Registered in Brassica vegetables for control of various grasses and broadleaf weeds . PER14127 allows use in Brassica leafy vegetables for control of weeds as listed on table D of the product labels.		P-A		-
Propachlor (Ramrod) Nufarm	K**	Brassica vegetables/pre-emergent	Registered in Brassica vegetables for control of annual grasses and broadleaf weeds as per product label. PER12008 allows use in Brassica leafy vegetables. Spray immediately after seeding or transplanting. [Max no. of applications not specified]		P-A		-
Pendimethalin + Dimethenamid (Podium) BASF	D+K**	Ornamental plants & recreational turf / pre-emergent /grass and broadleaf	Registered in ornamentals & recreational turf for control of grass and broadleaf weeds [Max. no. of applications not specified; re-treatment interval 60 – 90 d]		P		-
<p>Annual rye grass (<i>Lolium rigidum</i>) (VIC), Brassica weeds (<i>Brassica</i> spp.) (QLD), Capeweed (<i>Arctotheca calendula</i>) (VIC), Chickweed (<i>Stellaria media</i>) (VIC & QLD), Fat hen (<i>Chenopodium album</i>) (QLD), Fleabane (<i>Conyza</i> spp.) (QLD), Groundsel (<i>Senecio</i> spp.) (VIC), Marshmallow (<i>Malva parviflora</i>) (QLD), Nutgrass (<i>Cyperus rotundus</i>) (VIC & QLD), Pigweed (<i>Portulaca oleracea</i>) (QLD), Stinging nettle (<i>Urtica</i> spp.) (VIC) and Wireweed (<i>Polygonum aviculare</i>) (VIC).</p>							
<p>The above weeds were issues in one or two States. Managing these would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.</p>							
2,4-D Acid (Farmalinx)	I**	Post-emergent spot spray/selective	Registered for spot spraying on all situations for control of a range of weeds including Nutgrass . Thorough wetting of weed essential. [Spray within 4 weeks of foliage emergence; repeat if necessary].	NR	A	ALL	-
Chlorthal-Dimethyl (AgProject)	D**	Brassica leafy vegetables / pre-emergent	Registered in Brassica leafy vegetables for control of various grass weeds including Ryegrass and broadleaf weeds including Cape weed, Chickweed, Fat hen, Pigweed, Stinging nettle and Wireweed . Spray at transplanting.	NR	A	ALL	-
Glyphosate (various)	M**	General knockdown. Pre-crop spray	Registered for control of general weeds as a pre-crop spray	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Linuron (4Farmers) 4Farmers	C**	Carrots / pre-emergent	Registered in potatoes for control of a range of broadleaf weeds including Fat hen and Pigweed .		P		
Metolachlor+ Prosulfocarb (Boxer Gold) Syngenta	J+K**	Potatoes / Pre-emergent weed control	Registered in potatoes for control of Ryegrass . Apply after planting, but no later than 25% potato shoot emergence. Hort Innovation is progressing to undertake the required studies in carrots for a label registration		P		
Norflurazon (Zoliar) Agnova	F**	asparagus, citrus, grapes, nuts, stone and pome fruits / pre-emergent / grass and broadleaf	Registered in asparagus, citrus, grapes, nuts, stone and pome fruits for control of grass and broadleaf weeds including Nut grass . [Max. 2 applications per year; re-treatment interval not specified].		P		
Pendimethalin (Stark) Ruralco Holdings	D**	Carrots, beans, Brassica vegetables/ pre-emergent / grass and broadleaf	Registered in wheat, barley, chickpeas, faba beans, safflower, lupins and field peas for control of Annual ryegrass . Registered in carrots and Brassica vegetables for control of various grasses and broadleaf weeds.		P		
Pendimethalin + Dimethenamid (Podium) BASF	D+K**	Ornamental plants & recreational turf / pre-emergent /grass and broadleaf	Registered in ornamentals & recreational turf for control of grass and broadleaf weeds [Max. no. of applications not specified; re-treatment interval 60 – 90 d]		P		
Propachlor (Ramrod) Nufarm	K**	Brassicas/ Selective pre-emergent	Registered in Brassica vegetables for control of several broadleaf and grass weeds including Fat hen . Spray at time of seeding or transplanting.		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.comlaw.gov.au/Series/F2012L02501
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 2018-19	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/

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 Brassica leafy vegetables

Appendix 2. Products available for control of insects, mites and other invertebrates in Brassica leafy vegetables

Appendix 3. Products available for weed control in Brassica leafy vegetables

Appendix 4. Current permits for use in Brassica leafy vegetables

Appendix 5. Brassica Leafy Vegetable Maximum Residue Limits (MRLs)

Appendix 6. Brassica Leafy Vegetable regulatory risk assessment

Appendix 1. Products available for disease control in Brassica leafy vegetables

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
1,3-dichloropropene (Tri-Form)	-	Field crops -soil fumigant	Soil borne diseases, plant parasitic nematodes. Restricted chemical.	ALL	NR	-
Azoxystrobin (Amistar)	11	Brassica leafy vegetables	Alternaria leaf spot, White blister and Sclerotinia rot	ALL	7	-
Azoxystrobin + oxathiapiprolin (Orondis)	11+49	Brassica leafy vegetables	Downy mildew and suppression of Alternaria and sclerotinia.	ALL	42 NG	-
<i>Bacillus amyloliquefaciens</i> strain QST 713 (Serenade Opti) PER87630	44	Brassica leafy vegetables	Suppression of Bacterial spot/blight (<i>Xanthomonas</i> spp.)	ALL (excl. VIC)	NR	-
Boscalid (Filan)	7	Leafy vegetables (including Brassica leafy vegetables)	Sclerotinia rot	ALL	7	-
Chloropicrin (Tripicrin)	8A	General pre-plant soil fumigation	Nematodes, insects, <i>Pythium</i> , <i>Phytophthora</i> , <i>Fusarium</i> , and <i>Verticillium</i> .	ALL	NR	-
Chlorothalonil (Bravo) PER82895	M5	Brassica leafy vegetables (Various types, refer to permit) Field only	Downy mildew, Alternaria leaf blight, Cercospora and Botrytis grey mould	ALL (excl. VIC)	7	R3
Copper oxychloride (Uniguard)	M1	<i>Brassica</i> spp.	Black rot, Peppery leaf spot, Ring spot, and Downy mildew	ALL	1	-
Copper products (various) PER14038	M1	Brassica leafy vegetables (<i>Brassica</i> spp.)	Downy mildew	ALL (excl. VIC)	1	-
Cupric Hydroxide + Mancozeb (ManKocide)	M1+M3	<i>Brassica</i> spp.	Downy mildew Black rot, Alternaria, Ring spot, and Anthracnose	ALL	7 NG	R2
Cyazofamid (Ranman)	21	Brassica leafy vegetable seedlings	Downy mildew	ALL	NR NG	-
Cyprodinil + fludioxonil (Switch)	9+12	Asian leafy greens, Chinese cabbage	Sclerotinia	ALL	7	R3

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
Difenoconazole (Score) PER82136	3	Brassica leafy vegetables	Ring spot (<i>Mycosphaerella brassicicola</i>)	ALL (excl. VIC)	H:3 NG	R3
Mancozeb (Penncozeb) PER80538	M3	Brassica leafy vegetables	Anthracnose and Septoria	ALL (excl. VIC)	H:14 NG	R2
Mancozeb (Penncozeb) + dimethomorph (Acrobat) PER14958	M3+40	Brassica leafy vegetables	Downy mildew and White blister	ALL (excl. VIC)	H:14 NG	R2
Mancozeb + Metalaxyl-M (Ridomil Gold) PER14045	M3+4	Brassica leafy vegetables	Downy mildew and White blister	ALL (excl. VIC)	14	R2
Mancozeb + Sulphur (Richgro)	M3+UN	Seedlings (general)	Damping off	ALL	7	R2
Mandipropamid (Revus)	40	Brassica leafy vegetables	Downy mildew	ALL	1	-
Metalaxyl + copper as hydroxide (Ridomil Gold Plus)	M1+M3	Brassica leafy vegetables	White blister and Downy mildew	ALL	14	-
Oxathiapiprolin (Zorvec)	49	Brassica leafy vegetables	Downy mildew	ALL	3	-
Penthiopyrad (Fontelis)	7	Brassica leafy vegetables (various varieties, refer to label)	White mould (Sclerotinia stem rot)	ALL	Nil	-
Phosphorous acid (various) PER14184	-	Brassica leafy vegetables (various varieties, refer to permit)	Damping off and Downy mildew	ALL (excl. VIC)	Nil	-
Propamocarb + Fluopicolide (Infinito)	28+43	Brassica leafy vegetables	Downy mildew	ALL	7 NG	-
Propiconazole (Tilt) PER14479	3	Gai lum (Chinese broccoli)	Cercospora leaf spot, Rust, and Septoria leaf spot	ALL	14	-

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
Potassium bicarbonate (Eco-Carb) PER13695	M2	Brassica leafy vegetables (various varieties, refer to permit)	Powdery mildew	ALL (excl. VIC)	NR	-
Zineb (Barmac)	Y	Crucifers	Downy mildew	ALL	7	R2
Zineb (Barmac) PER10845	Y	Crucifers	Cercospora leaf spot and Downy mildew	ALL	10	R2

Appendix 2. Products available for control of insects, mites and other invertebrates in Brassica leafy vegetables

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Abamectin (Vantal)	6	Brassica leafy vegetables	Western flower thrips (field only)	ALL	21	-
Afidopyropen (Versys)	9D	Brassica leafy vegetables	Control of Cabbage aphid and suppression of Silverleaf whitefly. (field only)	ALL	1	-
Alpha-cypermethrin (various) PER81702	3A	Brassica leafy vegetables	Plague thrips (field only)	ALL (excl. VIC)	1	-
<i>Bacillus thuringiensis subsp. kurstaki</i> (Biocrystal)	11A	Vegetables	Armyworm, Cotton bollworm, Native budworm, Cabbage moth, Cabbage white butterfly, Green looper, Lightbrown apple moth, Pear looper, Soybean looper, Vine moth, and Tobacco looper. (field and protected cropping systems)	ALL	NR	-
<i>Bacillus thuringiensis</i> (Xentari WG) PER87670	11A	Vegetables	Diamondback moth, Cabbage white butterfly, Helicoverpa and Vegetable looper	ALL	NR	-
<i>Beauveria bassiana</i> (Broadband OD / Velifer)	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	-
Bifenthrin (Talstar) PER82039	3A	Chinese cabbage	Symphyla <i>Scutigerellidae</i> (<i>Hanseniella</i> spp. and <i>Scutigereilla immaculate</i>) (field only)	NSW	NR	R3
Chlorantraniliprole (Coragen)	28	Brassica leafy vegetables (Various types, refer to label)	Cabbage-centre grub, Cabbage cluster caterpillar, Cabbage leafminer, Cabbage white butterfly, Cluster caterpillar, Cotton bollworm, Diamondback moth, Native budworm, and Soybean looper. (field and protected cropping)	ALL	3	-
Chlorantraniliprole (Coragen) PER89259	28	Brassica leafy vegetables	Fall armyworm (<i>Spodoptera frugiperda</i>) (field and protected cropping)	ALL (excl. VIC)	1	-

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Chlorantraniliprole + thiamethoxam (Durivo)	28+4A	Brassica leafy vegetables	Diamondback moth, Cabbage white butterfly, Corn earworm, Native budworm, Cabbage centre grub, Cabbage cluster caterpillar, Cluster caterpillar, Soybean looper, Cabbage aphid, Green peach aphid, Silverleaf whitefly, Greenhouse whitefly, Green vegetable bug, Western flower thrips, and Onion thrips. (field only)	ALL	42	R2
Chlorantraniliprole + Thiamethoxam (Durivo) PER89280	4A+28	Brassica vegetables	Fall armyworm (<i>Spodoptera frugiperda</i>) (field only) Do not transplant seedlings treated by seedling drench into hydroponic production systems.	ALL (excl. VIC)	42	R2
Chlorpyrifos (Sinon) PER14583	1B	Brassica leafy vegetables At planting	African black beetle, Wireworms and False wireworms. (field only). Do not apply in domestic areas, public places or container/potted plants.	ALL (excl. VIC)	NR	R1
Cypermethrin (CyruX)	3A	Kale and Chinese cabbage	Cabbage white butterfly, Cabbage moth, Cluster caterpillar, and <i>Helicoverpa</i> spp. (field only)	Variable refer to label	1	-
Diazinon (Barmac)	1B	Kale and kohlrabi	Cabbage white butterfly, Centre grub, Cluster caterpillar, Cabbage aphid, Green peach aphid, Cabbage moth, and Looper. (field only)	Variable refer to label	14	R3
Emamectin (Proclaim Opti)	6	Brassica leafy vegetables	Diamondback moth, <i>Helicoverpa</i> spp., Cabbage white butterfly, Cluster caterpillar and Vegetable looper. (field only)	ALL	3 NG	-
Emamectin (Proclaim Opti) PER14907	6	Brassica leafy vegetables	Diamondback moth, <i>Helicoverpa</i> spp., Cabbage white butterfly, and Vegetable looper. (protected cropping)	ALL (excl. VIC)	1 NG	-
Emamectin (Proclaim Opti) PER89263	6	Brassica leafy vegetables, (field only).	Fall armyworm (<i>Spodoptera frugiperda</i>). (field only)	ALL (excl. VIC)	3	-
Emamectin (Proclaim Opti) PER89285	6	Brassica leafy vegetables, (protected cropping)	Fall armyworm (<i>Spodoptera frugiperda</i>) (protected cropping)	ALL (excl. VIC)	3	-

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Esfenvalerate (Flex)	3A	Kale and Kohlrabi	Cabbage moth, Cabbage white butterfly, Cabbage centre grub, and <i>Helicoverpa</i> spp. (field only)	Variable refer to label	2	-
Flubendiamide (Belt)	28	Brassica leafy vegetables (Various types, refer to label)	Diamondback moth, Cabbage white butterfly, Cluster caterpillar, <i>Helicoverpa</i> spp. and Soybean looper. (field & protected cropping systems)	ALL	1	-
Helicoverpa NPV (Helicovex)	31	Brassica leafy vegetables	Cotton bollworm, Corn earworm, Tobacco budworm and Native budworm. (field and protected cropping)	ALL	Nil	-
Imidacloprid (Eureka)	4A	Brassicicas	Grey cabbage aphid and Turnip aphid. (field only)	ALL	7	R2
Imidacloprid (Confidor 200SC) PER14584	4A	Brassica leafy vegetables (various varieties, refer to permit)	Aphids, Whitefly, and Thrips (except Western flower thrips) (field only)	ALL (excl. VIC)	3	R2
Indoxacarb (Avatar)	22A	Kale, bok choy, choy sum, and Chinese cabbage	Cotton bollworm and Native budworm. (field only)	ALL	3	R3
Indoxcarb (Avatar) PER89278	22A	Leafy vegetables and Chinese leafy vegetables	Fall armyworm (<i>Spodoptera frugiperda</i>) (field only)	ALL (excl. VIC)	3	R3
Maldison (Fyfanon)	1B	Vegetables	Aphid, Green vegetable bug, Jassid, Leaf hopper, Red legged earth mite, Rutherglen bug and Twenty-eight spotted ladybirds. (field only)	ALL	3	-
Petroleum oil PER12221	-	Brassica leafy vegetables (various varieties, refer to permit)	Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug, and Thrips. (field only)	ALL (excl. VIC)	1	-
Pirimicarb (Aphidex)	1A	Brassica leafy vegetables	Cabbage aphid and Green peach aphid, (field only)	ALL	2	R3
Prothiofos (Tokuthion)	1B	Kale and Chinese cabbage	Cabbage white butterfly, Cabbage moth, Cluster caterpillar, and <i>Helicoverpa</i> spp. (field only)	ALL	7	R3
Pymetrozine (Chess)	9B	Leafy vegetables including Asian Brassica, Chinese cabbage & Kale	Green peach aphid	ALL	3	R3

Active Ingredient (Trade Name)	Chem. group	Situation	Pests / Comments	States	WHP Days	Regulatory risk
Pyrethrins (Pyganic)	3A	Brassica leafy vegetables	Fruit fly, Rutherglen bug & Spiders. Clean-up spray prior to harvest. (field only)	ALL	1	-
Pyrethrins + piperonyl butoxide (Kendon)	3A	Vegetables	Ants, Aphids, Thrips, Caterpillars, Leaf hoppers, and whitefly. (field and protected cropping systems)	ALL	1	-
Rotenone (Amgrow Derris Dust)	21B	Vegetables	Aphids, Cabbage white butterfly, Cabbage moth, Cabbage centre grub, Caterpillars, Potato moth and Thrips. (field only)	ALL	1	-
Spinetoram (Success Neo)	5A	Brassica leafy vegetables	Diamondback moth, Cabbage white butterfly, Cabbage cluster caterpillar, Cabbage centre grub, Loopers, Cluster caterpillar, Western flower thrips, and <i>Helicoverpa</i> spp. (field only)	ALL	3	-
Spinetoram (Success Neo) PER89241	5	Brassica vegetables	Fall armyworm (<i>Spodoptera frugiperda</i>) (field only)	ALL (excl. VIC)	3	-
Spirotetramat (Movento)	23	Brassica leafy vegetables	Green peach aphid, Grey cabbage aphid, Diamondback moth and Silverleaf whitefly (Biotype B) (field and protected cropping systems)	ALL	3	-
Sulfoxaflor (Transform)	4C	Asian leafy greens	Green peach aphid, Brown sowthistle aphid, Turnip aphid, Cabbage aphid, Rutherglen bug and Greenhouse whitefly. (field only)	ALL	3	-
Trichlorfon (Tyranax)	1B	Vegetables	Cabbage white butterfly, Cabbage moth, Green vegetable bug and Rutherglen bug. (field only)	ALL	2	R1

Appendix 3. Products available for weed control in Brassica leafy vegetables

Active ingredient (Trade Name)	Chem. Group	Situation	Comment / Use / Weed	WHP (days)	States	Regulatory risk
2,4-D Acid (Farmalinx)	I**	Post-emergent spot spray/selective	A range of weeds including Nutgrass.	NR	ALL	-
Chlorthal-dimethyl (Pterodactyl)	D**	Asian Brassicas, kale and Brassica leafy vegetables / Pre-emergent	Many broadleaf and some grassweeds	NR NG	ALL	-
Clethodim PER82459	A***	Brassica leafy vegetables (various varieties, refer to permit) Field and protected	Various grass weeds	28	ALL	R3
Fluazifop-P-Butyl (Fusilade) PER81244	A***	Brassica leafy vegetables (various types, refer to permit)	Grass weeds as specified on the approved label	H:28 NG	ALL (excl. VIC)	-
Glyphosate (various)	M**	General seed bed preparation	General weeds as a pre-crop spray	NR	ALL	R3
Metolachlor (Bouncer)	K**	Chinese cabbage / Pre-plant residual	Many broadleaf and some grassweeds. Some crop retardation in Brassicas in soils with low organic matter, refer to label.	NR	WA	-
Paraquat + diquat (various)	L**	General seed bed preparation	General weeds as a pre-crop spray	NR	ALL	R3
Pendimethalin (Stark) PER14127	D**	Brassica leafy vegetables (various varieties, refer to permit)	Weeds as listed on table D of the product labels	NR	ALL (excl. VIC)	-
Propachlor (Ramrod) PER12008	K**	Brassica leafy vegetables (various varieties, refer to permit)	Annual grasses and broadleaf weeds as per product label	NR	ALL (excl. VIC)	-
Pyraflufen-ethyl (Sledge)	G**	General pre-plant following agent/post-emergent	Broadleaf and grass weeds.	7	ALL	-
S-Metolachlor (Dual Gold) PER13154	K**	Brassica leafy vegetables (various varieties, refer to permit)	Selected grasses and broadleaf weeds as per the label for Brassicas	ALL	ALL	-

Appendix 4. Current permits for use in Brassica leafy vegetables

Permit No.	Description	Issued Date	Expiry Date	Permit Holder
PER87630	<i>Bacillus amyloliquefaciens</i> strain QST 713 (Serenade Opti) / Brassica leafy vegetables / Bacterial spot / blight	18-Jun-19	30-Jun-22	Hort Innovation
PER87670	<i>Bacillus thuringiensis</i> (Xentari WG) / Brassica leafy vegetables / Diamond back moth, Cabbage White Butterfly, Helicoverpa & Vegetable Looper	01-Jul-19	31-Jul-24	Hort Innovation
PER82039	Bifenthrin (Talstar) / Chinese cabbage / Symphyla <i>Scutigerellidae</i> (<i>Hanseniella</i> spp. and <i>Scutigera immaculate</i>) (NSW only)	20-Nov-15	30-Sep-23	Hort Innovation
PER89259	Chlorantraniliprole (Coragen) / Various Crops / Fall Armyworm	06-Mar-20	31-Mar-23	Hort Innovation
PER89280	Chlorantraniliprole + Thiamethoxam (Durivo) / Brassicas, Leafy vegetables / Fall armyworm	12-Mar-20	31-Mar-23	Hort Innovation
PER82895 Version 3	Chlorothalonil (Bravo) / Brassica leafy vegetables (Various varieties, refer to permit) Field only / Downy mildew, Alternaria leaf blight, and Botrytis grey mould	04-Aug-17	31-Aug-20 (renewal submitted to APVMA)	Hort Innovation
PER14583 Version 4	Chlorpyrifos / Brassica leafy vegetables / African black beetle, wireworms and false wireworms	01-Apr-14	31-Oct-21	Hort Innovation
PER82459	Clethodim / Brassica leafy vegetables (various varieties, refer to permit), field and protected / Various grass weeds	19-Apr-17	30-Sep-21	Hort Innovation
PER14038 Version 2	Copper products / Brassica leafy vegetables (<i>Brassica</i> spp.) / Downy mildew	01-Apr-13	30-Sep-23	Hort Innovation
PER82136	Difenoconazole (Score) / Brassica leafy vegetables (various varieties, refer to permit) / Ring spot (<i>Mycosphaerella brassicicola</i>)	13-Jul-17	30-Sep-20 (renewal submitted to APVMA)	Hort Innovation
PER14907 Version 3	Emamectin (Proclaim) / Brassica leafy vegetables (various varieties, refer to permit) / Diamondback moth, <i>Helicoverpa</i> spp., cabbage white butterfly, vegetable looper	09-Dec-14	30-Nov-24	Hort Innovation
PER89263	Emamectin (Proclaim Opti) / Various crops / Fall Armyworm	10-Mar-20	31-Mar-23	Hort Innovation
PER89285	Emamectin (Proclaim Opti) / Various crops/ protected cropping / Fall Armyworm	16-Mar-20	31-Mar-23	Hort Innovation
PER81244 Version 3	Fluazifop-P-Butyl (Fusilade) / Brassica leafy vegetables (various varieties, refer to permit) / Grass weeds as specified on the approved label	01-Jul-16	30-Jun-22	Hort Innovation
PER14584 Version 3	Imidacloprid (Confidor 200SC) / Brassica leafy vegetables (various varieties, refer to permit) / Aphids, whitefly, and thrips (except Western flower thrips)	01-Apr-14	31-Jan-24	Hort Innovation

Permit No.	Description	Issued Date	Expiry Date	Permit Holder
PER89278	Indoxacarb (Avatar) / Various Crops / Fall Armyworm	13-Mar-20	31-Mar-23	Hort Innovation
PER80538 Version 2	Mancozeb (Penncozeb) / Brassica leafy vegetables (various varieties, refer to permit) / Anthracnose and Septoria	01-Apr-15	31-Mar-25	Hort Innovation
PER14958 Version 2	Mancozeb (Pebncozeb) + dimethomorph (Acrobat) / Brassica leafy vegetables (various varieties, refer to permit) / Downy mildew and white blister	21-Dec-14	31-Dec-22	Hort Innovation
PER14045 Version 3	Mancozeb + Metalaxyl-M (Ridomil Gold) / Brassica leafy vegetables (various varieties, refer to permit) / Downy mildew and white blister	01-Apr-13	31-Mar-22	Hort Innovation
PER89293	Methomyl (Lannate-L) / Various Crops as per Label / Fall Armyworm	10-Apr-20	30-Apr-23	Hort Innovation
PER14127 Version 3	Pendimethalin (Stark) / Brassica leafy vegetables (various varieties, refer to permit) / Weeds	31-Oct-13	31-Aug-23	Hort Innovation
PER12221 Version 4	Petroleum oil / Brassica leafy vegetables (various varieties, refer to permit) / Aphids, green mirid, green vegetable bug, grey cluster bug, leafhoppers, mites, Rutherglen bug, and thrips	29-Jun-12	30-Nov-22	Hort Innovation
PER14184 Version 2	Phosphorous acid (Agri-fos) / Brassica leafy vegetables (various varieties, refer to permit) / Damping off and downy mildew	01-Jul-13	30-Jun-22	Hort Innovation
PER13695 Version 2	Potassium bicarbonate (Eco-carb) / Brassica leafy vegetables (various varieties, refer to permit) / Powdery mildew	31-Oct-12	30-Sep-20 (renewal submitted to APVMA)	Hort Innovation
PER12008 Version 6	Propachlor (Ramrod) / Brassica leafy vegetables (various varieties, refer to permit) / Annual grasses and broadleaf weeds as per product label	18-Jun-12	30-Nov-25	Hort Innovation
PER13154 Version 2	S-Metolachlor (Dual Gold) / Brassica leafy vegetables (various varieties, refer to permit) / Selected grasses and broadleaf weeds as per the label for brassicas	20-Feb-12	31-Mar-22	Hort Innovation
PER89241	Spinetoram (Success Neo and Delegate) / Various Crops / Fall Armyworm	06-Mar-20	31-Mar-23	Hort Innovation
PER10845 Version 4	Zineb (Barmac) / Brassica Leafy Vegetables / Cercospora leaf spot, Downy Mildew	11-Jun-09	31-May-25	Hort Innovation

Appendix 5. Brassica Leafy Vegetables Maximum Residue Limits (MRLs)

CODEX commodity groupings of Brassicas and subgroups:

VL 0053	Leafy vegetables
VL 0054	Brassica leafy vegetables
-	Mizuna
VL 0506	Turnip greens
VL 0485	Mustard greens
VL 0467	Chinese cabbage
VL 4355	Kale, curly
VL 0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kele)
VL 0466	Chinese cabbage (type pak-choy)
-	Brassica forage crops (kale, rape, swede and turnips)
VL 0479	Japanese greens
VB 0401	Broccoli, Chinese (Gai lan)
-	Gai lum (Chinese broccoli)

Note: Currently production of all Brassica leafy vegetables 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
Abamectin	VL0053	Leafy vegetables	T0.5	-
Afidopyropen	VL0053	Leafy vegetables	5	5 ¹
Aldrin and Dieldrin	VL0053	Leafy vegetables	-	E0.05
Ametoctradin	VL0053	Leafy vegetables	50 ²	50
Azoxystrobin	VL0053	Leafy vegetables	15	-
Bifenthrin	VL0053	Leafy vegetables (except Mizuna)	T2	-
	VL0485	Mustard greens	-	4
	-	Mizuna	T0.5	-
Boscalid	VL0053	Leafy vegetables	30	40
Bromide Ion	VL0506	Turnip greens	-	1,000
Buprofezin	-	Mizuna	T50	-
Chlorantraniliprole	VL0053	Leafy vegetables	15	20
Chlorfenapyr	-	Mizuna	T3	-
	VL0054	Brassica leafy vegetables [except Chinese cabbage]	T3	-
	VL0467	Chinese cabbage	3	-
Chlorothalonil	VL0053	Leafy vegetables	T100	-
Chlorpyrifos	VL0467	Chinese cabbage (type pe-tsai/wombok)	-	1
Clothianidin	VL0053	Leafy vegetables	0.7	2
Cyantraniliprole	VL0053	Leafy vegetables	-	20
Cyazofamid	VL0054	Brassica leafy vegetables	-	15
Cycloxydim	VL4355	Kale, curly	-	3
Cypermethrin	VL0053	Leafy vegetables	T5	0.7
Cyprodinil	VL0054	Brassica leafy vegetables	-	15

¹ 2019 JMPR recommendation for VL 0054 Leaves of Brassicaceae

² Schedule 20 of the FSANZ Food Code

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
	VL0053	Leafy vegetables	10	-
Cyromazine	VL0485	Mustard greens	-	10
Deltamethrin	VL0053	Leafy vegetables	-	2
Diazinon		Vegetables	0.7	
	VL0467	Chinese cabbage (type pe-tsai/wombok)	-	0.05
	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)		
Dichlobenil	VL0053	Leafy vegetables	-	0.3
Difenoconazole	VL0054	Brassica leafy vegetables	T5	-
	-	Mizuna	T5	-
Diflubenzuron	VL0485	Mustard greens	-	10
Dimethoate	VL0506	Turnip greens	-	1
Dimethomorph	-	Mizuna	T10	-
	VL0053	Leafy vegetables	T10	-
Dinotefuran	VL0053	Leafy vegetables	-	6
Dithiocarbamates	VL0053	Leafy vegetables	5	
	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	15
Emamectin benzoate	VL0053	Leafy vegetables	0.3	-
	VL0485	Mustard greens	-	0.2
Etoxazole	-	Mizuna	T1	-
Fenhexamid	-	Mizuna	T15	-
Fenvalerate	VL0054	Brassica leafy vegetables	1	1
Fluazifop-p-butyl	VL0053	Leafy vegetables	T2	-
Flubendiamide	VL0053	Leafy vegetables	10	
Fludioxonil	VL0485	Mustard greens		10
	VL0053	Leafy vegetables	10	-
Fluopicolide	VL0053	Leafy vegetables	30	30
Flutolanil	VL0054	Brassica leafy vegetables	-	0.07
Fluxapyroxad	VL0054	Brassica leafy vegetables	-	4
Fosetyl	VL0053	Leafy vegetables	T0.2	-
Glyphosate	VL0053	Leafy vegetables	*0.1	-
Haloxypop	-	Mizuna	T0.5	-
	VL0053	Leafy vegetables	T0.5	-
Imidacloprid	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	5
	VL0054	Brassica leafy vegetables	15	-
Indoxacarb	VL0053	Leafy vegetables	5	-
Iprodione	VL0054	Brassica leafy vegetables	15	-
Malathion	VL0506	Turnip greens	-	5
	VL0485	Mustard greens	-	2
Maldison	VL0054	Brassica leafy vegetables [except kale]	2	-
	VL0480	Kale	3	-
Mandipropamid	-	Mizuna	30	-
	VL0053	Leafy vegetables	30	25

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
Metaflumizone	VL0466	Chinese cabbage (type pak-choy)	-	6
Metalaxyl	VL0053	Leafy vegetables	0.3	-
Methomyl	VL0054	Brassica leafy vegetables	T0.7	-
Methoxyfenozide	VL0485	Mustard greens	-	30
Metolachlor	VL0054	Brassica leafy vegetables	*0.01	-
	-	Mizuna	T*0.05	-
Myclobutanil	VL0053	Leafy vegetables	-	0.05
Novaluron	VL0485	Mustard greens	-	25
Oxathiapiprolin	VL0053	Leafy vegetables	15	-
Oxydemeton-methyl	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	*0.01
Paraquat	VL0053	Leafy vegetables	-	0.07
Pendimethalin	VL0053	Leafy vegetables	*0.05	-
Penthiopyrad	VL0506	Turnip greens	-	50
	VL0054	Brassica leafy vegetables	70	-
Permethrin	VL0467	Chinese cabbage (type pe-tsai/wombok)	-	5
	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	5
Phenmedipham	VL0053	Leafy vegetables	T1	-
Phorate	-	Mizuna	T*0.01	-
	VL0053	Leafy vegetables	T*0.01	-
Phosphorous acid	VL0053	Leafy vegetables	T150	-
	-	Mizuna	T150	-
Piperonyl Butoxide	VL0485	Mustard greens	-	50
Pirimicarb	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	0.3
	VL0053	Leafy vegetables	7	-
Procymidone	-	Mizuna	T2	-
Propachlor	-	Mizuna	T1	-
	VL0053	Leafy vegetables	T1	-
Propamocarb	VL0053	Leafy vegetables	70	-
Propiconazole	-	Gai lum (Chinese broccoli)	T1	-
Prothiofos	VB0040	Brassica (cole or cabbage) vegetables, head cabbages, flowerhead Brassicas	0.2	-
Pydiflumetofen	VL0054	Brassica leafy vegetables	T10	-
Pymetrozine	VB0053	Leafy vegetables	5	-
	-	Mizuna	5	-
Pyraclostrobin	VL0480	Kale including: Collards, Curly kale, Scotch kale, thousand-headed kale; not including Marrow-stem kale)	-	1
	VL0054	Brassica leafy vegetables	T3	-
	VB0401	Broccoli, Chinese (Gai lan)	T1	-

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
Pyrimethanil	VL0053	Leafy vegetables	T5	-
Pyriproxyfen	-	Mizuna	T5	-
Sethoxydim	VL0053	Leafy vegetables	T0.5	-
Spinetoram	-	Mizuna	0.7	-
	VL0053	Leafy vegetables	0.7	-
Spinosad	VL0479	Japanese greens	5	-
	VL0053	Leafy vegetables	5	10
Spirotetramat	VL0054	Brassica leafy vegetables	10	-
	VL0053	Leafy vegetables	-	7
Sulfoxaflor	VL0053	Leafy vegetables	5	6
Tebufozide	VL0053	Leafy vegetables	-	10
Thiamethoxam	VL0053	Leafy vegetables	2	3
Trichlorfon	VL0480	Kale	0.2	-
Trifluralin	-	Mizuna	T*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 Instrument No. 4 (MRL Standard) 2019. Compilation 4. Prepared 15 January 2020. CODEX MRLs: In addition to the online CODEX database, meeting reports were used to update recent changes (to July 2019).

Appendix 6: Brassica Leafy Vegetable Regulatory Risk Assessment

Brassica leafy vegetables Agrichemical Regulatory Risk Assessment

August 2019

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 that requiring the generation of new data. A consequence of which can be that many of these agrichemicals are not meeting contemporary risk assessment standards as the necessary data is unavailable, or where data is available, the 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 an 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 Brassica leafy vegetables as well as current initiatives aimed at addressing identified pest management deficiencies.

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	Pyrethrins	3A		
Aphids				
Aphids	Imidacloprid	4A	APVMA – Under review Canada – Under review EU – Removal of all field uses USA: Re-registration with new risk mitigation measures	
	Pirimicarb (PER14864)	1A	Codex - JMPR Periodic re-evaluation 2020	
	Petroleum oil	-		
Brown sowthistle aphid	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Sulfoxaflor	4C	USA – Pollinator concerns	
Cabbage aphid	Afidopyropen	9D		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Pirimicarb (PER14864)	1A	Codex - JMPR Periodic re-evaluation 2020	
	Spirotetramat	23		
Cotton aphid	Afidopyropen	9D		
	Pymetrozine	9B	EU- Being phased out Codex – No registrant support	
Currant lettuce aphid	Afidopyropen	9D		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	

Problem	Active Constituents	Chemical Group	Comment	Activities
Green peach aphid	Afidopyropen	9D		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Pirimicarb (PER14864)	1A	Codex - JMPR Periodic re-evaluation 2020	
	Spirotetramat	23		
	Sulfoxaflor	4C	USA – Pollinator concerns	
Potato aphid	Pymetrozine	9B	EU- Being phased out Codex – No registrant support	
Beetles				
African black beetle	Chlorpyrifos	1B	Currently under review by the APVMA & outcome uncertain. Potential issues w.r.t. environmental loading and dietary exposure. EU: Under review Canada – proposed cancellation of most uses. USA – EPA decision to allow continued use	
False wireworm	Chlorpyrifos	1B		
Wireworm	Chlorpyrifos	1B		
Vegetable weevil	Chlorpyrifos	1B		
	Alpha-cypermethrin	3A		

Problem	Active Constituents	Chemical Group	Comment	Activities
Lepidoptera				
Budworms - Native (<i>Helicoverpa punctigera</i>) Corn earworm/Cotton bollworm (<i>Helicoverpa armigera</i>)	<i>B. thuringiensis</i> aizawai (PER87670)	11A		
	Emamectin benzoate (PER14907)	6		
	Flubendiamide	28		
	Spinetoram	5		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Helicoverpa NPV	31		
	Chlorantraniliprole	28		
	Indoxacarb	22		
Cabbage cluster caterpillar	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Spinetoram	5		
Cabbage white butterfly	<i>B. thuringiensis</i> aizawai (PER87670)	11A		
	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Emamectin benzoate (PER14907)	6		
	Flubendiamide	28		
	Spinetoram	5		
Cabbage-centre grub	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Spinetoram	5		
Caterpillars	Pyrethrins	3A		
	Spinetoram	5		

Problem	Active Constituents	Chemical Group	Comment	Activities
Cluster caterpillar	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Emamectin benzoate (PER14907)	6		
	Flubendiamide	28		
	Spinetoram	5		
Diamondback (Cabbage) moth	<i>B thuringiensis</i> aizawai (PER87670)	11A		
	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Emamectin benzoate (PER14907)	6		
	Flubendiamide	28		
	Pyrethrins	3A		
	Spinetoram	5		
Loopers	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Emamectin benzoate (PER14907)	6		
	Spinetoram	5		
Lucerne leafroller	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
Soybean looper	<i>B thuringiensis</i> aizawai (PER87670)	11A		
	Chlorantraniliprole	28		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Flubendiamide	28		
Vegetable looper	<i>B thuringiensis</i> aizawai (PER87670)	11A		
	Emamectin benzoate (PER14907)	6		

Problem	Active Constituents	Chemical Group	Comment	Activities
Grasshoppers/Locusts				
Field crickets	Chlorpyrifos	1B	Currently under review by the APVMA & outcome uncertain. Potential issues w.r.t. environmental loading and dietary exposure.	
Mole crickets	Chlorpyrifos	1B	EU: Under review Canada – proposed cancellation of most uses. USA – EPA decision to allow continued use	
Jassids/Plant bugs				
Green mirid	Petroleum oil	-		
Green vegetable bug	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Petroleum oil	-		
Grey cluster bug	Petroleum oil	-		
Leafhoppers	Petroleum oil	-		
	Pyrethrins	3A		
Rutherglen bug	Petroleum oil	-		SYNFOI21 – New
Vegetable leafhopper	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
Mites				
Mites	Petroleum oil	-		
Blue oat mite	Chlorpyrifos	1B	Currently under review by the APVMA & outcome uncertain. Potential issues w.r.t. environmental loading and dietary exposure.	
Redlegged earth mite	Chlorpyrifos	1B	EU: Under review Canada – proposed cancellation of most uses. USA – EPA decision to allow continued use	
	Alpha-cypermethrin	3A		
Two-spotted (Red spider) mite	Pyrethrins	3A		

Problem	Active Constituents	Chemical Group	Comment	Activities
Thrips				
Onion thrips	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	Hort Innovation data generation project will commence for a label registration for a new Syngenta registration in Australia for a SYNFOI21 Plague thrips, Western Flower thrips & Rutherglen bugs
Plague thrips	Alpha-cypermethrin	3A		
Thrips	Imidacloprid	4A	APVMA – Under review Canada – Under review EU – Removal of all field uses USA: Re-registration with new risk mitigation measures	
	Petroleum oil	-		
	Pyrethrins	3A		
Western flower thrips	Abamectin	6		
	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Spinetoram	5		
Whitefly				
Greenhouse whitefly	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
	Sulfoxaflor	4C	USA – Pollinator concerns	
Silverleaf (Poinsettia) whitefly	Afidopyropen	9D		
	Spirotetramat	23		
Silverleaf whiteflies	Chlorantraniliprole + thiamethoxam	4A + 28	Thiamethoxam: Canada – Proposal to deregister outdoor uses Europe – Outdoor uses deregistered	
Whiteflies	Imidacloprid	4A	APVMA – Under review Canada – Under review EU – Removal of all field uses USA: Re-registration with new risk mitigation measures	
Whitefly	Pyrethrins	3A		

Problem	Active Constituents	Chemical Group	Comment	Activities
Other				
Earwig	Pyrethrins	3A		
Vegetable leafminer	Abamectin (PER81876)	6		

Problem	Active Constituents	Chemical Group	Comment	Activities
DISEASES				
Alternaria leaf spots	Azoxystrobin	11		
	Chlorothalonil	M5	APVMA - Nominated for review Canada – Review recently completed; continued use considered acceptable Europe - Deregistration proposed.	
Alternaria spot/blight	Chlorothalonil (PER82895)	M5	APVMA - Nominated for review Canada – Review recently completed; continued use considered acceptable Europe - Deregistration proposed.	
	Iprodione	2	Europe – Deregistered Canada – Majority of food crop uses deleted Codex – Review scheduled for 2022	
Anthracnose	Mancozeb (PER80538)	M3	APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
Bactericide	Iodine	-		
Bacterial spot	<i>B. amyloliquifaciens</i> (PER87630)	-		
Cercospora leaf spot	Zineb (PER10845)	M3	APVMA - Nominated for review Canada – Proposed cancelling of foliar uses Codex - To be reviewed 2022/23 Europe - Deregistered	
Damping off	Phosphorous acid (PER14184)	33		

Problem	Active Constituents	Chemical Group	Comment	Activities
Downy mildew	Chlorothalonil (PER82895)	M5	APVMA - Nominated for review Canada – Review recently completed; continued use considered acceptable Europe - Deregistration proposed.	Hort Innovation data generation project underway for Zampro® (dimethomorph + ametoctradin)
	Dimethomorph + mancozeb (PER14958)	40 + M3	Mancozeb: APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
	Fluopicolide +propamocarb HCl	28 + 43		
	Mancozeb	M3	APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
	Metalaxyl/metalaxyl-M	4		
	Mandipropamid	40		
	Oxathiapiprolin	49		
	Phosphorous acid (PER14184)	33		
	Zineb (PER10845)		APVMA - Nominated for review Canada – Proposed cancelling of foliar uses Codex - To be reviewed 2022/23 Europe - Deregistered	
Grey mould	Chlorothalonil	M5	APVMA - Nominated for review Canada – Review recently completed, continued use considered acceptable Europe - Deregistration proposed.	
	Iprodione	2	Europe – Deregistered Canada – Majority of food crop uses deleted Codex – Review scheduled for 2022	
	Penthiopyrad	7		
Powdery mildew	Potassium bicarbonate (PER13695)	M2		
	Penthiopyrad	7		
Ring spot	Difenoconazole (PER82136)	3	APVMA - Nominated for review Canada – Currently under reviewed	

Problem	Active Constituents	Chemical Group	Comment	Activities
Sclerotinia rot	Azoxystrobin	11		Hort Innovation data generation project underway for Luna Experience
	Boscalid	7		
	Cyprodinil + fludioxonil	9 + 12	Cyprodinil: Canada – Currently under reviewed Fludioxonil” EU – Currently under reviewed	
	Iprodione	2	Europe – Deregistered Canada – Majority of food crop uses deleted Codex – Review scheduled for 2022	
	Penthiopyrad	7		
Septoria leaf spot	Mancozeb	M3	APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
White blister	Azoxystrobin	11		
	Dimethomorph + mancozeb (PER14958)	40 + M3	Mancozeb: APVMA - Nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	

Problem	Active Constituents	Chemical Group	Comment	Activities
WEEDS				
Broadleaf weeds and grasses	Chlorthal-dimethyl	D	EU: No authorisation in place	
	Clethodim (PER82459)	A		
	Fluazifop-P as butyl	A		
	Pendimethalin (PER14127)			
	Propachlor (PER12008)		EU: No authorisation in place	
	S-metolachlor (PER13154)			

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