# Zucchini

## Strategic Agrichemical Review Process (SARP)

## July 2021

Hort Innovation
Project - VG18004

**Hort Innovation Project Number:**
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 Zucchini industry across Australia. The information in this report will assist the industry with its agrichemical selection and usage into the future.

**Date of report:**
July 2021

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# 1. Summary

The strategic levy investment project Vegetable Industry SARP Report Updates (VG18004) is part of the Hort Innovation Vegetable Fund. A Strategic Agrichemical Review Process (SARP), through the process of a desktop audit and industry liaison;

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

(ii) Evaluates the availability and effectiveness of fungicides, insecticides and herbicides (pesticides) to control the plant pests;

(iii) Determines any gaps in the pest control strategy and

(iv) Identifies suitable new or alternatives pesticides to address the gaps.

Alternative pesticides should ideally be selected for benefits of:

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

The results of this process will provide the Zucchini 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 |
|---|---|
| Powdery Mildew | *Sphaerotheca fuliginea* |
| Downy Mildew | *Pseudoperonospora cubensis* |
| Mosaic Viruses | Cucumber Mosaic Virus<br>Papaya Ringspot Virus<br>Zucchini Yellow Mosaic Virus<br>Squash Mosaic Virus |

## 1.2 Insects and mites

The high priority insects and mites are:

| Common name | Scientific name |
|---|---|
| Green Peach Aphid | *Myzus persicae* |
| Silverleaf Whitefly | *Bemisia tabaci* |
| Greenhouse Whitefly | *Trialeurodes vaporariorum* |
| Western Flower Thrips | *Frankliniella occidentalis* |
| Tomato Thrips | *Frankliniella schultzei* |
| Plague Thrips | *Thrips imaginis* |

## 1.3 Weeds

The moderate priority weeds are:

| Common Name | Scientific Name |
|---|---|
| Amaranthus | *Amaranthus* spp. |
| Blackberry Nightshade | *Solanum nigrum* |
| Fat Hen | *Chenopodium album* |
| Nutgrass | *Cyperus rotundus* |
| Pigweed | *Portulaca* spp. |

# 2. The Australian Zucchini Industry

The Australian Zucchini industry is a small horticultural industry.

Zucchini is a summer crop. The majority of Zucchinis are field grown in the warmer states. Major production areas include the Atherton Tablelands, Bowen & Bundaberg regions in Queensland; the Bathurst region in New South Wales; the Sunraysia region in Victoria; Adelaide plains in South Australia and the Perth region in Western Australia.

Australian production of zucchini[1] for the year ending June 2020 was 44,078 tonnes. Ninety-eight percent was sent for fresh supply and two percent was sent for processing.

Due to Australia's varying weather conditions, the Australian industry can supply domestic markets with fresh Zucchini throughout the year. Southern states are unable to produce Zucchini for the colder parts of the year, but this is supplemented by exports from warmer states.

Fresh Zucchini Seasonality by State

| State | 19/20 t | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New South Wales (19%) | 8,550 | | | | | | | | | | | | |
| Victoria (26%) | 11,645 | | | | | | | | | | | | |
| Queensland (47%) | 20,571 | | | | | | | | | | | | |
| Western Australia (4%) | 1,665 | | | | | | | | | | | | |
| South Australia (4%) | 1,525 | | | | | | | | | | | | |
| Tasmania (<1%) | 98 | | | | | | | | | | | | |
| Northern Territory (<1%) | 24 | | | | | | | | | | | | |
| Availability legend | | | High | | | Medium | | | Low | | | None | |

The Zucchini species referred to in this report is *Cucurbita pepo var. cylindrica,* also known as a courgette or summer squash.

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

# 3. Introduction

## 3.1 Background

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

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

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

In combination with cultural practices, pesticides are important tools in Zucchini 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 Zucchini 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 Zucchini 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 Zucchini 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 Zucchini 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 Zucchini 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 Zucchini as a minor crop. The crop fits within the APVMA crop group Crop Group 011: Fruiting vegetables, Cucurbits (Subgroup 11A Squash, Summer - Zucchini). Pesticide use is generally covered under the cucurbit crop group for label registrations and minor use permits.

Therefore, access to minor use permits can be relatively straight forward as long as a reasonable justification is provided in accordance with the APVMA's minor use guidance[2].

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

[2] https://apvma.gov.au/node/10931

## 3.3 Methods

The current update of the Zucchini 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 | Engagement and consultation with growers and other relevant stakeholders. Including; Online crop specific surveys, workshops and one on one consultation Nationally.<br><br>Collation of information collected by commodity on applicable pests, diseases and weeds in order of priority. |
| MT17019 – Regulatory Support & Co-ordination (AKC) | **Zucchini Agrichemical Regulatory Risk Assessment Document**<br>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 Zucchini as well as current initiatives aimed at addressing identified pest management deficiencies. |
| VG18004 – Vegetable Strategic Agrichemical Review Process (SARP) Report Updates | **SARP updated via a desktop audit:**<br>Review list of priorities ranked as high, moderate and low for each plant pest groups (disease, insects and weeds) – provided by VG16060.<br>Identify industries pest priority gaps in order of importance.<br>Update current pesticides available via label registrations or minor use permits.<br>Update available pesticide use patterns, IPM ranking/compatibility, mode of action and chemical group.<br>Identify pesticides at risk (under review and/or limited uses) via MT17019 Regulatory Support & Co-ordination – AKC consulting.<br>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).<br>Include known pesticide solutions that are currently under development with registrants for new uses in the nominated crops or in current Hort Innovation projects.<br>Update MRL tables to include Australian MRL's, Codex and any applicable export market MRL's |

## 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 zucchini
Appendix 2. Products available for control of insects and mites in zucchini
Appendix 3. Products available for weed control in zucchini
Appendix 4. Current permits for use in zucchini
Appendix 5. Zucchini Maximum Residue Limits (MRLs)
Appendix 6. Zucchini Agrichemical Regulatory Risk Assessment

# 4. Diseases, Pests and weeds of Zucchini

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[3].

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

Some of the suggested options have no overseas MRLs (see Appendix 5). If treated fruit is to be exported nil residues at harvest would be needed for these options.

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

[3] https://www.croplife.org.au/resources/programs/resistance-management/

## 4.1 Diseases of zucchini

### 4.1.1 Disease priorities

| Common name | Scientific name |
|---|---|
| **High** | |
| Powdery Mildew | *Sphaerotheca fuliginea* |
| Downy Mildew | *Pseudoperonospora cubensis* |
| Mosaic Viruses | Cucumber Mosaic Virus<br>Papaya Ringspot Virus<br>Zucchini Yellow Mosaic Virus<br>Squash Mosaic Virus |
| **Moderate** | |
| Grey Mould | *Botrytis cinerea* |
| Alternaria Leaf Blight | *Alternaria cucumerina* |
| Damping-Off | *Pythium spp., Phytophthora spp.* |
| Gummy Stem Blight | *Didymella bryoniae* |
| Bacterial Spot | *Xanthomonas campestris* |
| **Low** | |
| Angular Leaf Spot | *Pseudomonas syringae* |
| Anthracnose | *Colletotrichum orbiculare* |
| Phytophthora Soil Fungus | *Phytophthora spp.* |
| Rhizoctonia Ground Rot | *Rhizoctonia solani* |
| Scab | *Cladosporium spp.* |
| Septoria Spot | *Septoria cucurbitacearum* |
| Bacterial Soft Rot | *Erwinia spp.* |

The most important disease issues based on the feedback received were Powdery Mildew, Downy Mildew and Mosaic Viruses.

Several viruses can infect cucurbits, including zucchini, with key differences in how the viruses are transmitted and spread and management options varying accordingly. Cucumber Mosaic Virus, Papaya Ringspot Virus and Zucchini Yellow Mosaic Virus are spread by many species of aphid with transmission occurring with a very short feeding time. Cucumber Mosaic Virus is not considered to be spread by plant-to-plant contact in the field or in seed. Papaya Ringspot Virus can be spread by mechanical transmission in the field, but it is not thought to be transmitted on seed. Squash Mosaic Virus can be introduced through seed, and secondary infection can occur via leaf-chewing beetles such as 28-spotted ladybird and by mechanical spread by workers and contaminated equipment.

Management options include the use of clean planting material, general farm hygiene, early detection and disposal of infected seedlings and resistant varieties. Control of insect vectors is usually ineffective due to the rapid transmission of the virus during feeding.

**Resistance Management**

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

There are several disease strategies that apply to cucurbits on the CropLife website[4], including Powdery Mildew and Downy Mildew.

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

## 4.1.2 Available and potential products for priority diseases

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

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

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Powdery Mildew** (*Sphaerotheca fuliginea*)<br>**Priority: High** | | | | | | | |
| Powdery Mildew was ranked as a high priority in VIC, QLD & NSW. Powdery Mildew causes a characteristic white, powdery growth on infected plants. Photosynthetic efficiency is reduced in affected leaves and fruit can be scarred and damaged, causing produce to be downgraded. Severe outbreaks can cause defoliation, exposing fruit to sunburn and predisposing them to secondary rots. | | | | | | | |
| Azoxystrobin (Amistar) | 11 | Protectant & curative | 1 | A | ALL | Registered in cucurbits for the control of **Powdery Mildew**, Downy Mildew and Gummy Stem Blight. Commence soon after transplanting and continue till fruit maturity. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7-14 d] | - |
| Azoxystrobin + Oxathiapiprolin (Orondis Flexi) Syngenta | 11+49 | Protective & curative | 3 NG | A | ALL | Registered in cucurbits for the control of Downy Mildew and suppression of **Powdery Mildew**, Gummy Stem Blight and *Sclerotinia* spp. [Max. 2 applications per crop; re-treatment interval: 7-14 d] | - |
| Boscalid + Kresoxim-Methyl (Colliss) BASF | 7+11 | Protectant & curative | 7 | A | ALL | Registered in cucurbits for control of **Powdery Mildew**. [Max. 2 applications per crop; re-treatment interval: 7-10 d] | - |
| Bupirimate (Nimrod) | 8 | Protectant & curative | 1 | A | ALL | Registered in cucurbits including pumpkins, cucumber & zucchini for control of **Powdery Mildew**. [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 |
|---|---|---|---|---|---|---|---|
| Copper Octanoate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of **Powdery Mildew** and Downy Mildew. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Cyflufenamid (Flute) AgNova | U6 | Protectant & curative | 1 | A | ALL | Registered in cucurbits for control of **Powdery Mildew**. Begin application at first sign of disease. [Max. 2 applications per crop; re-treatment interval: 7-10 d] | - |
| Hydrogen Peroxide + Peroxyacetic Acid (Peratec Plus) | M | Protectant | 1 | A | ALL | Registered in zucchini for control of **Powdery Mildew** (*Sphaerotheca* spp.). [Max. 4 applications per crop; re-treatment interval: 5-7 d] | - |
| Metrafenone (Vivando) BASF | U8 | Protectant | 7 | A | ALL | Registered in cucurbits for control of **Powdery Mildew**. [Max. 4 applications per crop; 2 sequential applications; re-treatment interval: 7-10 d] | - |
| Penthiopyrad (Fontelis) Corteva | 7 | Protectant | 1 | A | ALL | Registered in zucchini (field and protected) for control of Botrytis Grey Mould, **Powdery Mildew**, and Gummy Stem Blight. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7–14 d] | - |
| Potassium Bicarbonate (EcoCarb) | M2 | Protectant | NR | A | ALL | Registered in zucchini for control of **Powdery Mildew**. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Proquinazid (Talendo) Corteva | 13 | Protectant | 1 | A | ALL | Registered in cucurbits (field grown only) for control of **Powdery Mildew**. [Max. 3 applications per crop; 2 sequential applications; re-treatment interval: 10-14 d] | - |
| Pyriofenone (Kusabi) AgNova | 50 | Protectant & Curative | NR | A | ALL | Registered for control of **Powdery Mildew** in cucurbits (field). [Max. 3 applications per crop; re-treatment interval: 7-10 d]. | - |
| *Streptomyces lydicus* (Actinovate) | BM 02 | Biological | NR | A | ALL | Registered in cucurbits for suppression of **Powdery Mildew.** [Max no of applications and re-treatment intervals not specified] | - |
| Sulphur | M2 | Protectant | NR | A | ALL | Registered in vegetables (field & protected) for control of **Powdery Mildew** and Rust. [Max no of applications not specified; re-treatment interval 14-21 d] | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Tea Tree Oil (Timorex) | 46 | Protectant | NR | A | ALL | Registered in cucurbits for control of **Powdery Mildew**. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Triadimefon | 3 | Protectant & curative | 1 | A | NSW & WA | Registered in cucurbits for control of **Powdery Mildew**. [Max. no. of applications not specified; re-treatment interval: 5-10 d] | R3 |
| Triadimenol (Bayfidan) | 3 | Protectant & curative | 1 | A | ALL | Registered in cucurbits for control of **Powdery Mildew**. [Max. 4 applications per crop; re-treatment interval: 5-10 d] | R3 |
| ADM1700F Adama | TBC | | | P | | Fungicide in development from Adama with **Powdery Mildew** activity | - |
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | NR | P | | Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. Permitted for control of **Powdery Mildew** in eggplant. US registration for control of **Powdery Mildew** in cucurbits, grapes, pome fruit, stone fruit and strawberries. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. Permitted for suppression of **Powdery Mildew** in nursery stock. US registration for control of **Powdery Mildew** in artichoke, berries, brassica leafy vegetables, bulb vegetables, cucurbits, fruiting vegetables, grapes, hops, leafy vegetables, legume vegetables, pome fruit, stone fruit, sugar beet and tobacco. | - |
| BLAD (ProBlad Plus) | BM 01 | Biological | NR | P | | Registered for control of Brown Rot and Blossom Blight in stone fruit. US registration for control of **Powdery Mildew** in cucurbits, fruiting vegetables, grapes, hops, pome fruit and strawberries. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protectant & Curative | | P | | New active in development from Corteva with activity on Septoria, **Powdery Mildew**, Botrytis, Anthracnose, Alternaria, Scab, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and **Powdery Mildew** in grapevines. US registration for control of **Powdery Mildew** in almond, Brassica leafy vegetables, cucurbits, grapes, hops, dry and succulent beans, stone fruit and sunflower. | R3 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Fluopyram + Trifloxystrobin (Luna Sensation) Bayer | 7+11 | Protectant & Curative | | P | | Registered for control of **Powdery Mildew** in apples. US registration for control of **Powdery Mildew** in artichoke, almond, low growing berry except cranberry, Brassica vegetables, Brassica leafy vegetables, carrot cherry, dill seed, pome fruit, small vine climbing fruit except kiwi fruit, ginseng, herbs, hops, leafy greens, cucurbits, pecan, leafy petioles (including celery fennel (bulb) & rhubarb) fruiting vegetables & root vegetables except sugar beet. | - |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of Alternaria Leaf Blight, **Powdery Mildew**, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| NUL3195 Nufarm | TBC | | | P | | Fungicide in development from Nufarm with activity on **Powdery Mildew** and *Botrytis*. | - |
| Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta | 7+12 | Protectant & Curative | | P | | Registered for control of Botrytis in berries and grapes, and Botrytis and Sclerotinia in leafy vegetables and potato. US registration for control of **Powdery Mildew** in brassica vegetables cucurbits, fruiting vegetables, grapes, specific leaf petioles, leafy greens, root and tuber vegetables, mustard greens, potato, root vegetables. strawberry and tuberous and corm vegetables. | R3 |
| **Downy Mildew** (*Pseudoperonospora cubensis*)<br>**Priority: High** | | | | | | | |
| Downy Mildew was ranked as a high priority in QLD and as a moderate priority in VIC & NSW. It is a common disease that is characterised by a white downy fungal growth that develops on the underside of the leaf and is favoured by warm, moist weather. Management options include general farm hygiene, crop rotation, planting space and the use of fungicide applications when conditions favour disease. | | | | | | | |
| Azoxystrobin (Amistar) | 11 | Protectant & curative | 1 | A | ALL | Registered in cucurbits for the control of Powdery Mildew, **Downy Mildew** and Gummy Stem Blight. Commence soon after transplanting and continue till fruit maturity. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7-14 d] | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Azoxystrobin + Oxathiapiprolin (Orondis Flexi) Syngenta | 11+49 | Protective & curative | 3 NG | A | ALL | Registered in cucurbits for the control of **Downy Mildew** and suppression of Powdery Mildew, Gummy Stem Blight and *Sclerotinia* spp. [Max. 2 applications per crop; re-treatment interval: 7-14 d] | - |
| Chlorothalonil (Bravo) | M5 | Protectant | 1 | A | ALL | Registered in zucchini for control of **Downy Mildew**, Gummy Stem Blight**,** Anthracnose, Alternaria Leaf Blight and Target Leaf Spot and suppression of Belly Rot. [Max. no. of applications not specified; re-treatment interval: 7-14 d] | R3 |
| Copper Ammonium Acetate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of Angular Leaf Spot, Bacterial Leaf Spot and **Downy Mildew**. Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Octanoate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of Powdery Mildew and **Downy Mildew**. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Oxychloride | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, **Downy Mildew**, Anthracnose and Gummy Stem Blight. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Dimethomorph (Acrobat) BASF | 40 | Protectant | 7 | A | ALL | Registered in cucurbits for control of **Downy Mildew**, Anthracnose, Gummy Stem Blight, Alternaria Leaf Spot and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | **-** |
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Protectant | 7 | A | ALL | Registered in cucurbits for control of **Downy Mildew**. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | R2 |
| Mancozeb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits (field) for control of Alternaria Spot, Anthracnose, **Downy Mildew**, Ring Spot, Gummy Stem Blight, and Septoria Spot. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | R2 |
| Mancozeb + Metalaxyl-M (Ridomil Gold MZ) Syngenta | M3+4 | Protectant & Curative | 7 | A | ALL | Registered in cucurbits (field) for control of **Downy Mildew**. [Max. 4 applications per crop; apply 2 consecutive applications at re-treatment interval of 7-10 d] | R2 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Metiram (Polyram) BASF | M3 | Protectant | 7 | A | ALL | Registered in cucurbits for the control of **Downy Mildew** and Gummy Stem Blight. [Max. no. of applications not specified; re-treatment interval: 7 d] | R2 |
| Oxathiapiprolin (Zorvec Enicade) Corteva | 49 | Protectant | 1 | A | ALL | Registered in cucurbits for control of **Downy Mildew.** [Max. 3 applications per crop; 2 consecutive; re-treatment interval 7-10 d] | - |
| Phosphorous Acid | 33 | Protectant | NR | A | ALL | Registered in cucurbits for the control of **Downy Mildew.** [Max. no. of applications not specified; re-treatment interval 7 d] | - |
| Propamocarb Hydrochloride + Fluopicolide (Infinito) Bayer | 28+43 | Protectant | 1 | A | ALL | Registered in cucurbits (field and protected) for the control of **Downy Mildew.** Use subject to CropLife Resistance management strategies. [max 2 applications per crop; re-treatment interval: 7-10 d] | - |
| Propineb (Antracol) Bayer | M3 | Protectant | 3 | A | ALL | Registered in cucurbits for the control of **Downy Mildew**. [Max. 4 applications per crop; re-treatment interval: 7 d] | R2 |
| Propineb + Oxadixyl (Rebound) Kiwi Rural Trading | 4+M3 | Protectant | 3 | A | ALL | Registered in cucurbits for the control of **Downy Mildew**, Gummy Stem Blight, and Anthracnose. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7–10 d] | R2 |
| Zineb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits for the control of **Downy Mildew** and Anthracnose. [Max. no. of applications not specified; re-treatment interval: 7 d] | R2 |
| Hydrogen Peroxide + Peroxyacetic Acid (Peratec Plus) | M | Protectant | 1 | P-A | ALL | Registered in zucchini for control of Powdery Mildew. Registered for control of **Downy Mildew** in brassica vegetables, bulb vegetables and grapes. | - |
| Acibenzolar-S-Methyl (Actigard Plant Activator) Syngenta | P01 | Protectant | | P | | Registered in tomatoes for the suppression of Bacterial Speck, Bacterial Spot, Bacterial Canker and Powdery Mildew. US registration for control of **Downy Mildew** in Brassica leafy vegetables, cucurbits, leafy vegetables, spinach, and suppression of **Downy Mildew** in bulb onion. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Cyazofamid (Ranman) ISK | 21 | Protectant | | P | | Registered for control of Late Blight and White Blister in potatoes and broccoli. US registration for control of **Downy Mildew** in herbs, brassica leafy vegetables, cucurbits, grapes, hops, leafy greens, succulent-podded and succulent-shelled beans and bulb vegetables. | - |
| Dimethomorph + Amitoctradin (Zampro) AgNova | 40+45 | Protectant | | P | | Registered for control of **Downy Mildew** in grape vines. Application for a label extension submitted by BASF in June 2020 for control of Downy Mildew in cucurbits, supported by data generated in Hort Innovation project ST17000. | - |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of **Downy Mildew** in cucurbits. | - |
| Mandipropamid (Revus) Syngenta | 40 | Protectant | | P | | Registered for control of **Downy Mildew** in grapes and brassica leafy crops. US registration for suppression of **Downy Mildew** in cucurbits and control of Downy Mildew in basil, edible podded bean, brassica vegetables, leafy vegetables, bulb vegetables, fruiting vegetables (except tomatoes), grapes and hops. | - |

**Mosaic Viruses:** Cucumber Mosaic Virus, Papaya Ringspot Virus, Zucchini Yellow Mosaic Virus, Squash Mosaic Virus
**Priority: High**

Mosaic Viruses were ranked as a high priority in QLD and as a moderate priority in VIC & NSW. Several viruses can infect cucurbits, including zucchini, with key differences in how the viruses are transmitted and spread and management options varying accordingly. Cucumber Mosaic Virus, Papaya Ringspot Virus and Zucchini Yellow Mosaic Virus are spread by many species of aphid with transmission occurring with a very short feeding time. Cucumber Mosaic Virus is not considered to be spread by plant-to-plant contact in the field or in seed. Papaya Ringspot Virus can be spread by mechanical transmission in the field, but it is not thought to be transmitted on seed. Squash Mosaic Virus can be introduced through seed, and secondary infection can occur via leaf-chewing beetles such as 28-spotted ladybird and by mechanical spread by workers and contaminated equipment.
Management options include the use of clean planting material, general farm hygiene, early detection and disposal of infected seedlings and resistant varieties. Control of insect vectors is usually ineffective due to the rapid transmission of the virus during feeding.

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Grey Mould** (*Botrytis cinerea*)<br>**Priority: Moderate** | | | | | | | |
| Grey Mould was ranked as a moderate priority in VIC, QLD & NSW. It can affect plants at most stages of production. Affected fruit become water-soaked and soft and are rapidly covered with a thick grey mould. Other plant parts such as stems can also be affected. *Botrytis* also causes secondary rots on fruit and vegetables in storage or transit and in the marketplace. | | | | | | | |
| *Aureobasidium pullulans*<br>(Botector)<br>Nufarm | BM 02 | Biological | NR | A | | Registered in cucurbits (field & protected) for control of ***Botrytis*** and suppression of *Sclerotinia* spp. [Max. 5 applications per crop; re-treatment interval: 7–10 d] | - |
| Penthiopyrad<br>(Fontelis)<br>Corteva | 7 | Protectant | 1 | A | ALL | Registered in zucchini (field and protected) for control of **Botrytis Grey Mould**, Powdery Mildew, and Gummy Stem Blight. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7–14 d] | - |
| *Bacillus amyloliquefaciens*<br>(Serenade Opti)<br>Bayer | BM 02 | Biological | NR | P | | Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. US registration for control of ***Botrytis*** in artichoke, asparagus, berries, bulb vegetables, fruiting vegetables, grapes, cucurbits, grapes, herbs/spices, legume vegetables, root/tuber and corm vegetables, stone fruit and kiwi. | - |
| *Bacillus amyloliquefaciens strain MBI 600*<br>(Serifel)<br>BASF | BM 02 | Biological | NR | P | | Registered for control of ***Botrytis*** in grapevines and strawberries. US registration for control of ***Botrytis*** in artichoke, asparagus, berries, brassica leafy vegetables, bulb vegetables, fruiting vegetables, grapes, leafy vegetables, legume vegetables, pome fruit, stone fruit and tobacco. | - |
| BLAD<br>(ProBlad Plus) | BM 01 | Biological | NR | P | | Registered for control of Brown Rot and Blossom Blight in stone fruit. US registration for control of ***Botrytis*** in fruiting vegetables, grapes, strawberries and ornamentals. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Cyprodinil + Fludioxonil (Switch) Syngenta | 9+12 | Protective & Curative | | P | | Registered for control of Sclerotinia**,** Botrytis and other diseases in several vegetable crops including leafy vegetables, peas, beans, leafy vegetables & lettuce. US registration for control of ***Botrytis*** in beans (dried & succulent except cowpea), berries, grapes and small fruit vine climbing (except fuzzy kiwifruit), herbs, leafy greens, bulb vegetables, pistachio and fruiting vegetables, and control of Alternaria, Gummy Stem Blight and Powdery Mildew in cucurbits. | R3 |
| DC-126 Bayer | TBC | | | P | | New product from Bayer with ***Botrytis*** activity. | - |
| Fenpyrazamine (Prolectus) Sumitomo | 17 | Protectant & Curative | | P | | Registered for ***Botrytis*** control in grapes. US registration for control of ***Botrytis*** in berries, ginseng, lettuce, pistachio, small fruit vine climbing (except fuzzy kiwifruit) and ornamentals. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protective & Curative | | P | | New active in development from Corteva with activity on Septoria, Powdery Mildew, **Botrytis**, Anthracnose, Alternaria, Scab, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of **Grey Mould** and Powdery Mildew in grapevines. US registration for control of ***Botrytis*** in almond, artichoke, berries, brassica vegetables, Brassica leafy greens, stone fruit, dill seed, pome fruit, small fruit vine climbing (except fuzzy kiwifruit), herbs, hops, leafy greens, cucurbits, pistachio, fruiting vegetables and root vegetables (except sugar beet). | R3 |
| Fluopyram + Trifloxystrobin (Luna Sensation) Bayer | 7+11 | Protectant & Curative | | P | | Registered for control of Powdery Mildew in apples. US registration for control of ***Botrytis* spp.** in almond, cherry, pistachio, potato, watermelon and wine grapes. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control ***Botrytis* spp.** in bulb vegetables, leafy vegetables, pome fruit, stone fruit, strawberries and tree nuts, and for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| Isofetamid (Kenja) ISK / AgNova | 7 | Protectant | | P | | Registered for control of ***Botrytis*** in berries***.*** | - |
| NUL3195 Nufarm | TBC | | | P | | New product from Nufarm with ***Botrytis*** activity. | - |
| Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta | 7+12 | Protective & Curative | | P | | Registered for control of ***Botrytis*** in berries, grapes and strawberries and control of ***Botrytis*** and *Sclerotinia* in leafy vegetables, lettuce and potatoes. US registration for control of ***Botrytis*** in berries, bulb vegetables, cucurbits, grapes and small fruit vine climbing (except fuzzy kiwifruit), specific leaf petioles, specific leafy greens, pistachio, tuberous and corm vegetables, and suppression of ***Botrytis*** in fruiting vegetables and potatoes. | R3 |
| **Alternaria Leaf Blight** (*Alternaria cucumerina*)<br>**Priority: Moderate** | | | | | | | |
| Alternaria Leaf Blight was ranked as a moderate priority in QLD & NSW and as a low priority in VIC. *Alternaria* species produce various sorts of toxic metabolites during their active growth and causes severe diseases in many plants by limiting their productivity. Crop rotation, removal and burning of plant debris, if infected, and eradication of weed hosts help reduce the inoculum for subsequent plantings of susceptible crops. | | | | | | | |
| Chlorothalonil (Bravo) | M5 | Protectant | 1 | A | ALL | Registered in zucchini for control of Downy Mildew, Gummy Stem Blight**,** Anthracnose, **Alternaria Leaf Blight** and Target Leaf Spot and suppression of Belly Rot. [Max. no. of applications not specified; re-treatment interval: 7-14 d] | R3 |
| Dimethomorph (Acrobat) BASF | 40 | Protectant | 7 | A | ALL | Registered in cucurbits for control of Downy Mildew, Anthracnose, Gummy Stem Blight, **Alternaria Leaf Spot** and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | **-** |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Protectant | 7 | A | QLD & NT | Registered in cucurbits for control of Downy Mildew, Anthracnose, Gummy Stem Blight, **Alternaria Leaf Spot** and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | R2 |
| Mancozeb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits (field) for control of **Alternaria Spot**, Anthracnose, Downy Mildew, Ring Spot, Gummy Stem Blight, and Septoria Spot. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | R2 |
| Mancozeb + Metalaxyl-M (Ridomil Gold MZ) Syngenta | M3+4 | Protectant & Curative | 7 | A | QLD | Registered in cucurbits (field) for control of Downy Mildew, Anthracnose, Gummy Stem Blight and **Alternaria Leaf Spot**. [Max. 4 applications per crop; apply 2 consecutive applications at re-treatment interval of 7-10 d] | R2 |
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | NR | P | | Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. US registration for control of ***Alternaria*** in berries, brassica vegetables, citrus, bulb vegetables, herbs/spices, root/tuber and corm vegetables, stone fruit and tree nuts. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of ***Alternaria*** in artichoke, asparagus, berries, brassica leafy vegetables, bulb vegetables, citrus, cucurbits, pome fruit, stone fruit and tobacco. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protective & curative | | P | | New active in development from Corteva with activity on Septoria, Powdery Mildew, Botrytis, Anthracnose, **Alternaria**, Scab, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluazinam (Shirlan) Syngenta | 29 | Protective | | P | | Registered in Brassica vegetables for control of Club Root. US registration for control of ***Alternaria*** in carrots. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of ***Alternaria*** in almond, Brassica leafy greens, bulb vegetables, cucurbits, pistachio, tree nuts and sunflower. | R3 |
| Fluopyram + Trifloxystrobin (Luna Sensation) Bayer | 7+11 | Protectant & Curative | | P | | Registered for control of ***Alternaria***, Black Spot and Powdery Mildew in apples, Black Spot in pears, Blossom Blight, Brown Rot, Hull Rot, Shot Hole and Rust in stone fruit, and various leaf diseases in tropical fruits. US registration for control of ***Alternaria*** in almond, Brassica vegetables, Brassica leafy vegetables, carrot, citrus, pome fruit, small vine climbing fruit except kiwi fruit, leafy greens, cucurbits, tree nuts, fruiting vegetables & root vegetables except sugar beet. | - |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of **Alternaria Leaf Blight**, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| NUL3446 Nufarm | TBC | TBC | | P | | New active in development from Nufarm with activity on ***Alternaria*** spp. | - |
| Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta | 7+12 | Protectant & Curative | | P | | Registered for control of Botrytis in berries and grapes, and Botrytis and Sclerotinia in leafy vegetables and potato. US registration for control of ***Alternaria*** in berries, brassica vegetables, bulb vegetables, carrots, cucurbits, fruiting vegetables, grape and small fruit vine climbing (except fuzzy kiwifruit), specific leaf petioles, specific leafy greens, root and tuber vegetables, lemon and lime, mustard greens, pistachio, potato, root vegetables and tuberous and corm vegetables. | R3 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Damping-Off** (*Pythium* spp*., Phytophthora* spp.)<br>**Priority: Moderate** | | | | | | | |
| Damping-Off was ranked as a moderate priority in QLD & NSW and as a low priority in VIC. The disease attacks seedlings at the 1-2 leaf stage, causing water-soaked lesions on the stem and roots. Severe infections can cause stunting and yellowing in older crops. | | | | | | | |
| 1,3-dichloropropene + Chloropicrin (Telone C-35) | 8B | Soil fumigant | NR | A | ALL (Restricted use TAS, VIC & SA) | Registered in various crops including vegetables for control of plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases (including *Fusarium* and *Verticillium* wilts, *Rhizoctonia, **Pythium***) and suppression of weeds. Restricted chemical. [Users may require fumigator license] | - |
| Dazomet (Basamid) | 8F | Soil fumigant | NR | A | ALL | Registered in broadacre seed beds for control of soil fungi (including *Pythium, **Phytophthora,** Fusarium,* and *Verticillium*), nematodes (cyst and non-cyst forming), soil insects and germinating seeds of weeds. | - |
| Metalaxyl-M (Ridomil Gold 25G) Syngenta | 4 | Protectant | 7 | A | QLD, NSW & WA | Registered in cucurbits for control of **Damping Off**. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | - |
| Metham Sodium | - | Fumigant | NR | A | ALL | Registered in food crops as a pre-plant fumigant for control of fungal diseases including ***Rhizoctonia***, ***Pythium***, *Fusarium*, ***Phytophthora***, *Verticillium*, *Sclerotinia* and Club Root of crucifers. Applied as a soil injection, soil surface spray in front of a rotary tiller or through approved trickle irrigation systems. | - |
| *Streptomyces lydicus* (Actinovate) | BM 02 | Biological | NR | A | ALL | Registered in cucurbits for suppression of Powdery Mildew and in vegetables for control of **Fusarium**, **Rhizoctonia** and **Pythium** as seed treatment in vegetables. | - |
| *Bacillus amyloliquefaciens Strain QST 713* (Serenade Prime Soil Ameliorant and Biofungicide) Bayer | BM 02 | Biological | NR | P-A | ALL | Registered in vegetables for application to soil to improve bioavailability of soil resources to horticultural crops. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Amisulbrom (Amishield 500WG) Nufarm | 21 | Protectant | | P | | Registered for control of Clubroot and suppression of **Damping Off** in brassica vegetables, and control of Powdery Scab and suppression of Pink Rot in potatoes. | - |
| Fludioxonil + Metalaxyl-M (Maxim XL) Syngenta | 12+4 | Protectant & Curative | | P | | Registered for control of **Damping Off** in canola, industrial hemp, maize, oilseed mustard, silverbeet, sorghum, spinach and sweet corn. | R3 |
| Fludioxonil + Metalaxyl-M + Azoxystrobin (Dynasty Seed Treatment) Syngenta | 12+4 +11 | Protectant & Curative | | P | | Registered for control of **Damping Off** in cotton. | R3 |
| Fludioxonil + Sedaxane (Vibrance Premium Seed Treatment) Syngenta | 12+7 | Protectant & Curative | | P | | Registered in potatoes for control of Black Scurf (***Rhizoctonia***), Silver Surf, Black Rot, Gangrene and Fusarium Dry Rot and suppression of Scab. Hort innovation is conducting research for use in beetroot to control ***Rhizoctonia***. | R3 |
| NUL3163 Nufarm | TBC | | | P | | New active in development from Nufarm with activity on ***Fusarium***, ***Pythium*** & ***Rhizoctonia*.** | - |
| Thiophanate-Methyl + Etridiazole (Banrot) | 1+14 | Protectant | | P | | Registered in container grown ornamentals and in ground bedding plants as a post plant soil drench for control of ***Pythium, Phytophthora, Rhizoctonia*** and *Thielaviopsis*. | - |
| Thiram + Thiabendazole (P-Pickel T) | 1+M3 | Protectant | | P | | Registered in field & garden peas for control of Black Spot (*Mycosphaerella pinodes*) & Seedling Root Rots (***Fusarium, Pythium*** & *Macrofomina* spp.). Use as a liquid seed dressing. | R2 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Gummy Stem Blight** (*Didymella bryoniae*)<br>**Priority: Moderate** | | | | | | | |
| Gummy Stem Blight was ranked as a moderate priority in VIC & QLD and as a low priority in NSW. The fungus usually attacks stems causing a watery rot at ground level which may spread up the stem and into roots. Infection of the root and stem prevents the flow of water and nutrients, and plants wilt. Management options include use of clean seed and good on-farm hygiene. | | | | | | | |
| Azoxystrobin (Amistar) | 11 | Protectant & curative | 1 | A | ALL | Registered in cucurbits for the control of Powdery Mildew, Downy Mildew and **Gummy Stem Blight**. Commence soon after transplanting and continue till fruit maturity. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7-14 d] | - |
| Azoxystrobin + Oxathiapiprolin (Orondis Flexi) Syngenta | 11+49 | Protective & curative | 3 NG | A | ALL | Registered in cucurbits for the control of Downy Mildew and suppression of Powdery Mildew, **Gummy Stem Blight** and *Sclerotinia* spp. [Max. 2 applications per crop; re-treatment interval: 7-14 d] | - |
| Chlorothalonil (Bravo) | M5 | Protectant | 1 | A | ALL | Registered in zucchini for control of Downy Mildew, **Gummy Stem Blight,** Anthracnose, Alternaria Leaf Blight and Target Leaf Spot and suppression of Belly Rot. [Max. no. of applications not specified; re-treatment interval: 7-14 d] | R3 |
| Copper Oxychloride | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, Anthracnose and **Gummy Stem Blight**. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Dimethomorph (Acrobat) BASF | 40 | Protectant | 7 | A | ALL | Registered in cucurbits for control of Downy Mildew, Anthracnose, **Gummy Stem Blight**, Alternaria Leaf Spot and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | - |
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Protectant | 7 | A | QLD & NT | Registered in cucurbits for control of Downy Mildew, Anthracnose, **Gummy Stem Blight**, Alternaria Leaf Spot and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | R2 |
| Mancozeb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits (field) for control of Alternaria Spot, Anthracnose, Downy Mildew, Ring Spot, **Gummy Stem Blight**, and Septoria Spot. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | R2 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Mancozeb + Metalaxyl-M (Ridomil Gold MZ) Syngenta | M3+4 | Protectant & Curative | 7 | A | QLD | Registered in cucurbits (field) for control of Downy Mildew, Anthracnose, **Gummy Stem Blight** and Alternaria Leaf Spot. [Max. 4 applications per crop; apply 2 consecutive applications at re-treatment interval of 7-10 d] | R2 |
| Metiram (Polyram) BASF | M3 | Protectant | 7 | A | ALL | Registered in cucurbits for the control of Downy Mildew and **Gummy Stem Blight**. [Max. no. of applications not specified; re-treatment interval: 7 d] | R2 |
| Penthiopyrad (Fontelis) Corteva | 7 | Protectant | 1 | A | ALL | Registered in zucchini (field and protected) for control of Botrytis Grey Mould, Powdery Mildew, and **Gummy Stem Blight**. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7–14 d] | - |
| Propineb + Oxadixyl (Rebound) Kiwi Rural Trading | 4+M3 | Protectant | 3 | A | ALL | Registered in cucurbits for the control of Downy Mildew, **Gummy Stem Blight**, and Anthracnose. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7–10 d] | R2 |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of **Gummy Stem Blight** in cucurbits. | - |
| Cyprodinil + Fludioxonil (Switch) Syngenta | 9+12 | Protective & Curative | | P | | Registered for control of Sclerotinia**,** Botrytis and other diseases in several vegetable crops including leafy vegetables, peas, beans, leafy vegetables & lettuce. US registration for control of **Gummy Stem Blight** in cucurbits. | R3 |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of **Gummy Stem Blight** in cucurbits. | R3 |
| Fluopyram + Trifloxystrobin (Luna Sensation) Bayer | 7+11 | Protectant & Curative | | P | | Registered for control of *Alternaria*, Black Spot and Powdery Mildew in apples, Black Spot in pears, Blossom Blight, Brown Rot, Hull Rot, Shot Hole and Rust in stone fruit, and various leaf diseases in tropical fruits. US registration for control of **Gummy Stem Blight** in cucurbits. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, **Gummy Stem Blight**, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta | 7+12 | Protectant & Curative | | P | | Registered for control of Botrytis in berries and grapes, and Botrytis and Sclerotinia in leafy vegetables and potato. US registration for control of **Gummy Stem Blight** in cucurbits. | R3 |
| **Bacterial Spot** (*Xanthomonas campestris*)<br>**Priority: Moderate** | | | | | | | |
| Bacterial Spot was ranked as a moderate priority in QLD and as a low priority in VIC & NSW. The bacterium may be introduced in seed or in surviving undecomposed crop residue or other host plants. Bacteria spread in water splash during wet, windy weather or by overhead irrigation. It can also disperse on insects, or on people or equipment moving through the crop. Applications of copper may reduce disease spread. | | | | | | | |
| Copper Ammonium Acetate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of Angular Leaf Spot, **Bacterial Leaf Spot** and Downy Mildew. Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Hydroxide | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of Angular Leaf Spot and **Bacterial Leaf Spot.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Oxychloride | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of Angular Leaf Spot, **Bacterial Leaf Spot**, Downy Mildew, Anthracnose and Gummy Stem Blight. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper as Tribasic Copper Sulfate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of Angular Leaf Spot and **Bacterial Leaf Spot.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper as Cuprous Oxide | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of Angular Leaf Spot and **Bacterial Leaf Spot.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | NR | P | | Registered for suppression of **Bacterial Spot** in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. US registration for control of ***Xanthomonas* spp.** in fruiting vegetables, root/tuber and corm vegetables and stone fruit. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of ***Xanthomonas* spp.** in citrus, fruiting vegetables, leafy vegetables, stone fruit, root and tuber vegetables and tree nuts, and control of Anthracnose, Alternaria Leaf Spot, Downy Mildew, Gummy Stem Blight and Powdery Mildew in cucurbits. | - |
| Acibenzolar-S-Methyl (Actigard Plant Activator) Syngenta | P01 | Protectant | | P | | Registered in tomatoes for the suppression of Bacterial Speck, Bacterial Spot (***Xanthomonas* spp.**), Bacterial Canker and Powdery Mildew. US registration for suppression of ***Xanthomonas* spp.**in Brassica leafy vegetables, cucurbits, low growing berry, bulb onion, pepper and tomato. | - |
| **Angular Leaf Spot** (*Pseudomonas syringae*)<br>**Priority: Low** | | | | | | | |
| Angular Leaf Spot was ranked as a low priority in VIC, QLD & NSW. Symptoms first appear as small, water-soaked spots on leaves, but spread rapidly when in warm and moist conditions. | | | | | | | |
| Copper Ammonium Acetate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of **Angular Leaf Spot**, Bacterial Leaf Spot and Downy Mildew. Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Hydroxide | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of **Angular Leaf Spot** and Bacterial Leaf Spot**.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper Oxychloride | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of **Angular Leaf Spot**, Bacterial Leaf Spot, Downy Mildew, Anthracnose and Gummy Stem Blight. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Copper as Tribasic Copper Sulfate | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of **Angular Leaf Spot** and Bacterial Leaf Spot**.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Copper as Cuprous Oxide | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for the control of **Angular Leaf Spot** and Bacterial Leaf Spot**.** Apply at first signs of disease. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | NR | P | | Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. US registration for control of ***Pseudomonas* spp.** in berries, cucurbits, fruiting vegetables and stone fruit. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of ***Pseudomonas* spp.** in fruiting vegetables, leafy vegetables, stone fruit, tobacco and tree nuts, and control of Anthracnose, Alternaria Leaf Spot, Downy Mildew, Gummy Stem Blight and Powdery Mildew in cucurbits. | - |
| Acibenzolar-S-Methyl (Actigard Plant Activator) Syngenta | P01 | Protectant | | P | | Registered in tomatoes for the suppression of Bacterial Speck (***Pseudomonas syringae***), Bacterial Spot, Bacterial Canker and Powdery Mildew. US registration for suppression of ***Pseudomonas* spp.** in cucurbits and tomato. | - |
| **Anthracnose** (*Colletotrichum orbiculare*)<br>**Priority: Low** | | | | | | | |
| Anthracnose was ranked as a low priority in VIC, QLD & NSW. Can be seed-borne and carries over on crop residue in the soil. It is spread in water droplets and is favoured by warm, humid weather. | | | | | | | |
| Chlorothalonil (Bravo) | M5 | Protectant | 1 | A | ALL | Registered in zucchini for control of Downy Mildew, Gummy Stem Blight**, Anthracnose**, Alternaria Leaf Blight and Target Leaf Spot and suppression of Belly Rot. [Max. no. of applications not specified; re-treatment interval: 7-14 d] | R3 |
| Copper Oxychloride | M1 | Protectant | 1 | A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, **Anthracnose** and Gummy Stem Blight. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | - |
| Dimethomorph (Acrobat) BASF | 40 | Protectant | 7 | A | ALL | Registered in cucurbits for control of Downy Mildew, **Anthracnose**, Gummy Stem Blight, Alternaria Leaf Spot and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | **-** |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Protectant | 7 | A | QLD & NT | Registered in cucurbits for control of Downy Mildew, **Anthracnose**, Gummy Stem Blight, Alternaria Leaf Spot and Septoria Spot. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | R2 |
| Mancozeb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits (field) for control of Alternaria Spot, **Anthracnose**, Downy Mildew, Ring Spot, Gummy Stem Blight, and Septoria Spot. [Max. no. of applications not specified; re-treatment interval: 7-10 d] | R2 |
| Mancozeb + Metalaxyl-M (Ridomil Gold MZ) Syngenta | M3+4 | Protectant & Curative | 7 | A | QLD | Registered in cucurbits (field) for control of Downy Mildew, **Anthracnose**, Gummy Stem Blight and Alternaria Leaf Spot. [Max. 4 applications per crop; apply 2 consecutive applications at re-treatment interval of 7-10 d] | R2 |
| Propineb + Oxadixyl (Rebound) Kiwi Rural Trading | 4+M3 | Protectant | 3 | A | ALL | Registered in cucurbits for the control of Downy Mildew, Gummy Stem Blight, and **Anthracnose**. [Max. no. of applications not specified; 2 sequential applications; re-treatment interval: 7-10 d] | R2 |
| Zineb | M3 | Protectant | 7 | A | ALL | Registered in cucurbits for the control of Downy Mildew and **Anthracnose**. [Max. no. of applications not specified; re-treatment interval: 7 d] | R2 |
| *Aureobasidium pullulans* (Botector) Nufarm | BM 02 | Biological | NR | P-A | | Registered in cucurbits (field & protected) for control of *Botrytis* and suppression of *Sclerotinia* spp. US registration for the control of **Anthracnose** in berries, stone fruit, almond, fruiting vegetables, cucurbits, leafy vegetables, ornamentals and hops. | - |
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | | P | | Registered for control of **Anthracnose** in avocado and several tropical fruits. US registration for the control of **Anthracnose** in berries, citrus, fruiting vegetables, herbs/spices, pome fruit, stone fruit and tree nuts. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of **Anthracnose** in artichoke, asparagus, berries, citrus, cucurbits, fruiting vegetables, pome fruit, stone fruit, tobacco, root and tuber vegetables (except sugar beet) and tree nuts. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| BLAD (ProBlad Plus) | BM 01 | Biological | NR | P | | Registered for control of Brown Rot and Blossom Blight in stone fruit. US registration for control of **Anthracnose** in grapes and strawberries, and for control of Powdery Mildew in cucurbits. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protectant & Curative | | P | | New active in development from Corteva with activity on Septoria, Powdery Mildew, Botrytis, **Anthracnose**, Alternaria, Scab, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of **Anthracnose** in almond, cucurbits and tree nuts. | R3 |
| Fluopyram + Trifloxystrobin (Luna Sensation) Bayer | 7+11 | Protective & Curative | | P | | Registered for control of **Anthracnose** and Stem End Rot in tropical and sub-tropical fruit. US registration for control of **Anthracnose** in almond, berries, cherry, citrus, specific cucurbits, tree nuts, tomato and root vegetables (except sugar beet). | - |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of Alternaria Leaf Blight, Powdery Mildew, **Anthracnose**, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| Isofetamid (Kenja) ISK / AgNova | 7 | Protective & Curative | | P | ALL | Registered for control of Botrytis Grey Mould in berries. US registration for control of **Anthracnose** in almond, grapes and low-growing berries. | - |
| Pydiflumetofen + Fludioxonil (Miravis Prime) Syngenta | 7+12 | Protectant & Curative | | P | | Registered for control of Botrytis in berries and grapes, and Botrytis and Sclerotinia in leafy vegetables and potato. US registration for control of **Anthracnose** in berries and tuberous and corm vegetables, suppression of **Anthracnose** in lemons and limes, potato, and control of Alternaria, Cercospora, Gummy Stem Blight, Powdery Mildew, Scab, Septoria, Target Spot, Grey Mould and suppression of Fusarium Wilt in cucurbits. | R3 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Phytophthora Soil Fungus** (*Phytophthora spp.*)<br>**Priority: Low** | | | | | | | |
| Phytophthora Soil Fungus was ranked as a low priority in VIC, QLD & NSW. A soil-borne disease that is widespread in most regions, it enters through the roots and the leaves of affected plants show yellowing, curling and eventually wither and decay. Cultural controls recommended including crop rotation, improving drainage and the use of resistant varieties. | | | | | | | |
| 1,3-dichloropropene + Chloropicrin (Telone C-35) | 8B | Soil fumigant | NR | A | ALL (Restricted use TAS, VIC & SA) | Registered in various crops including vegetables for control of plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases (including *Fusarium* and *Verticillium* wilts, *Rhizoctonia, Pythium*) and suppression of weeds. Restricted chemical. [Users may require fumigator license] | - |
| Dazomet (Basamid) | 8F | Soil fumigant | NR | A | ALL | Registered in broadacre seed beds for control of soil fungi (including *Pythium, **Phytophthora,** Fusarium,* and *Verticillium*), nematodes (cyst and non-cyst forming), soil insects and germinating seeds of weeds. | - |
| Metham Sodium | - | Fumigant | NR | A | ALL | Registered in food crops as a pre-plant fumigant for control of fungal diseases including *Rhizoctonia*, *Pythium*, *Fusarium*, ***Phytophthora***, *Verticillium*, *Sclerotinia* and Club Root of crucifers. Applied as a soil injection, soil surface spray in front of a rotary tiller or through approved trickle irrigation systems. | - |
| *Bacillus amyloliquefaciens Strain QST 713* (Serenade Prime Soil Ameliorant and Biofungicide) Bayer | BM 02 | Biological | NR | P-A | ALL | Registered in vegetables for application to soil to improve bioavailability of soil resources to horticultural crops. | - |
| *Streptomyces lydicus* (Actinovate) | BM 02 | Biological | NR | P-A | ALL | Registered in cucurbits for suppression of Powdery Mildew and in vegetables for control of Fusarium, Rhizoctonia and Pythium as seed treatment in vegetables. Registered for control of **Phytophthora** in strawberries and tomato. | - |
| Metalaxyl-M (Ridomil Gold 25G) Syngenta | 4 | Protectant | 7 | P-A | QLD, NSW & WA | Registered in cucurbits (field & protected) for control of Damping Off. Registered for control of **Phytophthora Root Rot** in avocado and macadamia. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Oxathiapiprolin (Zorvec Enicade) Corteva | 49 | Protectant | 1 | P-A | ALL | Registered in cucurbits for control of Downy Mildew. US registration for control of ***Phytophthora* spp.** in cucurbits, fruiting vegetables, ginseng, tuberous and corm vegetables and tobacco. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of **Phytophthora Root Rot** in brassica leafy vegetables, citrus, cucurbits, corn, fruiting vegetables, legume vegetables, oilseeds, soybean, strawberries and root and tuber vegetables. | - |
| Fosetyl-Aluminium (Aliette) Bayer | 33 | Protectant | | P | | Registered for control of ***Phytophthora* spp.** in apples, peaches, avocados & pineapples. | - |
| Mandipropamid (Revus) Syngenta | 40 | Protectant | | P | | Registered for control of Downy Mildew in Asian leafy vegetables, brassica leafy vegetables, grapes, leafy vegetables, poppy oilseed, rocket, silverbeet and spinach. US registration for control of ***Phytophthora* spp.** in citrus, ginseng and potatoes, and suppression of Phytophthora spp. in cucurbits and fruiting vegetables. | - |
| Thiophanate-Methyl + Etridiazole (Banrot) | 1+14 | Protectant | | P | | Registered in container grown ornamentals and in ground bedding plants as a post plant soil drench for control of *Pythium,* ***Phytophthora,*** *Rhizoctonia* and *Thielaviopsis*. | - |
| **Rhizoctonia Ground Rot** (*Rhizoctonia solani*)<br>**Priority: Low** | | | | | | | |
| Rhizoctonia Ground Rot was ranked as a low priority in VIC, QLD & NSW. A common soil-borne disease, the symptoms can vary from water-soaked cankers in stems and roots to damaged fruit that is growing near the ground. | | | | | | | |
| 1,3-dichloropropene + Chloropicrin (Telone C-35) | 8B | Soil fumigant | NR | A | ALL (Restricted use TAS, VIC & SA) | Registered in various crops including vegetables for control of plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases (including *Fusarium* and *Verticillium* wilts, *Rhizoctonia, Pythium*) and suppression of weeds. Restricted chemical. [Users may require fumigator license] | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Chlorothalonil (Bravo) | M5 | Protectant | 1 | A | ALL | Registered in zucchini for control of Downy Mildew, Gummy Stem Blight**,** Anthracnose, Alternaria Leaf Blight and Target Leaf Spot and suppression of **Belly Rot (*Rhizoctonia solani*)**. [Max. no. of applications not specified; re-treatment interval: 7-14 d] | R3 |
| Dazomet (Basamid) | 8F | Soil fumigant | NR | A | ALL | Registered in broadacre seed beds for control of soil fungi (including *Pythium, **Phytophthora,** Fusarium,* and *Verticillium*), nematodes (cyst and non-cyst forming), soil insects and germinating seeds of weeds. | - |
| Metham Sodium | - | Fumigant | NR | A | ALL | Registered in food crops as a pre-plant fumigant for control of fungal diseases including ***Rhizoctonia***, *Pythium*, *Fusarium*, *Phytophthora*, *Verticillium*, *Sclerotinia* and Club Root of crucifers. Applied as a soil injection, soil surface spray in front of a rotary tiller or through approved trickle irrigation systems. | - |
| *Streptomyces lydicus* (Actinovate) | BM 02 | Biological | NR | A | ALL | Registered in cucurbits for suppression of Powdery Mildew and in vegetables for control of Fusarium, **Rhizoctonia** and Pythium as seed treatment in vegetables. | - |
| *Bacillus amyloliquefaciens Strain QST 713* (Serenade Prime Soil Ameliorant & Biofungicide) Bayer | BM 02 | Biological | NR | P-A | ALL | Registered in vegetables for application to soil to improve bioavailability of soil resources to horticultural crops. | - |
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | NR | P | | Registered for control of Botrytis in grapevines and strawberries. US registration for control of ***Rhizoctonia* spp.** in artichoke, asparagus, brassica leafy vegetables, bulb vegetables, cucurbits, corn, fruiting vegetables, leafy vegetables, legume vegetables, oilseeds, soybean, strawberries and root and tuber vegetables. | - |
| Fludioxonil + Metalaxyl-M (Maxim XL) Syngenta | 12+4 | Protectant & Curative | | P | | Registered for the control of **Rhizoctonia Rot** in Canola seedlings and for control of Damping Off in canola, industrial hemp, maize, oilseed mustard, silverbeet, sorghum, spinach and sweet corn. | R3 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Fludioxonil + Sedaxane (Vibrance Premium Seed Treatment) Syngenta | 12+7 | Protectant & Curative | | P | | Registered in potatoes for control of Black Scurf (***Rhizoctonia***), Silver Surf, Black Rot, Gangrene and Fusarium Dry Rot and suppression of Scab. Hort innovation is conducting research for use in beetroot to control ***Rhizoctonia***. | R3 |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of ***Rhizoctonia*** in cucurbits and for suppression of ***Rhizoctonia*** in Brassica leafy vegetables. | R3 |
| NUL3163 Nufarm | TBC | | | P | | New active in development from Nufarm with activity on *Fusarium, Pythium* & ***Rhizoctonia*.** | - |
| Penflufen+ Trifloxystrobin (Evergol Extend) Bayer | 7+11 | Protectant | | P | | Registered for control of ***Rhizoctonia*** **spp.** in canola, forage brassicas, pastures and cotton. | - |
| Thiophanate-Methyl + Etridiazole (Banrot) | 1+14 | Protectant | | P | | Registered in container grown ornamentals and in ground bedding plants as a post plant soil drench for control of *Pythium, Phytophthora,* ***Rhizoctonia*** and *Thielaviopsis*. | - |
| **Scab** (*Cladosporium spp.*)<br>**Priority: Low** | | | | | | | |
| Scab was ranked as a low priority in VIC, QLD & NSW. | | | | | | | |
| Copper | M1 | Protectant | 1 | P-A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, Anthracnose and Gummy Stem Blight. Registered for control of **Scab (*Cladosporium carpophilum*)** in stone fruit. | - |
| Mancozeb | M3 | Protectant | 7 | P-A | ALL | Registered in cucurbits (field) for control of Alternaria Spot, Anthracnose, Downy Mildew, Ring Spot, Gummy Stem Blight, and Septoria Spot. Registered for control of **Scab (*Cladosporium carpophilum*)** in stone fruit. | R2 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Penthiopyrad (Fontelis) Corteva | 7 | Protectant | 1 | P-A | ALL | Registered in zucchini (field and protected) for control of Botrytis Grey Mould, Powdery Mildew, and Gummy Stem Blight. Registered for control of **Scab (*Cladosporium carpophilum*)** in stone fruit. | - |
| Azoxystrobin (Amistar) | 11 | Protectant & curative | 1 | P-A | ALL | Registered in cucurbits for the control of Powdery Mildew, Downy Mildew and Gummy Stem Blight. Registered for control of ***Cladosporium*** in passionfruit and Rubus. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protective & curative | | P | | New active in development from Corteva with activity on Septoria, Powdery Mildew, Botrytis, Anthracnose, Alternaria, **Scab**, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 7+3 | Protectant & Curative | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of ***Cladosporium* spp.** in almond, bulb vegetables, stone fruit and tree nuts, and control of Powdery Mildew, Alternaria Leaf Spot, Gummy Stem Blight, Belly Rot and Anthracnose in cucurbits. | R3 |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of ***Cladosporium* spp.** in almonds. US registration for control of **Scab** in stone fruit and tree nuts, and for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| **Septoria Spot** (*Septoria cucurbitacearum*)<br>**Priority: Low** | | | | | | | |
| Septoria Spot was ranked as a low priority in VIC, QLD & NSW. Light brown irregular spots occur between the leaf veins which expand rapidly and cover the leaves. The fungus can survive on the old leaves removed at harvest, on weeds, and as spores on seed. The use of drip irrigation is recommended rather than sprinklers. | | | | | | | |
| Dimethomorph (Acrobat) BASF | 40 | Protectant | 7 | A | ALL | Registered in cucurbits for control of Downy Mildew, Anthracnose, Gummy Stem Blight, Alternaria Leaf Spot and **Septoria Spot**. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | **-** |
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Protectant | 7 | A | QLD & NT | Registered in cucurbits for control of Downy Mildew, Anthracnose, Gummy Stem Blight, Alternaria Leaf Spot and **Septoria Spot**. [Max. 4 applications per crop; re-treatment interval: 7-10 d] | R2 |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Copper | M1 | Protectant | 1 | P-A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, Anthracnose and Gummy Stem Blight. Registered for control of **Septoria Spot** in citrus, passionfruit, blackcurrant, flowers, parsnips and tomatoes. | - |
| Florylpicoxamid (Adavelt) Corteva | 21 | Protective & Curative | | P | | New active in development from Corteva with activity on **Septoria**, Powdery Mildew, Botrytis, Anthracnose, Alternaria, Scab, Monilinia, Rust and *Mycosphaerella* spp. Scheduled for JMPR evaluation in 2023. | - |
| Fluopyram + Tebuconazole (Luna Experience) Bayer | 3+7 | Protective | | P | | Registered for control of Yellow Sigatoka, Leaf Speckle and Cordana Leaf Spot in bananas and for control of Grey Mould and Powdery Mildew in grapevines. US registration for control of **Septoria Spot** in dry and succulent beans and pistachio, and for control of Powdery Mildew, Alternaria Leaf Spot Gummy Stem Blight, Belly Rot and Anthracnose in cucurbits. | R3 |
| Fluxapyroxad + Pyraclostrobin (Merivon) BASF | 7+11 | Protectant & Curative | | P | | Registered for control of Alternaria Leaf Spot, Black Spot, Brown Rot Nut Scab, Shot Hole and Rust in almond, Brown Rot in cherries and Husk Spot in macadamia. US registration for control of **Septoria Spot** in leafy vegetables, and for control of Alternaria Leaf Blight, Powdery Mildew, Anthracnose, Cercospora Leaf Spot, Gummy Stem Blight, Microdochium Blight, Target Leaf Spot and suppression of Downy Mildew in cucurbits. | - |
| **Bacterial Soft Rot** (*Erwinia spp.*)<br>**Priority: Low** | | | | | | | |
| Bacterial Soft Rot was ranked as a low priority in QLD. The bacterium may be introduced in seed or in surviving undecomposed crop residue or other host plants. It can spread in water splash and so overhead irrigation should be avoided. | | | | | | | |
| Copper | M1 | Protectant | 1 | P-A | ALL | Registered in cucurbits for control of Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, Anthracnose and Gummy Stem Blight. Registered for control of ***Erwinia spp.*** in celery. | - |
| *Bacillus amyloliquefaciens* (Serenade Opti) Bayer | BM 02 | Biological | NR | P | | Registered for suppression of Bacterial Spot in capsicum, chilli and tomato, Anthracnose and Stem End Rot in avocado and mango, and Botrytis in grapevines and strawberries. US registration for control of ***Erwinia spp.*** in pome fruit and root/tuber and corm vegetables, and for control of Powdery Mildew and Angular Leaf Spot in cucurbits. | - |

| Disease / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Regulatory risk |
|---|---|---|---|---|---|---|---|
| *Bacillus amyloliquefaciens strain MBI 600* (Serifel) BASF | BM 02 | Biological | | P | | Registered for control of *Botrytis* in grapes and strawberries. US registration for control of ***Erwinia spp.*** in pome fruit and root and tuber vegetables and for control of Anthracnose, Alternaria Leaf Spot, Downy Mildew, Gummy Stem Blight and Powdery Mildew in cucurbits. | - |
| Acibenzolar-S-Methyl (Actigard Plant Activator) Syngenta | P01 | Protectant | | P | | Registered in tomatoes for the suppression of Bacterial Speck, Bacterial Spot, Bacterial Canker and Powdery Mildew. US registration for suppression of ***Erwinia spp.*** in pome fruit. | - |

## 4.2 Insect and mite pests of zucchini

### 4.2.1 Insect and mite pest priorities

| Common name | Scientific name |
|---|---|
| **High** | |
| Green Peach Aphid | *Myzus persicae* |
| Silverleaf Whitefly | *Bemisia tabaci* |
| Greenhouse Whitefly | *Trialeurodes vaporariorum* |
| Western Flower Thrips | *Frankliniella occidentalis* |
| Tomato Thrips | *Frankliniella schultzei* |
| Plague Thrips | *Thrips imaginis* |
| **Moderate** | |
| Green Vegetable Bug | *Nezara viridula* |
| Cotton Bollworm / Corn Earworm | *Helicoverpa armigera* |
| Native Budworm | *Helicoverpa punctigera* |
| Two-Spotted Mites | *Tetranychus urticae* |
| Fungus Gnats | *Bradysia* spp., Sciaridae |
| **Low** | |
| Ants | *Formicidae* |
| Cucumber Fruit Fly | *Bactrocera cucumis* |
| Cucumber Moth | *Diaphania indica* |
| Jassids / Leafhoppers | Cicadellidae |
| Mealybugs | *Pseudococcidae* |
| Rutherglen Bug | *Nysius vinitor* |
| Pumpkin Beetle | *Aulacophora hilaris* |
| 28-Spotted Potato Ladybird | *Henosepilachna vigintisexpunctata* |
| Wingless Grasshopper | *Phaulacridium vittatum* |

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

| **New Pest to Australia (unknown priority)** | |
|---|---|
| Fall Armyworm | *Spodoptera frugiperda* |
| Tomato Potato Psyllid | *Bactericera cockerelli* |
| Tomato Red Spider Mite | *Tetranychus evansi* |
| Vegetable Leafminer | *Liriomyza sativae* |
| Serpentine Leafminer | *Liriomyza huidobrensis* |
| American Serpentine Leafminer | *Liriomyza trifolii* |

The feedback received from the different States ranked Aphids, Whiteflies and Thrips as high priority pests. Available and potential products for these high priority insects and mites are in Section 4.2.2.

**Resistance Management**

There are several insecticide management strategies that apply to cucurbits on the CropLife website[5], including Aphids, Silverleaf Whitefly, Mites & Thrips.

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

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

## 4.2.2 Available and potential products for 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 |
|---|---|---|---|---|---|---|---|---|
| **Green Peach Aphid** (*Myzus persicae*)<br>**Priority: High** | | | | | | | | |
| Green Peach Aphids were ranked as a high priority in QLD and as a moderate priority in VIC & NSW. Aphids suck on sap, causing loss of vigour, and in some cases yellowing, stunting or distortion of plant parts. Honeydew can cause sooty mould to develop on leaves. Green Peach Aphid is an important disease vector in zucchini. | | | | | | | | |
| Afidopyropen (Versys) BASF | 9D | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of **Green Peach Aphid**, Cabbage Aphid, Currant Lettuce Aphid and Cotton/Melon Aphids and suppression of Silverleaf Whitefly. [Max. 2 applications per crop; re-treatment interval 14 d] | L<br>Bee:L | - |
| *Beauveria bassiana* (Velifer) BASF | UNF | Biological | NR | A | ALL | Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion Thrips, Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, **Green Peach Aphid** & Two-Spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d] | L<br>Bee:L | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables (field only) for control of Silverleaf Whitefly, Heliothis, Potato Moth, Cucumber Moth, Cluster Caterpillar, **Green Peach Aphid,** Two-Spotted Mite and suppression of Western Flower Thrips, Tomato Thrips & Plague Thrips [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M Bee:VH | - |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of **Aphids**, Jassids, Mites, Leafhoppers, Green Vegetable Bug, Thrips, and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H Bee:H | R1 |
| Flonicamid (Mainman) UPL | 9C | Ingestion | 1 | A | ALL | Registered in cucurbits for control of **Green Peach Aphid**, Melon Aphid, and Silverleaf Whitefly. [Max. 3 applications per crop; re-treatment interval 14 d] | M Bee:L | - |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, **Aphids**, Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Imidacloprid (formulations suitable for foliar application 200SC, 350SC) | 4A | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits for control of **Green Peach Aphid** as a foliar treatment. [Max. no. of applications & re-treatment intervals not specified. Do not use consecutive applications] | M Bee:M | R2 |
| Maldison | 1B | Contact | 3 | A | ALL | Registered in vegetables including cucurbits for control of **Aphid**, Green Vegetable Bug, Jassid, Leafhopper, Rutherglen Bug, Redlegged Earth Mite (excl. TAS) & 28-Spotted Ladybird (excl. TAS) [Apply at first sight of infestation: max no. of applications not specified] | H Bee:H | R3 |
| Petroleum Oil | UN | Contact | 1 | A | ALL | Registered in cucurbits (field & protected) for control of **Aphids**, Mites, Thrips and Leafhopper. [Max. 4 applications per season; re-treatment intervals not specified] | VL Bee:L | - |
| Pirimicarb (Aphidex) | 1A | Contact & Ingestion | 2 | A | ALL | Registered in cucurbits for control of **Aphids.** [Max. no. of applications not specified; re-treatment 5-10 d] | VL Bee:VL | R3 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of **Aphids**, Thrips, Mealybug, Two-Spotted Mites, Spider Mite and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L Bee:L | - |
| Pymetrozine (Chess) Syngenta | 9B | Ingestion | 3 | A | ALL | Registered in cucurbits (field and protected) for control of Melon Aphid, **Green Peach Aphid,** Potato Aphid and Cowpea Aphid; and for suppression of Silverleaf Whitefly and Greenhouse Whitefly. [Max. 2 applications per crop; re-treatment interval 7 d] | L Bee:VL | R3 |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Silverleaf Whitefly, **Green Peach Aphid** and Cotton Aphid. [Max 3 applications per crop; re-treatment interval 7 d] | M Bee:VL | - |
| Sulfoxaflor (Transform) Corteva | 4C | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits (field grown only) for control of **Green Peach Aphid**, Melon Aphid and Greenhouse Whitefly and suppression of Rutherglen Bug. Do not use if honeybees are foraging. [Max. no. of applications not specified; re-treatment interval 7-10 d] | M Bee:VH | - |
| Cyantraniliprole (Benevia) FMC | 28 | Ingestion | 1 | P-A | ALL | Registered in cucurbits for the control of Melon Aphid, Silverleaf Whitefly, Cotton Bollworm, Cucumber Moth, Native Budworm & suppression of Western Flower Thrips. Registered for control of **Green Peach Aphid** in strawberries and suppression of **Green Peach Aphid** in fruiting vegetables and potatoes. | M Bee:VH | - |
| Emulsifiable Botanical Oil (Eco-Oil) | - | Contact | | P-A | | Registered in vegetables for control of Greenhouse Whitefly. Registered for control of Aphids in tomatoes, cucumbers, capsicums, strawberries and ornamentals. | L Bee:L | - |
| Dimpropyridaz (Axalion) BASF | TBC | | | P | | BASF has applied for registration in leafy vegetables, brassica vegetables and fruiting vegetables, including cucurbits to control Whitefly, Aphids and **Thrips**. Pending regulatory approvals, first market introduction in Australia is expected by late 2022 or early 2023. | - | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of **Green Peach Aphid** in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse Whitefly, **Green Peach Aphid** & Cotton Aphid. | L Bee:VL | - |
| Novaluron + Acetamiprid (Cormoran) Adama | 15+4A | Contact & Ingestion | | P | | Registered for control of **Green Peach Aphid** in stone fruit. | M Bee:M | R2 |
| **Silverleaf Whitefly** *(Bemisia tabaci)*<br>**Greenhouse Whitefly** *(Trialeurodes vaporariorum)*<br>**Priority: High** | | | | | | | | |
| Silverleaf whitefly was ranked as a high priority in QLD and as a moderate priority in VIC & NSW. High reproduction rate and short generation time results in large numbers that can retard plants through sap feeding. Silverleaf Whitefly is able to develop resistance very quickly when insecticides are used repeatedly. | | | | | | | | |
| Afidopyropen (Versys) BASF | 9D | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Green Peach Aphid, Cabbage Aphid, Currant Lettuce Aphid and Cotton/Melon Aphids and suppression of **Silverleaf Whitefly**. [Max. 2 applications per crop; re-treatment interval 14 d] | L Bee:L | - |
| *Beauveria bassiana* (Velifer) BASF | UNF | Biological | NR | A | ALL | Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion Thrips, **Greenhouse Whitefly**, **Silverleaf Whitefly**, Sweet Potato Whitefly, Green Peach Aphid & Two-Spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d] | L Bee:L | - |
| Bifenthrin (Talstar) | 3A | Contact | 1 | A | QLD, NSW, NT & WA | Registered in cucurbits (field grown only) for control of Native Budworm, Corn Earworm, Cucumber Moth and **Silverleaf Whitefly**. Adult insects should be targeted. [Max. 2 applications per crop; re-treatment interval not specified] | VH Bee:H | R3 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Buprofezin (Applaud) PER82467 | 16 | Ingestion / IGR | 3 | A | ALL (excl. VIC) | Permitted for use in zucchini (field & protected) for control of **Greenhouse Whitefly**, Sweet Potato Whitefly and **Silverleaf Whitefly**. [Max. 2 applications per crop; re-treatment interval 14 d] | L Bee:L | - |
| Chlorpyrifos (Lorsban) | 1B | Contact | 5 | A | NSW, WA & ACT | Registered in cucurbits for control of **Whiteflies**. [Max. no. of applications not specified; re-treatment interval 10-14 d] | H Bee:H | R1 |
| Cyantraniliprole (Benevia) FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Melon Aphid, **Silverleaf Whitefly**, Cotton Bollworm, Cucumber Moth, Native Budworm & suppression Of Western Flower Thrips. [Max. 2 applications per crop; re-treatment interval 7-10 d] | M Bee:VH | - |
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables. (field only) for control of **Silverleaf Whitefly**, Heliothis, Potato Moth, Cucumber Moth, Cluster Caterpillar, Green Peach Aphid**,** Two-Spotted Mite and suppression of Western Flower Thrips, Tomato Thrips & Plague Thrips [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M Bee:VH | - |
| Emulsifiable Botanical Oil (Eco-Oil) | - | Contact | NR | A | ALL | Registered in vegetables for control of **Greenhouse Whitefly.** [Max. 3 applications per crop; re-treatment interval 27-56 d] | L Bee:L | - |
| Flonicamid (Mainman) UPL | 9C | Ingestion | 1 | A | ALL | Registered in cucurbits for control of Green Peach Aphid, Melon Aphid and **Silverleaf Whitefly**. [Max. 3 applications per crop; re-treatment interval 14 d] | M Bee:L | - |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, Aphids, Caterpillars, Earwigs, **Whitefly**, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Imidacloprid (formulations suitable for soil application 350SC, 750WG) | 4A | Contact & Ingestion | NR | A | ALL | Registered in cucurbits for control of **Silverleaf Whitefly** as a soil application. Applied either as sub-surface trickle irrigation injection 5-7 days after planting or as a furrow spray not earlier than 5 days pre-plant. [Max. 1 application per crop] | M Bee:M | R2 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Petroleum Oil PER12221 | UN | Contact | 1 | A | ALL (excl. VIC) | Permitted for use in cucurbits for control of **Greenhouse Whitefly** and **Silverleaf Whitefly**. [Max. no. of applications and re-treatment intervals not specified] | VL Bee:L | - |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of Aphids, Thrips, Mealybug, Two-Spotted Mites, Spider Mite and **Whitefly**. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L Bee:L | - |
| Pymetrozine (Chess) Syngenta | 9B | Ingestion | 3 | A | ALL | Registered in cucurbits (field and protected) for control of Melon Aphid, Green Peach Aphid, Potato Aphid and Cowpea Aphid; and for suppression of **Silverleaf Whitefly** and **Greenhouse Whitefly**. [Max. 2 applications per crop; re-treatment interval 7 d] | L Bee:VL | R3 |
| Pyriproxyfen (Admiral) Sumitomo | 7C | Ingestion / IGR | 1 NG | A | ALL | Registered in cucurbits for control of **Silverleaf Whitefly** biotype B) and Greenhouse Whitefly. [Max. 2 applications per season; re-treatment interval 14 d] | VL Bee:L | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of **Silverleaf Whitefly**, Green Peach Aphid and Cotton Aphid. [Max 3 applications per crop; re-treatment interval 7 d] | M Bee:VL | - |
| Sulfoxaflor (Transform) Corteva | 4C | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits (field grown only) for control of Green Peach Aphid, Melon Aphid and **Greenhouse Whitefly** and suppression of Rutherglen Bug. Do not use if honeybees are foraging. [Max. no. of applications not specified; re-treatment interval 7-10 d] | M Bee:VH | - |
| *Clitoria ternatea* Extract (Sero-X) Growth Agriculture | - | Biological | NR | P | | Registered for control of *Helicoverpa* spp., Green Mirids and **Silverleaf Whitefly** in cotton and for control of Diamondback Moth in brassica leafy vegetables. | L Bee:VL | - |
| Dimpropyridaz (Axalion) BASF | TBC | | | P | | BASF has applied for registration in leafy vegetables, brassica vegetables and fruiting vegetables, including cucurbits to control **Whitefly**, Aphids and Thrips. Pending regulatory approvals, first market introduction in Australia is expected by late 2022 or early 2023. | - | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of **Whitefly** in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of **Silverleaf Whitefly**, Greenhouse Whitefly, Green Peach Aphid & Cotton Aphid . | L Bee:VL | - |
| NUL3145 Nufarm | TBC | | | P | | New product from Nufarm with activity on Scale, Nematodes, Mealybug and **Whitefly**. | - | - |
| **Western Flower Thrips** (*Frankliniella occidentalis*)<br>**Tomato Thrips** (*Frankliniella schultzei*)<br>**Plague Thrips** (*Thrips imaginis*)<br>**Priority: High** | | | | | | | | |
| Thrips were ranked as a high priority in QLD and as a moderate priority in VIC & NSW. Western Flower Thrips were ranked as a high priority in QLD and as a moderate priority in VIC & NSW. Western Flower Thrips develop resistance more easily than other thrips species. It is a vector for many viruses including Tomato Spotted Wilt Virus. Identification of the correct species is important prior to treatment. MT16009 IPM Project Recommends: The use of predatory thrips, mites & bug releases, control flowering weeds, mulch and use of certified seed. | | | | | | | | |
| *Beauveria bassiana* (Velifer) BASF | UNF | Biological | NR | A | ALL | Registered in protected vegetables and ornamentals for suppression of various pests including: **Western Flower Thrips**, **Onion Thrips**, Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-Spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d] | L Bee:L | - |
| Cyantraniliprole (Benevia) FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Melon aphid, Silverleaf Whitefly, Cotton Bollworm, Cucumber Moth, Native Budworm & suppression of **Western Flower Thrips**. [Max. 2 applications per crop; re-treatment interval 7-10 d] | M Bee:VH | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables (field only) for control of Silverleaf Whitefly, Heliothis, Potato Moth, Cucumber Moth, Cluster Caterpillar, Green Peach Aphid, Two-Spotted Mite and suppression of **Western Flower Thrips**, **Tomato Thrips** & **Plague Thrips**. [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M Bee:VH | - |
| Diazinon | 1B | Contact | 14 G:14 | A | ALL (excl. TAS) | Registered in cucurbits for control of **Thrips**. [Max no. of applications and re-treatment interval not specified] | H Bee:VH | R3 |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, Jassids, Mites, Leafhoppers, Green Vegetable Bug, **Thrips** and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H Bee:H | R1 |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, Aphids, Caterpillars, Earwigs, Whitefly, **Thrips** and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Methomyl PER82428 | 1A | Contact | 3 | A | ALL | Permitted in zucchini (field) for control of *Helicoverpa* spp., Cucumber Moth, Cluster Caterpillar, Loopers, Webworm, Rutherglen Bug and **Thrips** including **Western Flower Thrips**. [Max. 6 applications per season; re-treatment intervals not specified] | VL Bee:L | - |
| Petroleum Oil | UN | Contact | 1 | A | ALL | Registered in cucurbits (field & protected) for control of Aphids, Mites, **Thrips** and Leafhopper. [Max. 4 applications per season; re-treatment intervals not specified] | VL Bee:L | - |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of Aphids, **Thrips**, Mealybug, Two-Spotted Mites, Spider Mite and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L Bee:L | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Spinetoram (Success Neo) Corteva | 5 | Ingestion | 3 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of *Helicoverpa*, Cucumber Moth & **Western Flower Thrips.** [Max 4 applications per crop; re-treatment interval: 7-14 d] | M Bee:H | - |
| Spinosad (Entrust Organic) Corteva | 5 | Ingestion | 3 G:14 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of Cucumber Moth, *Helicoverpa* & **Western Flower Thrips**. [Max. 4 applications per season; re-treatment interval 7-14 d] | L Bee:L | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | P-A | A | Registered in cucurbits for control of Cotton Aphid, Green Peach Aphid & Silverleaf Whitefly. Registered for control of **Western Flower Thrips** and **Tomato Thrips** in green beans, control of **Western Flower Thrips**, **Tomato Thrips** and **Plague Thrips** in celery and rhubarb, herbs, bulb vegetables, and control of **Western Flower Thrips** in lettuce. | M Bee:VL | - |
| Dimpropyridaz (Axalion) BASF | TBC | | | P | | BASF has applied for registration in leafy vegetables, brassica vegetables and fruiting vegetables, including cucurbits to control Whitefly, Aphids and **Thrips**. Pending regulatory approvals, first market introduction in Australia is expected by late 2022 or early 2023. | - | - |
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for suppression of **Thrips** in berries, citrus, fruiting vegetables, tropical and subtropical fruit, and control of Leafhoppers, Aphids, Squash Bug and Whitefly in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse Whitefly, Green Peach Aphid & Cotton Aphid . | L Bee:VL | - |
| NUL3445 Nufarm | TBC | | | P | | New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, Fruit Fly and **Thrips**. | - | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| SYNFOI21 Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for **Thrips**, Bugs, Mites and Caterpillars | - | - |
| **Green Vegetable Bug** (*Nezara viridula*)<br>**Priority: Moderate** | | | | | | | | |
| Green Vegetable Bug was ranked as a moderate priority in VIC, QLD & NSW. They use their long, thin mouthpart to suck nutrients from the aerial parts of the plant. It emits a foul smell when disturbed to deter predators. Nymphs are attacked by ants, spiders & predatory bugs. It is important to monitor crops for eggs and nymphs of pest species by regular field scouting. | | | | | | | | |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, Jassids, Mites, Leafhoppers, **Green Vegetable Bug**, Thrips, and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R1 |
| Maldison | 1B | Contact | 3 | A | ALL | Registered in vegetables including cucurbits for control of Aphid, **Green Vegetable Bug**, Jassid, Leafhopper, Rutherglen Bug, Redlegged Earth Mite (excl. TAS) & 28-Spotted Ladybird (excl. TAS) [Apply at first sight of infestation: max no. of applications not specified] | H<br>Bee:H | R3 |
| Trichlorfon (Lepidex) | 1B | Contact | 2 | A | ALL | Registered in vegetables for control of **Green Vegetable Bug** and Rutherglen Bug. Apply at first sight of infestation. [Max no. of applications not specified; re-treatment interval 7-10 d] | H<br>Bee:H | R2 |
| Sulfoxaflor (Transform) Corteva | 4C | Contact & Ingestion | 1 | P-A | ALL | Registered in cucurbits (field grown only) for control of Green Peach Aphid, Melon Aphid and Greenhouse Whitefly and suppression of Rutherglen Bug. US registration for suppression of **Stink Bugs** in succulent, edible podded and dry beans. | M<br>Bee:H | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of Leafhoppers, Aphids, Squash Bug and Whitefly in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse whitefly, Green Peach Aphid & Cotton Aphid. | L Bee:VL | - |
| NUL3445 Nufarm | TBC | | | P | | New product in development from Nufarm with activity on Lepidoptera, **Bugs**, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| SYNFOI21 Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, **Bugs**, Mites and Caterpillars. | - | - |
| **Cotton Bollworm / Corn Earworm** (*Helicoverpa armigera*)<br>**Native Budworm** (*Helicoverpa punctigera*)<br>**Priority: Moderate** | | | | | | | | |
| Helicoverpa was ranked as a moderate priority in VIC, QLD & NSW. *Helicoverpa armigera* is generally regarded as the more serious pest because of its greater capacity to develop resistance to insecticides, broader host range, and persistence in cropping areas from year to year. Larvae feed on leaves but are most damaging when feeding on growing terminals, buds, flowers and fruit. Damage also occurs through bud/fruit shedding and reduced quality. | | | | | | | | |
| *Bacillus thuringiensis subsp. kurstaki* (DiPel) | 11A | Biological | NR | A | ALL | Registered in vegetables for control of Caterpillars, including ***Helicoverpa* spp.** [Apply a minimum of 2 sprays, 3 d apart; re-treatment interval 3-5 d] | VL Bee:L | - |
| Bifenthrin (Talstar) | 3A | Contact | 1 | A | QLD, NSW, NT & WA | Registered in cucurbits (field grown only) for control of **Native Budworm**, **Corn Earworm**, Cucumber Moth and Silverleaf Whitefly. Target larvae < 5 mm in length. [Max. 2 applications per crop; re-treatment interval not specified] | VH Bee:H | R3 |
| Chlorantraniliprole (Coragen) FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of **Cotton Bollworm**, **Native Budworm** and Cucumber Moth. [Max. 3 applications per crop, no more than 2 consecutive; re-treatment interval 5 d] | L Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Cyantraniliprole (Benevia) FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Melon Aphid, Silverleaf Whitefly, **Cotton Bollworm**, Cucumber Moth, **Native Budworm** & suppression Of Western Flower Thrips. [Max. 2 applications per crop; re-treatment interval 7-10 d] | M Bee:VH | - |
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables. (field only) for control of Silverleaf Whitefly, **Heliothis**, Potato Moth, Cucumber Moth, Cluster Caterpillar, Green Peach Aphid, Two-Spotted Mite and suppression of Western Flower Thrips, Tomato Thrips & Plague Thrips [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M Bee:VH | - |
| Emamectin (Proclaim Opti) Syngenta | 6 | Ingestion | 3 NG | A | ALL | Registered in cucurbits (field & protected) for control of **Heliothis**, Cluster Caterpillar and Cucumber Moth. [Max. 4 applications per crop; re-treatment interval 7 d] | M Bee:H | - |
| Flubendiamide (Belt) Bayer | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of ***Helicoverpa* spp.** and Cucumber Moth. [Max. 3 applications per crop; re-treatment interval 7-14 d] | L-M Bee:L | - |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, Aphids, **Caterpillars**, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Helicoverpa NPV (Vivus Max) AgBiTech | 31 | Biological | NR | A | ALL | Registered in cucurbits for control of ***Helicoverpa* spp.** Effective on larvae of <7 mm. [Max no. of applications not specified; re-treatment interval 2-3 d] | VL Bee:L | - |
| Indoxacarb (Avatar eVo) FMC | 28 | Ingestion | 3 NG | A | ALL | Registered in cucurbits (field) for control of **Cotton Bollworm**, **Native Budworm** and Cluster Caterpillar. [Max. 3 applications per crop, no more than 2 consecutive; min. re-treatment interval 7 d] | M Bee:H | R3 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Methomyl<br>PER82428 | 1A | Contact | 3 | A | ALL | Permitted in zucchini (field) for control of ***Helicoverpa* spp.**, Cucumber Moth, Cluster Caterpillar, Loopers, Webworm, Rutherglen Bug and Thrips including Western Flower Thrips. [Max. 6 applications per season; re-treatment intervals not specified] | VL<br>Bee:L | - |
| Spinetoram<br>(Success Neo)<br>Corteva | 5 | Ingestion | 3 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of ***Helicoverpa***, Cucumber Moth & Western Flower Thrips. [Max 4 applications per crop; re-treatment interval: 7-14 d] | M<br>Bee:H | - |
| Spinosad<br>(Entrust Organic)<br>Corteva | 5 | Ingestion | 3<br>G:14 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of Cucumber Moth, ***Helicoverpa*** & Western Flower Thrips. [Max. 4 applications per season; re-treatment interval 7-14 d] | L<br>Bee:L | - |
| Broflanilide<br>(Vedira)<br>BASF | 30 | Contact & Ingestion | | P | | Pending registration as an ant bait. It also has potential uses as a seed treatment for the control of Wireworms, and a foliar treatment for the control of chewing pests in various crops. | - | - |
| *Clitoria ternatea*<br>Extract<br>(Sero-X)<br>Growth Agriculture | - | Biological | | P | | Registered in cotton for control of ***Helicoverpa* spp.**, Green Mirids and Silverleaf Whitefly and in brassica leafy vegetables for control of Diamondback Moth. Label extension has been submitted seeking to add new uses for control of Silverleaf Whitefly and Thrips in brassicas and cucurbits. | L<br>Bee VL | - |
| Indoxacarb +<br>Novaluron<br>(Plemax)<br>Adama | 22A+15 | Contact & Ingestion | | P | | Registered for the control of various Lepidoptera, including ***Helicoverpa* spp.** in brassica vegetables, leafy vegetables and fruiting vegetables. | M<br>Bee:H | R3 |
| NUL3445<br>Nufarm | TBC | | | P | | New product in development from Nufarm with activity on **Lepidoptera**, Bugs, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| SYNFOI21<br>Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for control of Thrips, Bugs, Mites and **Caterpillars**. | - | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| **Two-Spotted Mite** (*Tetranychus urticae*)<br>**Priority: Moderate** | | | | | | | | |
| Two-Spotted Mite was ranked as a moderate priority in QLD and as a low priority in VIC & NSW. They feed on aerial parts of the plant with the damage caused providing entry points for soil-borne diseases. | | | | | | | | |
| Abamectin | 6 | Contact | 3 | A | ALL | Registered in zucchini for control of **Two-Spotted Mite**. [Max 2 applications per crop; re-treatment interval 28 d] | M<br>Bee:H | - |
| *Beauveria bassiana*<br>(Velifer)<br>BASF | UNF | Biological | NR | A | ALL | Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion Thrips, Greenhouse Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & **Two-Spotted Spider Mites**. [Max. 3 application per crop; re-treatment interval 3-14 d] | L<br>Bee:L | - |
| Bifenazate<br>(Acramite)<br>UPL | 20D | Contact | 1 | A | ALL | Registered in cucurbits for control of **Two-Spotted Mite** and Bryobia Mite. [Max. 1 application per season] | L<br>Bee:H | - |
| Diafenthiuron + Cyantraniliprole<br>(Minecto Forte)<br>Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables (field only) for control of Silverleaf Whitefly, Heliothis, Potato Moth, Cucumber Moth, Cluster Caterpillar, Green Peach Aphid, **Two-Spotted Mite** and suppression of Western Flower Thrips, Tomato Thrips & Plague Thrips [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M<br>Bee:VH | - |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, Jassids, **Mites**, Leafhoppers, Green Vegetable Bug, Thrips, and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R1 |
| Etoxazole<br>PER82460 | 10B | Contact | 7 | A | ALL (excl. VIC) | Permitted for use in cucurbits including zucchini (field & protected) for control of **Two-Spotted Mite** and Tomato Red Spider Mite. [Max. 1 application per crop] | L<br>Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Hexythiazox (Calibre) PER14765 | 10A | Contact & Ingestion | 3 | A | ALL (excl. VIC) | Permitted for use in cucurbits including zucchini (field & protected) for control of Tomato Russet Mite, Broad Mite, Tomato Red Mite and **Two Spotted Mite**. [ Max. 1 application per crop] | L Bee:L | - |
| Petroleum Oil | UN | Contact | 1 | A | ALL | Registered in cucurbits (field & protected) for control of Aphids, **Mites**, Thrips and Leafhopper. [Max. 4 applications per season; re-treatment intervals not specified] | VL Bee:L | - |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of Aphids, Thrips, Mealybug, **Two-Spotted Mites**, Spider Mite and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L Bee:L | - |
| Propargite (Omite) | 12C | Contact | 7 | A | ALL | Registered in vegetables (field & protected) for control of **Two Spotted Mite**. Apply at first appearance and repeat as necessary. [Max no. of applications per crop and re-treatment interval not specified] | M Bee:L | R3 |
| Sulphur | UN | Contact | NR | A | VIC, TAS, SA & WA | Registered in vegetables (field & protected) for control of **Two-Spotted Mite**. [Max no. of applications not specified; re-treatment interval 14-21 d] | L Bee:L | - |
| Acequinocyl (Kanemite) UPL | 20B | Contact & Ingestion | | P | | Registered for control of Two-Spotted Mite in pome and stone fruit. Canadian registration for control of **Two-Spotted Spider Mite** and **Spruce Spider Mites** in greenhouse ornamentals, and **Two-Spotted Spider Mite** in greenhouse tomato, pepper, eggplant & cucumber. | L Bee:L | - |
| Cyflumetofen (Danisaraba) BASF | 25A | Contact | | P | | BASF is seeking registration in Australia for the control of Spider Mites in various crops. | L Bee:L | - |
| Spiromesifen (Oberon) Bayer | 23 | Ingestion | | P | | Australian Registration pending for control of **Mites** in various vegetables crops, including cucurbits. Hort Innovation project ST19020 is undertaking data generation for a new label registration to control **Two-Spotted Mite** in cucurbits. | M Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| **Fungus Gnats** (*Bradysia* spp., Sciaridae)<br>**Priority: Moderate** | | | | | | | | |
| Fungus Gnats were ranked as a moderate priority in VIC and as a low priority in QLD & NSW. They are small, mosquito-like flies which are a common problem in nurseries and greenhouses where propagation material and seedlings are being grown. | | | | | | | | |
| *Bacillus thuringiensis* (Vertobac) | 11A | Biological | NR | P | | Permitted for control of **Fungus Gnats** in capsicums (protected situations only). | VL L-Bees | - |
| **Ants** (Formicidae)<br>**Priority: Low** | | | | | | | | |
| Ants were ranked as a low priority in VIC, QLD & NSW. Chewing mouth parts can damage tender parts of the plants including flowers. This can lead to secondary fungal infections which can affect the yield and quality of crop. | | | | | | | | |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of **Ants**, Aphids, Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Broflanilide (Vedira) BASF | 30 | Contact & Ingestion | | P | | Pending registration as an **Ant** bait. | H Bee:VH | - |
| Metaflumizone (Siesta Ant Bait) BASF | 22B | Ingestion | | P | | Pending registration as an **Ant** bait. | M Bee:M | - |
| Pyriproxyfen (Distance Ant Bait) Sumitomo | 7C | IGR / Bait | | P | | Registered in fruit crops for control of invasive and nuisance **Ants**. | VL Bee L | - |
| **Cucumber Fruit Fly** (*Bactrocera cucumis*)<br>**Priority: Low** | | | | | | | | |
| Cucumber Fly was ranked as a low priority in VIC, QLD & NSW. *Bactrocera* spp. usually attacks fruits and cause rots and discolouration. Eggs are laid close to the surface inside the fruit with small, discoloured patches developing because of the stings. | | | | | | | | |
| Alpha-Cypermethrin PER80138 | 3A | Contact | 1 | A | ALL (excl. VIC) | Permitted for use in cucurbits (field) for control of **Cucumber Fruit Fly**. [Max. 3 applications per crop; 2 sequential; re-treatment interval 7 d] | VH Bee:H | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Clothianidin<br>PER80101 | 4A | Contact & Ingestion | 7<br>NG | A | ALL | Permitted for use in cucurbits including zucchini (field) for control of **Cucumber Fruit Fly**. [Max. 2 applications per crop; re-treatment interval 7 d] | M<br>Bee:VH | R2 |
| Dimethoate | 1B | Contact | 1 | A | QLD, NSW, WA & NT | Registered in zucchini for control of **Cucumber Fly**. Apply when pests first appear and repeat as needed. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R1 |
| Spinosad (Naturalure)<br>Corteva | 5 | Ingestion | NR | A | ALL | Registered in vegetables for control of **Fruit Fly** as a bait spray. [Max. no. of applications not specified; re-treatment interval 7 d] | L<br>Bee:L | - |
| Acetamiprid + Pyriproxyfen (Trivor)<br>Adama | 4A+7C | Contact & Ingestion / IGR | | P | | Registered for suppression of Queensland Fruit Fly and Mediterranean Fruit Fly in avocado, citrus and mango. | M<br>Bee:M | R2 |
| NUL3445<br>Nufarm | TBC | | | P | | New product in development from Nufarm with activity on Lepidoptera, Bugs, Beetles/Weevils, **Fruit Fly** and Thrips. | - | - |
| **Cucumber Moth** (*Diaphania indica*)<br>**Priority: Low** | | | | | | | | |
| Cucumber Moth was ranked as a low priority in VIC, QLD & NSW. The caterpillars do the damage. After hatching, they roll the leaves with silken threads and eat the leaves between the veins. Caterpillars attack the flowers and reduce the number of fruits set. Young fruits are also attacked which induces fungal rots thus downgrading the produce quality. | | | | | | | | |
| Bifenthrin (Talstar) | 3A | Contact | 1 | A | QLD, NSW, NT & WA | Registered in cucurbits (field grown only) for control of Native Budworm, Corn Earworm, **Cucumber Moth** and Silverleaf Whitefly. Adult insects should be targeted. [Max. 2 applications per crop; re-treatment interval not specified] | VH<br>Bee:H | R3 |
| Chlorantraniliprole (Coragen)<br>FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Cotton Bollworm, Native Budworm and **Cucumber Moth**. [Max. 3 applications per crop, no more than 2 consecutive; re-treatment interval 5 d] | L<br>Bee:VL | - |
| Cyantraniliprole (Benevia)<br>FMC | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of Melon Aphid, Silverleaf Whitefly, Cotton Bollworm, **Cucumber Moth**, Native Budworm & suppression Of Western Flower Thrips. [Max. 2 applications per crop; re-treatment interval 7-10 d] | M<br>Bee:VH | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits and fruiting vegetables. (field only) for control of Silverleaf Whitefly, Heliothis, Potato Moth, **Cucumber Moth**, Cluster Caterpillar, Green Peach Aphid**,** Two-Spotted Mite and suppression of Western Flower Thrips, Tomato Thrips & Plague Thrips [Max. 2 applications per crop; do not apply consecutive applications; re-treatment interval 28 d]. | M Bee:VH | - |
| Emamectin (Proclaim Opti) Syngenta | 6 | Ingestion | 3 NG | A | ALL | Registered in cucurbits (field & protected) for control of Heliothis, Cluster Caterpillar and **Cucumber Moth**. [Max. 4 applications per crop; re-treatment interval 7 d] | M Bee:H | - |
| Flubendiamide (Belt) Bayer | 28 | Ingestion | 1 | A | ALL | Registered in cucurbits for the control of *Helicoverpa* spp. and **Cucumber Moth**. [Max. 3 applications per crop; re-treatment interval 7-14 d] | L-M Bee:L | - |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, Aphids, **Caterpillars**, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Methomyl PER82428 | 1A | Contact | 3 | A | ALL | Permitted in zucchini (field) for control of *Helicoverpa* spp., **Cucumber Moth**, Cluster Caterpillar, Loopers, Webworm, Rutherglen Bug and Thrips including Western Flower Thrips. [Max. 6 applications per season; re-treatment intervals not specified] | VL Bee:L | - |
| Spinetoram (Success Neo) Corteva | 5 | Ingestion | 3 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of *Helicoverpa*, **Cucumber Moth** & Western Flower Thrips. [Max 4 applications per crop; re-treatment interval: 7-14 d] | M Bee:H | - |
| Spinosad (Entrust Organic) Corteva | 5 | Ingestion | 3 G:14 | A | ALL | Registered in cucurbits including zucchini (field & protected) for control of **Cucumber Moth**, *Helicoverpa* & Western Flower Thrips. [Max. 4 applications per season; re-treatment interval 7-14 d] | L Bee:L | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Indoxacarb (Avatar eVo) FMC | 28 | Ingestion | 3 NG | P-A | ALL | Registered in cucurbits (field) for control of Cotton Bollworm, Native Budworm and Cluster Caterpillar. | M Bee:H | R3 |
| Indoxacarb + Novaluron (Plemax) Adama | 22A+15 | Contact & stomach | | P | | Registered for control of various Lepidoptera in brassica vegetables, leafy vegetables and fruiting vegetables. | L Bee:H | R3 |
| NUL3445 Nufarm | TBC | | | P | | New product in development from Nufarm with activity on **Lepidoptera**, Bugs, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| SYNFOI21 Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for control of Thrips, Bugs, Mites and **Caterpillars**. | - | - |
| **Jassids/Leafhoppers** (Cicadellidae)<br>**Priority: Low** | | | | | | | | |
| Jassids were consistently ranked as a low priority in every consulted region, VIC, QLD & NSW. Soil fumigation can help. Adult and nymph leafhoppers suck sap and inject toxins. Some leafhopper species transmit diseases such as viruses and phytoplasmas. Perimeter sprays may be an option to minimise vector transmission | | | | | | | | |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, **Jassids**, Mites, **Leafhoppers**, Green Vegetable Bug, Thrips and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H Bee:H | R1 |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Contact | 1 | A | ALL | Registered in vegetables for control of Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips and **Leafhoppers**. Suitable for organic growers. Apply as a cover spray and re-apply as necessary every 2-3 weeks. | VH Bee:H | - |
| Maldison | 1B | Contact | 3 | A | ALL | Registered in vegetables including cucurbits for control of Aphid, Green Vegetable Bug, **Jassid**, **Leafhopper**, Rutherglen Bug, Redlegged Earth Mite (excl. TAS) & 28-Spotted Ladybird (excl. TAS) [Apply at first sight of infestation: max no. of applications not specified] | H Bee:H | R3 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Petroleum Oil | UN | Contact | 1 | A | ALL | Registered in cucurbits (field & protected) for control of Aphids, Mites, Thrips and **Leafhopper**. [Max. 4 applications per season; re-treatment intervals not specified] | VL<br>Bee:L | - |
| Buprofezin (Applaud)<br>PER82467 | 16 | Ingestion / IGR | 3 | P-A | ALL (excl. VIC) | Permitted for use in zucchini (field & protected) for control of Greenhouse Whitefly, Sweet Potato Whitefly and Silverleaf Whitefly. Registered for control of **Leafhopper** in citrus. | L<br>Bee:L | - |
| Sulfoxaflor (Transform)<br>Corteva | 4C | Contact and Ingestion | 1 | P-A | ALL | Registered in cucurbits (field grown only) for control of Green Peach Aphid, Melon Aphid and Greenhouse Whitefly and suppression of Rutherglen Bug. US registration for control of **Leafhoppers** in berries, pome fruit and root and tuber vegetables. | M<br>Bee:H | - |
| Flupyradifurone (Sivanto 200 SL)<br>Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of **Leafhoppers** in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse whitefly, Green Peach Aphid & Cotton Aphid . | L<br>Bee:VL | - |
| NUL3445<br>Nufarm | TBC | | | P | | New product in development from Nufarm with activity on Lepidoptera, **Bugs**, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| SYNFOI21<br>Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, **Bugs**, Mites and Caterpillars. | - | - |
| **Mealybugs** (Pseudococcidae)<br>**Priority: Low** | | | | | | | | |
| Mealybugs were ranked as a low priority in VIC, QLD & NSW. Mealybugs are small insects covered with a white mealy coating. The bugs feed by sucking on plant sap. Mealybugs excrete a sticky substance called honey dew which ants like to feed on. The honeydew also provides a perfect medium for sooty mould growth. If left uncontrolled, it can downgrade the quality of the fruit. | | | | | | | | |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of Aphids, Thrips, **Mealybug**, Two-Spotted Mites, Spider Mite and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L<br>Bee:L | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Buprofezin (Applaud) PER82467 | 16 | Ingestion / IGR | 3 | P-A | ALL (excl. VIC) | Permitted for use in zucchini (field & protected) for control of Greenhouse Whitefly, Sweet Potato Whitefly and Silverleaf Whitefly. Registered for control of **Mealybug** in citrus, cotton, custard apple, grapes, passionfruit, pear and persimmon. | L Bee:L | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | P-A | A | Registered in cucurbits for control of Cotton Aphid, Green Peach Aphid & Silverleaf Whitefly. Registered for control of **Mealybugs** in citrus, cotton, grapes, mango, passionfruit, pome fruit and stone fruit. | M Bee:VL | - |
| Sulfoxaflor (Transform) Corteva | 4C | Contact & Ingestion | 1 | P-A | ALL | Registered in cucurbits (field grown only) for control of Green Peach Aphid, Melon Aphid and Greenhouse Whitefly and suppression of Rutherglen Bug. Registered for control of **Mealybugs** in citrus, cotton, grapes, nashi pear and pome fruit. | M Bee:VH | - |
| Acetamiprid + Pyriproxyfen (Trivor) Adama | 4A+7C | Contact & Ingestion / IGR | | P | | Registered for control of **Mealybugs** in citrus, grapes and macadamia. | M Bee:M | R2 |
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of Leafhoppers, Aphids, Squash Bug and Whitefly in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse whitefly, Green Peach Aphid & Cotton Aphid . | L Bee:VL | - |
| NUL3145 Nufarm | TBC | | | P | | New product from Nufarm with activity on Scale, Nematodes, Mealybug and **Whitefly**. | - | - |
| SYNFOI21 Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, **Bugs**, Mites and Caterpillars. | - | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| **Rutherglen Bug** (*Nysius vinitor*)<br>**Priority: Low** | | | | | | | | |
| Rutherglen Bug was ranked as a low priority in VIC, QLD & NSW. It is important to monitor crops for eggs and nymphs by regular field scouting. Large numbers can cause significant feeding damage to foliage by sucking the sap and depleting the crop of nutrients. | | | | | | | | |
| Maldison | 1B | Contact | 3 | A | ALL | Registered in vegetables including cucurbits for control of Aphid, Green Vegetable Bug, Jassid, Leafhopper, **Rutherglen Bug**, Redlegged Earth Mite (excl. TAS) & 28-Spotted Ladybird (excl. TAS) [Apply at first sight of infestation: max no. of applications not specified] | H<br>Bee:H | R3 |
| Methomyl<br>PER82428 | 1A | Contact | 3 | A | ALL | Permitted in zucchini (field) for control of *Helicoverpa* spp., Cucumber Moth, Cluster Caterpillar, Loopers, Webworm, **Rutherglen Bug** and Thrips including Western Flower Thrips. [Max. 6 applications per season; re-treatment intervals not specified] | VL<br>Bee:L | - |
| Sulfoxaflor (Transform) | 4C | Contact & Ingestion | 1 | A | ALL | Registered in cucurbits (field grown only) for control of Green Peach Aphid, Melon Aphid and Greenhouse Whitefly and suppression of **Rutherglen Bug**. Do not use if honeybees are foraging. [Max. no. of applications not specified; re-treatment interval 7-10 d] | M<br>Bee:VH | - |
| Trichlorfon (Lepidex) | 1B | Contact | 2 | A | ALL | Registered in vegetables for control of Green Vegetable Bug and **Rutherglen Bug**. Apply at first sight of infestation. [Max no. of applications not specified; re-treatment interval 7-10 d] | H<br>Bee:H | R2 |
| Flupyradifurone (Sivanto 200 SL) Bayer | 4D | Contact & Ingestion | | P | | Registered in macadamia for control of Macadamia Lace Bug, Banana Spotting Bug, Fruit Spotting Bug and suppression of Scirtothrips. US registration for control of Leafhoppers, Aphids, Squash Bug and Whitefly in cucurbits. Bayer has a pending label registration with the APVMA and if approved, Sivanto will be registered late 2021 in cucurbits for control of Silverleaf Whitefly, Greenhouse whitefly, Green Peach Aphid & Cotton Aphid . | L<br>Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| NUL3445<br>Nufarm | TBC | | | P | | New product in development from Nufarm with activity on Lepidoptera, **Bugs**, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| SYNFOI21<br>Syngenta | TBC | TBC | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, **Bugs**, Mites and Caterpillars. | - | - |
| **Pumpkin Beetle** (*Aulacophora hilaris*)<br>**Priority: Low** | | | | | | | | |
| Pumpkin Beetle was ranked as a low priority in VIC, QLD & NSW. Adults feed on leaves, chewing large holes. Seedlings are particularly susceptible. Damage to young plants can delay crop maturity. Damage also occurs to flowers and small fruit. Attacks cause death of seedlings. | | | | | | | | |
| Maldison | 1B | Contact | 3 | A | SA, NSW, VIC, WA & NT | Registered in cucurbits for control of **Pumpkin Beetle**. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R3 |
| Spinosad (Entrust Organic)<br>Corteva | 5 | Contact and ingestion | 3<br>G:14 | P-A | ALL | Registered in cucurbits for control of Cucumber Moth, Helicoverpa & Western Flower Thrips. US registration for control of various beetles in asparagus, brassica leafy vegetables, bulb vegetables, ornamentals, root and tuber vegetables, spices and fruiting vegetables. | L<br>Bee:L | - |
| Cyantraniliprole + Thiamethoxam (Spinner)<br>Syngenta | 4A+28 | Contact & Ingestion | | P | | Registered for control of Cutworms, Armyworms, African Black Beetle larvae, Argentinian Scarab larvae and Stem Weevil larvae in turf. Canadian registration for control of various beetles in potatoes, leafy vegetables and brassica vegetables. | M<br>Bee:VH | R2 |
| Tetraniliprole (Vayego)<br>Bayer | 28 | Ingestion | | P | | Registered 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<br>Bee:VH | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| **28-Spotted Potato Ladybird** (*Henosepilachna vigintisexpunctata*)<br>**Priority: Low** | | | | | | | | |
| 28-Spotted Potato Ladybird was ranked as a low priority in VIC, QLD & NSW. The larvae graze the under surface, leaving the upper surface intact whereas the adults feed on both sides of the leaf, often making holes as they chew. Attacks cause death of seedlings. | | | | | | | | |
| Maldison | 1B | Contact | 3 | A | ALL | Registered in vegetables including cucurbits for control of Aphid, Green Vegetable Bug, Jassid, Leafhopper, Rutherglen Bug, Redlegged Earth Mite (excl. TAS) & **28-Spotted Ladybird** (excl. TAS) [Apply at first sight of infestation: max no. of applications not specified] | H<br>Bee:H | R3 |
| Spinosad<br>(Entrust Organic)<br>Corteva | 5 | Contact and ingestion | 3<br>G:14 | P-A | ALL | Registered in cucurbits for control of Cucumber Moth, Helicoverpa & Western Flower Thrips. US registration for control of various beetles in asparagus, brassica leafy vegetables, bulb vegetables, ornamentals, root and tuber vegetables, spices and fruiting vegetables. | L<br>Bee:L | - |
| Cyantraniliprole + Thiamethoxam<br>(Spinner)<br>Syngenta | 4A+28 | Contact & Ingestion | | P | | Registered for control of Cutworms, Armyworms, African Black Beetle larvae, Argentinian Scarab larvae and Stem Weevil larvae in turf. Canadian registration for control of various beetles in potatoes, leafy vegetables and brassica vegetables. | M<br>Bee:VH | R2 |
| Tetraniliprole<br>(Vayego)<br>Bayer | 28 | Ingestion | | P | | Registered 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<br>Bee:VH | - |
| **Wingless Grasshopper** (*Phaulacridium vittatum*)<br>**Priority: Low** | | | | | | | | |
| Wingless Grasshopper was ranked as a low priority in VIC, QLD & NSW. They have a voracious appetite and can cause severe damage to foliage if the numbers get high. Damage is limited to feeding on newly established plants and reducing plant populations. | | | | | | | | |
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, Jassids, Mites, Leafhoppers, Green Vegetable Bug, Thrips, and **Wingless Grasshopper**. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R1 |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| **Fall Armyworm** (*Spodoptera frugiperda*)<br>**Priority: Unknown** | | | | | | | | |
| Fall Armyworm was not ranked as a pest in zucchini. It is an exotic pest that is considered a potential threat that could affect most vegetable crops if allowed to spread. It is important to monitor crops for eggs and larvae of pest species by regular field scouting. Target sprays against mature eggs and newly hatched larvae before pests become entrenched. | | | | | | | | |
| Chlorantraniliprole (Coragen) PER89259 | 28 | Ingestion | 1 | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables including cucurbits (field) for control of **Fall Armyworm**. [Max. 3 applications per crop; 2 consecutive; re-treatment interval 7 d] | L Bee:VL | - |
| Emamectin (Proclaim Opti) PER89263 | 6 | Ingestion | 3 NG | A | ALL (excl. VIC) | Permitted for use in cucurbits (field & protected cropping) for control of **Fall Armyworm**. [Max 4 applications per crop; re-treatment interval: 7 d] | M Bee:H | - |
| Methomyl PER89293 | 1A | Contact | 3 | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables including cucurbits (field only) for control of **Fall Armyworm**. [Max. 6 application per crop; re-treatment interval 7 d] | H Bee:H | R2 |
| Spinetoram (Success Neo) PER89241 | 5 | Ingestion | 3 | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables including cucurbits (field) for control of **Fall Armyworm**. [Max. 4 applications per crop; re-treatment interval 7-14 d] | M Bee:H | - |
| Spinosad (Entrust Organic) PER89870 | 5 | Ingestion | 3 G:14 | A | ALL (excl. VIC) | Permitted for use in cucurbits (field & protected cropping) for control of **Fall Armyworm**. [Max. 4 applications per season; re-treatment interval 7-14 d] | L Bee:L | - |
| Indoxacarb (Avatar eVo) FMC | 28 | Ingestion | 3 NG | P-A | ALL | Registered in cucurbits (field) for control of Cotton Bollworm, Native Budworm and Cluster Caterpillar. Permitted for control of **Fall Armyworm** in broccoli, brussels sprouts, cabbage (closed head varieties only), cauliflower, celery, capsicum, eggplant, peppers tomato (field or trellis), leafy vegetables and chinese leafy vegetables. | M Bee:H | R3 |
| Amorphous Silica (Abrade) Grow Choice | - | Contact | | P | | Registered for control of *Spodoptera* spp. in fruiting vegetables and permitted for (PER90841) control of **Fall Armyworm** in sweet corn. | L Bee:L | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Broflanilide (Vedira) BASF | 30 | Contact & Ingestion | | P | | Registration submitted concurrently in Australia, Canada, USA, and Mexico as a soil application and seed treatment against chewing insects such as ants, cockroaches and ***Spodoptera* spp.** BASF are seeking registrations in amenity turf initially, then potential horticultural crops thereafter. | H Bee:VH | - |
| Magnet Insect Attractant Technology PER89398 | - | Attractant | | P | | Permitted for control of **Fall Armyworm** in cotton, cereal grains, sweet corn, pastures & oilseeds**.** | - | - |
| NUL3445 Nufarm | TBC | | | P | | New product in development from Nufarm with activity on **Lepidoptera**, Bugs, Beetles/Weevils, Fruit Fly and Thrips. | - | - |
| *Spodoptera frugiperda* Multiple Nucleopolyhedrovirus (Fawligen) AgBiTech | 31 | Biological | | P | | Permitted for control of **Fall Armyworm** in legume vegetables, root & tuber vegetables & sweet corn. | VL Bee:L | - |
| SYNFOI21 Syngenta | TBC | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, Bugs, Mites and **Caterpillars**. | - | - |
| Tetraniliprole (Vayego) Bayer | 28 | Ingestion | | P | | Registered 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. Indonesia registration for control of Liriomyza Leafminers and **Fall Armyworm** in vegetable crops. | M Bee:VH | - |
| **Tomato Potato Psyllid** (*Bactericera cockerelli*) **Priority: Unknown** | | | | | | | | |
| Tomato Potato Psyllid was not ranked as a pest in zucchini. It is an exotic pest that is considered a potential threat that could affect most vegetable crops if allowed to spread. | | | | | | | | |
| Cyantraniliprole (Benevia) PER84805 | 28 | Ingestion | 1 NG | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables (field) for control of **Tomato Potato Psyllid**. [Max. 2 application per crop; re-treatment interval 7-10 d] | M Bee:VH | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Sulfoxaflor (Transform) PER84743 | 4C | Contact & Ingestion | 1 | A | ALL (excl. VIC) | Permitted for use in in fruiting vegetables (field) for control of **Tomato Potato Psyllid**. [Max. 4 applications per crop; 2 consecutive; re-treatment interval 7-10 d] | M Bee:VH | - |
| Abamectin | 6 | Contact | 3 | P-A | ALL | Registered in zucchini for control of Two-Spotted Mite. Registered for control of Tomato Potato Psyllid in cut flowers, fruiting vegetables and nursery stock. | M Bee:H | - |
| Spinetoram (Success Neo) Corteva | 5 | Ingestion | 1 | P-A | ALL | Registered in cucurbits for the control of Cucumber Moth, *Helicoverpa* spp. and Western Flower Thrips**.** Permitted for control of **Tomato Potato Psyllid** in fruiting vegetables and root/tuber vegetables. | M Bee:H | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | P-A | A | Registered in cucurbits for control of Cotton Aphid, Green Peach Aphid & Silverleaf Whitefly. Permitted for control of **Tomato Potato Psyllid** in potato, sweet potato, tomato, capsicum, chilli, pepper and eggplant. | M Bee:VL | - |
| Spiromesifen (Oberon) Bayer | 23 | Ingestion | | P | | Australian registration pending for control of Mites in various vegetables crops, including cucurbits. US registration for control of **Tomato Potato Psyllid** in tuberous and corm vegetables. Hort Innovation project ST19020 is undertaking data generation for a new label registration to control Two-Spotted Mite in cucurbits. | M Bee:VL | - |
| **Tomato Red Spider Mite** (*Tetranychus evansi*)<br>**Priority: Unknown** | | | | | | | | |
| Tomato Red Spider Mite was not ranked as a pest in zucchini. Other industry sources indicate that it could be a potential threat. | | | | | | | | |
| Abamectin PER14722 | 6 | Contact | 3 | A | ALL (excl. VIC) | Permitted for use in zucchini (field & protected) for control of **Tomato Red Spider Mite**. [Max 2 applications per crop; re-treatment interval 28 d] | M Bee:H | - |
| Bifenazate (Acramite) UPL PER82341 | 20D | Contact & Ingestion | 1 NG | A | ALL (excl. VIC) | Permitted for use in cucurbits including zucchini (field & protected) for control of **Red Tomato Spider Mite**. [Max. 1 application per crop] | L Bee:H | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Dimethoate | 1B | Contact | 1 | A | ALL | Registered in zucchini for control of Aphids, Jassids, **Mites**, Leafhoppers, Green Vegetable Bug, Thrips, and Wingless Grasshopper. Apply before flowering commences. [Max. no. of applications and re-treatment interval not specified] | H<br>Bee:H | R1 |
| Etoxazole (Paramite) Sumitomo PER82460 | 10B | Contact | 7 | A | ALL (excl. VIC) | Permitted for use in cucurbits including zucchini (field & protected) for control of Two-Spotted Mite and **Tomato Red Spider Mite**. [Max. 1 application per crop] | L<br>Bee:VL | - |
| Hexythiazox (Calibre) Nufarm PER14765 | 10A | Contact & Ingestion | 3 | A | ALL (excl. VIC) | Permitted for use in cucurbits including zucchini (field & protected) for control of Tomato Russet Mite, Broad Mite, **Tomato Red Mite** and Two Spotted Mite. [ Max. 1 application per crop] | L<br>Bee:L | - |
| Petroleum Oil | UN | Contact | 1 | A | ALL | Registered in cucurbits (field & protected) for control of Aphids, **Mites**, Thrips and Leafhopper. [Max. 4 applications per season; re-treatment intervals not specified] | VL<br>Bee:L | - |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Contact | NR | A | ALL | Registered in vegetables for control of Aphids, Thrips, Mealybug, Two-Spotted Mites, **Spider Mite** and Whitefly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d] | L<br>Bee:L | - |
| Propargite (Omite) | 12C | Contact | 7 | A | QLD & WA | Registered in vegetables (field & protected) for control of **Spider Mite**. Apply at first appearance and repeat as necessary. [Max no. of applications per crop and re-treatment interval not specified] | M<br>Bee:L | R3 |
| *Beauveria bassiana* (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. | L<br>Bee:L | - |
| Spiromesifen (Oberon) Bayer | 23 | Ingestion | | P | | Australian registration pending for control of **Mites** in various vegetable crops, including cucurbits. Hort Innovation project ST19020 is undertaking data generation for a new label registration to control Two-Spotted Mite in cucurbits. | M<br>Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| SYNFOI21<br>Syngenta | New | | | P | | SYNFOI21 is not registered but the first global application is proposed for 2023 for Thrips, Bugs, **Mites** and Caterpillars. | - | - |
| **Vegetable Leafminer** (*Liriomyza sativae*)<br>**Serpentine Leafminer** (*Liriomyza huidobrensis*)<br>**American Serpentine Leafminer** (*Liriomyza trifolii*)<br>**Priority: Unknown** | | | | | | | | |
| Leafminer was not ranked as a pest in zucchini. Dipteran Leafminers (*Liriomyza* spp.) are exotic pests that have recently been detected and become problematic in Australia. For example, the Serpentine Leafminer was first detected in the Sydney area in October 2020 and has since been found in crops in SE Qld. As a group they are destructive pests and can cause significant economic loss through reduced yields and quality when uncontrolled. | | | | | | | | |
| Abamectin<br>PER81876 | 4C | Contact & Ingestion | 7<br>NG | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables including cucurbits (field) for suppression of **Leafminers** including **Vegetable Leafminer** and **Serpentine Leafminer**. [Max. 2 application per crop; re-treatment interval 7-14 d] | M<br>Bee:H | - |
| Cyantraniliprole (Benevia)<br>PER90387 | 28 | Ingestion | 1<br>NG | A | ALL (excl. VIC) | Permitted for use in fruiting vegetables (field) for control of **Liriomyza Leafminers**. [Max. 2 application per crop; re-treatment interval 7 d] | M<br>Bee:VH | - |
| Cyromazine (Diptex 150 WP)<br>PER81867 | 17 | Insect Growth Regulator | 7<br>NG | A | ALL | Permitted for use in fruiting vegetables including cucurbits for control of ***Liriomyza*** species, including: **Vegetable Leafminer** and **Serpentine Leafminer**. [Max. 6 applications per crop; re-treatment interval 7 d] | - | - |
| Spinosad (Entrust Organic)<br>PER90928 | 5 | Ingestion | 3 | A | ALL (excl. VIC) | Permitted for use in zucchini for control of ***Liriomyza*** species, including **Vegetable Leafminer**, **Pea Leafminer / Serpentine Leafminer** and **American Serpentine Leafminer**. [Max. 6 applications per crop; re-treatment interval 7 d] | L<br>Bee:L | - |
| Chlorantraniliprole (Coragen)<br>FMC | 28 | Ingestion | 1 | P-A | ALL | Registered in cucurbits for the control of Cotton Bollworm, Native Budworm and Cucumber Moth. Permitted for control of **Liriomyza Leafminers** in spinach and silverbeet. | L<br>Bee:VL | - |

| Pest / Active Ingredient (Trade Name) | Chemical group | Activity | WHP, days | Availability | States | Comments | Impact on Beneficials | Regulatory risk |
|---|---|---|---|---|---|---|---|---|
| Emamectin (Proclaim Opti) Syngenta | 6 | Ingestion | 3 NG | P-A | ALL | Registered in cucurbits (field & protected) for control of Heliothis, Cluster Caterpillar and Cucumber Moth. Permitted for control of ***Liriomyza*** species, including **Vegetable Leafminer** in Brassica vegetables. | M Bee:H | - |
| Spinetoram (Success Neo) Corteva | 5 | Ingestion | 1 | P-A | ALL | Registered in cucurbits for the control of Cucumber Moth, *Helicoverpa* spp. and Western Flower Thrips**.** Permitted for control of **Liriomyza Leafminers** in snow peas, sugar snap peas and green beans. | M Bee:H | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Ingestion | 1 | P-A | ALL | Registered in cucurbits for control of Cotton Aphid, Green Peach Aphid & Silverleaf Whitefly. Permitted for control of **Liriomyza Leafminers** in snow peas, sugar snap peas, lettuce, parsley, eggplant, capsicum, chilli, tomato, green beans, celery and rhubarb. | M Bee:VL | - |
| Tetraniliprole (Vayego 200 SC) Bayer | 28 | Ingestion | | P | | Registered 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. Indonesia registration for control of **Liriomyza Leafminers** and Fall Armyworm in vegetable crops. | M Bee:VH | - |

## 4.3 Weeds in Zucchini

### 4.3.1 Weed priorities

| Common name | Scientific name |
|---|---|
| **Moderate** | |
| Amaranthus | *Amaranthus* spp. |
| Blackberry Nightshade | *Solanum nigrum* |
| Fat Hen | *Chenopodium album* |
| Nutgrass | *Cyperus rotundus* |
| Pigweed | *Portulaca oleracea* |

All the weeds listed were ranked as a moderate priority in most consulted regions. Growers generally use a pre-plant weed control (general knockdown herbicides) to prepare the paddock. Growers then either alternate the herbicides used or use them in combination for effective weed control. All the herbicides registered/permitted are either pre-emergent herbicides or early post-emergent herbicides. Most weeds can be controlled with currently available herbicides.

Weed control in many cases is aided by soil fumigation, which also helps in controlling some soil borne pests and pathogens.

**Resistance management**

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[6].

Management options include use of herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying and mechanical devices.

[6] https://www.croplife.org.au/resources/programs/resistance-management/herbicide-resistance-management-strategies-2/

## 4.3.2 Available and potential products for weed control

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

| Availability | |
|---|---|
| A | Available via either registration or permit approval |
| P | Potential – a possible candidate to pursue for registration or permit |
| P-A | Potential, already approved in the crop for another use |

| Resistance risk | | Regulatory risk (refer to Appendix 6) | |
|---|---|---|---|
| | | R1 | Short-term: Critical concern over retaining access |
| ** | Moderate resistance risk | R2 | Medium-term: Maintaining access of significant concern |
| *** | High resistance risk | R3 | Long-term: Potential issues associated with use - Monitoring required |

| Withholding Period (WHP) – Number of days from last treatment to harvest (H) or Grazing (G) | | | |
|---|---|---|---|
| Harvest | H | Not Required when used as directed | NR |
| Grazing | G | No Grazing Permitted | NG |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Amaranthus** (*Amaranthus* spp.)<br>**Priority: Moderate** | | | | | | | |
| Amaranthus was ranked as a moderate priority in QLD & NSW. It is a short-lived annual weed that is a prolific seed producer. | | | | | | | |
| Clomazone | Q** | Cucurbits / Pre-emergent residual | Registered in cucurbits for control of various broadleaf weeds, including **Amaranthus**. | NR | A | ALL | - |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Amaranthus**. | NR | A | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Amaranthus**. | 1<br>G:1 | A | ALL | R3 |
| Chlorthal-Dimethyl (Dacthal) | D** | | Registered for control of various grass and broadleaf weeds including **Amaranthus** in lettuce. | | P | | - |
| Dimethenamid-P (Outlook) BASF | K** | | Registered for control of grass and broadleaf weeds including **Amaranthus** in sweet corn, beans, peas, pumpkins and kabocha. | | P | | - |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Phenmedipham (Betanal) Bayer | C** | | Registered for control of grass and broadleaf weeds including **Amaranthus** in silverbeet and beetroot. | | P | | R3 |
| Glufosinate-Ammonium (Basta) BASF | N** | | Registered for control of grass and broadleaf weeds including **Amaranthus** in berries, tomatoes, beans and fallow. | | P | | R3 |
| S-Metolachlor (Dual Gold) Syngenta | K** | | Registered for control of grass and broadleaf weeds including suppression of **Amaranthus** in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow. | | P | | - |
| NUL3438 Nufarm | TBC | | New active in development, Nufarm claims activity on broadleaf weeds. | | P | | - |
| Oxyfluorfen (Goal) | G** | | Registered for control of grass and broadleaf weeds, including **Amaranthus** in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat. | | P | | - |
| **Blackberry Nightshade** (*Solanum nigrum*)<br>**Priority: Moderate** | | | | | | | |
| Blackberry Nightshade was ranked as a moderate priority in QLD & NSW. Prolific weed that is widely adapted and difficult to eradicate, mainly due to its long-term seed viability. Management options include soil fumigation, pre-crop spraying, spot spraying or using mechanical devices. | | | | | | | |
| Clomazone | Q** | Cucurbits / Pre-emergent residual | Registered in cucurbits for control of various broadleaf weeds, including **Blackberry Nightshade**. | NR | A | ALL | - |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Blackberry Nightshade**. | NR | A | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Blackberry Nightshade**. | 1<br>G:1 | A | ALL | R3 |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Aclonifen (Emerger) Bayer | H** | Pre-Emergence | Bayer is expected to seek registration for pre-emergent control of grass and broadleaf weeds in various vegetable crops. Registered in Europe for use in potatoes, legume vegetables and cereals. **Blackberry Nightshade** is listed as moderately susceptible at a high rate. | | P | | - |
| Chloridazon (Pyramin) BASF | C** | | Registered for control of various grass and broadleaf weeds including **Blackberry Nightshade** in fodder beet, red beet and silver beet. | | P | | - |
| Chlorthal-Dimethyl (Dacthal) | D** | | Registered for control of various grass and broadleaf weeds including **Blackberry Nightshade** in lettuce. | | P | | - |
| Dimethenamid-P (Outlook) BASF | K** | | Registered for control of grass and broadleaf weeds including **Blackberry Nightshade** in sweet corn, beans, peas, pumpkins and kabocha. | | P | | - |
| S-Metolachlor (Dual Gold) Syngenta | K** | | Registered for control of grass and broadleaf weeds including **Blackberry Nightshade** in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow. | | P | | - |
| Norflurazon (Zoliar) AgNova | F** | | Registered for control of grass and broadleaf weeds including **Blackberry Nightshade** in asparagus, citrus, grapes, nuts, stone & pome fruits. | | P | | - |
| NUL3438 Nufarm | TBC | | New active in development, Nufarm claims activity on broadleaf weeds. | | P | | - |
| Oxyfluorfen (Goal) | G** | | Registered for control of grass and broadleaf weeds, including **Blackberry Nightshade** in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat. | | P | | - |
| Phenmedipham (Betanal) Bayer | C** | | Registered for control of grass and broadleaf weeds including **Blackberry Nightshade** in silverbeet and beetroot. | | P | | R3 |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Fat Hen** (*Chenopodium album*)<br>**Priority: Moderate** | | | | | | | |
| Fat Hen was ranked as a moderate priority in QLD & NSW. Herbicide control can be difficult and targeting weeds at early growth stages is critical. | | | | | | | |
| Clomazone | Q** | Cucurbits / Pre-emergent residual | Registered in cucurbits for control of various broadleaf weeds, including **Fat Hen**. | NR | A | ALL | - |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Fat Hen**. | NR | A | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Fat Hen**. | 1<br>G:1 | A | ALL | R3 |
| Aclonifen (Emerger) Bayer | H** | Pre-Emergence | Bayer is expected to seek registration for pre-emergent control of grass and broadleaf weeds in various vegetable crops. Registered in Europe for use in potatoes, legume vegetables and cereals. **Fat Hen** is listed as susceptible. | | P | | - |
| Bentazone (Basagran) BASF | C** | | Registered in beans for control of several broad leaf weeds including **Fat Hen**. [Max no. of applications and re-treatment interval not specified] | | P | | - |
| Chloridazon (Pyramin) BASF | C** | | Registered for control of various grass and broadleaf weeds including **Fat Hen** in fodder beet, red beet and silver beet. | | P | | - |
| Chlorthal-Dimethyl (Dacthal) | D** | | Registered for control of various grass and broadleaf weeds including **Fat Hen** in lettuce. | | P | | - |
| Dimethenamid-P (Outlook) BASF | K** | | Registered for control of grass and broadleaf weeds including **Fat Hen** in sweet corn, beans, peas, pumpkins and kabocha. | | P | | - |
| Glufosinate-Ammonium (Basta) BASF | N** | | Registered for control of grass and broadleaf weeds including **Fat Hen** in berries, tomatoes, beans and fallow. | | P | | R3 |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| S-Metolachlor (Dual Gold) Syngenta | K** | | Registered for control of grass and broadleaf weeds including **Fat Hen** in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow. | | P | | - |
| Norflurazon (Zoliar) AgNova | F** | | Registered for control of grass and broadleaf weeds including **Fat Hen** in asparagus, citrus, grapes, nuts, stone & pome fruits. | | P | | - |
| NUL3438 Nufarm | TBC | | New active in development, Nufarm claims activity on broadleaf weeds. | | P | | - |
| Oxyfluorfen (Goal) | G** | | Registered for control of grass and broadleaf weeds, including **Fat Hen** in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat. | | P | | - |
| Phenmedipham (Betanal) Bayer | C** | | Registered for control of grass and broadleaf weeds including **Fat Hen** in silverbeet and beetroot. | | P | | R3 |
| Propachlor (Ramrod) Nufarm | K** | | Registered for control of broadleaf and grass weeds including **Fat Hen** in Brassica vegetables | | P | | R3 |
| **Nutgrass** (*Cyperus rotundus*)<br>**Priority: Moderate** | | | | | | | |
| Nutgrass was ranked as a moderate priority in QLD & NSW. Prefers damp, water-logged soils but can survive for years underground during dry times. Herbicide options are limited and unreliable. Improve soil drainage if possible. | | | | | | | |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Nutgrass**. | NR | A | ALL | R3 |
| Norflurazon (Zoliar) AgNova | F** | | Registered for control of **Nutgrass** in asparagus, citrus, grapes, nuts, stone & pome fruits. | | P | | - |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| **Pigweed** (*Portulaca oleracea*)<br>**Priority: Moderate** | | | | | | | |
| Pigweed was ranked as a moderate priority in QLD & NSW. Summer growing weed that competes aggressively in-crop and can be difficult to control with herbicides. Management options include soil fumigation, pre-crop spraying, spot spraying or using mechanical devices. | | | | | | | |
| Clomazone | Q** | Cucurbits / Pre-emergent residual | Registered in cucurbits for control of various broadleaf weeds, including **Pigweed**. | NR | A | ALL | - |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Pigweed**. | NR | A | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds, including **Pigweed**. | 1<br>G:1 | A | ALL | R3 |
| Chloridazon (Pyramin)<br>BASF | C** | | Registered for control of various grass and broadleaf weeds including **Pigweed** in fodder beet, red beet and silver beet. | | P | | - |
| Chlorthal-Dimethyl (Dacthal) | D** | | Registered for control of various grass and broadleaf weeds including **Pigweed** in lettuce. | | P | | - |
| Dimethenamid-P (Outlook)<br>BASF | K** | | Registered for control of grass and broadleaf weeds including **Pigweed** in sweet corn, beans, peas, pumpkins and kabocha. | | P | | - |
| Glufosinate-Ammonium (Basta)<br>BASF | N** | | Registered for control of grass and broadleaf weeds including **Pigweed** in berries, tomatoes, beans and fallow. | | P | | R3 |
| S-Metolachlor (Dual Gold)<br>Syngenta | K** | | Registered for control of grass and broadleaf weeds including suppression of **Pigweed** in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow. | | P | | - |
| Norflurazon (Zoliar)<br>AgNova | F** | | Registered for control of grass and broadleaf weeds including **Pigweed** in asparagus, citrus, grapes, nuts, stone & pome fruits. | | P | | - |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| NUL3438 Nufarm | TBC | | New active in development, Nufarm claims activity on broadleaf weeds. | | P | | - |
| Oxyfluorfen (Goal) | G** | | Registered for control of grass and broadleaf weeds, including **Pigweed** in fallow, Brassica vegetables and fruit and nut trees. Compatible with glyphosate and diquat/paraquat. | | P | | - |
| Phenmedipham (Betanal) Bayer | C** | | Registered in silverbeet and beetroot for control of a range of weeds, including, Blackberry nightshade, Cape weed, Chickweed, Fat hen, **Pigweed** and Amaranthus. Apply when weeds are at 2-leaf stage. [Max no of applications and re-treatment interval not specified] | | P | | R3 |
| Propachlor (Ramrod) Nufarm | K** | | Registered for control of broadleaf and grass weeds including **Pigweed** in Brassica vegetables | | P | | R3 |
| **Grass Weeds Priority: Unknown** | | | | | | | |
| Grass Weeds were not ranked as priority. They can compete aggressively in-crop, particularly as the crop is establishing ground cover. | | | | | | | |
| Fluazifop-P Butyl (Fusilade) | A*** | Cucurbits / Selective post-emergent | Registered as a selective post-emergence application in cucurbits for control of grass weeds. | 21 | A | ALL | - |
| Glyphosate (Roundup) | M** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds. | NR | A | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | Pre-plant knockdown | Registered as a pre-plant knockdown application for control of grass and broadleaf weeds. | 1 G:1 | A | ALL | R3 |
| Sethoxydim (Sertin) | A*** | Zucchini / Selective post-emergent | Registered as a selective post-emergence application in zucchini for control of grass weeds. | 28 | A | ALL | - |
| Dimethenamid-P (Outlook) BASF | K** | | Registered for control of grass and broadleaf weeds in sweet corn, beans, peas, pumpkins and kabocha. | | P | | - |

| Active ingredient (Trade Name) | Chemical Group | Crop / Situation | Comment / Use / Weed | WHP (days) | Availability | States | Regulatory risk |
|---|---|---|---|---|---|---|---|
| Glufosinate-Ammonium (Basta) BASF | N** | | Registered for control of grass and broadleaf weeds in berries, tomatoes, beans and fallow. | | P | | R3 |
| S-Metolachlor (Dual Gold) Syngenta | K** | | Registered for control of grass and broadleaf weeds in Brassica vegetables, culinary herbs, rhubarb, spinach, silverbeet, spring onions, beans, sweet corn, sweet potato and fallow. | | P | | - |
| Norflurazon (Zoliar) AgNova | F** | | Registered for control of grass and broadleaf weeds in asparagus, citrus, grapes, nuts, stone & pome fruits. | | P | | - |
| Propachlor (Ramrod) Nufarm | K** | | Registered for control of broadleaf and grass weeds including **Fat Hen** in Brassica vegetables | | P | | R3 |

# 5. References

## 5.1 Information:

| | |
|---|---|
| AgChem Access Priority Access Forum | https://www.agrifutures.com.au/national-rural-issues/agvet-chemicals/ |
| Australian Pesticide and Veterinary Medicines Authority | www.apvma.gov.au |
| APVMA Chemical review | https://apvma.gov.au/chemicals-and-products/chemical-review/listing |
| APVMA MRLs | www.legislation.gov.au/Details/F2021C00380 |
| APVMA Permit search | https://productsearch.apvma.gov.au/permits |
| APVMA Product search | https://productsearch.apvma.gov.au/products |
| AUSVEG | https://ausveg.com.au |
| Codex MRL database | http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/ |
| Cotton Pest Management Guide 2018-19 | https://www.cottoninfo.com.au/publications/cotton-pest-management-guide |
| CropLife Australia (resistance management) | https://www.croplife.org.au/resources/programs/resistance-management/ |
| Growcom – Infopest Database | www.infopest.com.au |
| Hort Innovation | www.horticulture.com.au |

## 5.2 Abbreviations and Definitions:

| | |
|---|---|
| **APVMA** | Australian Pesticides and Veterinary Medicines Authority |
| **IPM** | Integrated pest management |
| **LOQ** | Limit of quantification |
| **MRL** | Maximum residue limit (mg/kg or ppm) |
| **Pesticides** | Plant protection products (fungicide, insecticide, herbicide, nematicides, rodenticides, etc.) |
| **Plant pests** | Diseases, insects, 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 zucchini
Appendix 2. Products available for control of insects and mites in zucchini
Appendix 3. Products available for weed control in zucchini
Appendix 4. Current permits for use in zucchini
Appendix 5. Zucchini Maximum Residue Limits (MRLs)
Appendix 6. Zucchini Agrichemical Regulatory Risk Assessment

## Appendix 1. Products available for disease control in zucchini

| Active Ingredient (Trade Name) | Chemical group | Situation | Diseases / Comments | States | WHP Days | Regulatory risk |
|---|---|---|---|---|---|---|
| 1,3-dichloropropene + Chloropicrin (Telone C-35) | 8B | Field crops / Fumigant | Plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases (including Fusarium and Verticillium Wilts, Rhizoctonia, Pythium) & suppression of weeds. | ALL (Restricted use TAS, VIC & SA) | NR | - |
| *Aureobasidium pullulans* (Botector) Nufarm | BM 02 | Cucurbits (field & protected) | *Botrytis* and suppression of Sclerotinia | ALL | NR | - |
| Azoxystrobin (Amistar) | 11 | Cucurbits (field) | Powdery Mildew, Downy Mildew, and Gummy Stem Blight | ALL | 1 | - |
| Azoxystrobin + Oxathiapiprolin (Orondis Flexi) Syngenta | 11+49 | Cucurbits | Downy Mildew<br>Suppression of Powdery Mildew, Gummy Stem Blight and *Sclerotinia* spp. | ALL | 3<br>NG | - |
| Boscalid + Kresoxim-Methyl (Collis) BASF | 7+11 | Cucurbits (field) | Powdery Mildew | ALL | 7 | - |
| Bupirimate (Nimrod) | 8 | Zucchini (field & protected) | Powdery Mildew *(Sphaerotheca fuliginea)* | ALL | 1 | - |
| Chlorothalonil (Bravo) | M5 | Zucchini (field) | Downy Mildew, Gummy Stem Blight, Alternaria Leaf Blight, Anthracnose, Target Leaf Spot and suppression of Belly Rot | ALL | 1 | R3 |
| Copper Ammonium Acetate | M1 | Cucurbits (field & protected) | Angular Leaf Spot, Bacterial Leaf Spot and Downy Mildew | ALL | 1 | - |
| Copper Hydroxide | M1 | Cucurbits (field & protected) | Angular Leaf Spot, Bacterial Leaf Spot | ALL | 1 | - |
| Copper Octanoate | M1 | Cucurbits (field & protected) | Powdery Mildew and Downy Mildew | ALL | 1 | - |
| Copper Oxychloride | M1 | Cucurbits (field & protected) | Angular Leaf Spot, Bacterial Leaf Spot, Downy Mildew, Anthracnose, Gummy Stem Blight | ALL | 1 | - |

| Active Ingredient (Trade Name) | Chemical group | Situation | Diseases / Comments | States | WHP Days | Regulatory risk |
|---|---|---|---|---|---|---|
| Copper as Tribasic Copper Sulfate | M1 | Cucurbits (field & protected) | Angular Leaf Spot, Bacterial Leaf Spot | ALL | 1 | - |
| Copper as Cuprous Oxide | M1 | Cucurbits (field & protected) | Angular Leaf Spot, Bacterial Leaf Spot | ALL | 1 | - |
| Cyflufenamid (Flute) AgNova | U6 | Cucurbits (field & protected) | Powdery Mildew (*Podosphaera xanthii*) | ALL | 1 | - |
| Dazomet (Basamid) | 8F | Vegetables | Soil fungi (including *Pythium, Phytophthora, Fusarium,* and *Verticillium*), nematodes (cyst and non-cyst forming), soil insects and germinating seeds of weeds | ALL | NR | - |
| Dimethomorph (Acrobat) BASF | 40 | Cucurbits (field & protected) | Downy Mildew, Anthracnose, Gummy Stem Blight, Alternaria Leaf Spot, and Septoria Spot. | QLD & NT | 7 | - |
| Dimethomorph + Mancozeb (Acrobat WDG) BASF | 40+M3 | Cucurbits | Downy Mildew | ALL | 7 | R2 |
| | | | Anthracnose, Gummy Stem Blight, Alternaria Leaf Spot, Septoria Spot | QLD & NT | | |
| Hydrogen Peroxide + Peroxyacetic Acid (Peratec Plus) | M | Cucurbits (field & protected) | Powdery Mildew *(Sphaerotheca spp.*) | ALL | 1 | - |
| Iodine | M | Cucurbits / Sanitiser / Post-Harvest Dip | Bacteria & Fungi | ALL | NR | - |
| Mancozeb | M3 | Cucurbits (field) | Alternaria Spot, Anthracnose, Downy Mildew, Ring Spot, Gummy Stem Blight, and Septoria Spot | ALL | 7 | R2 |
| Mancozeb + Metalaxyl-M (Ridomil Gold MZ) Syngenta | M3+4 | Cucurbits (field) | Downy Mildew | ALL | 7 | R2 |
| | | | Anthracnose, Gummy Stem Blight, and Alternaria Leaf Spot | QLD | | |
| Metalaxyl-M (Ridomil Gold 25G) Syngenta | 4 | Cucurbits (field & protected) | Damping Off (*Pythium* and *Phytophthora* spp.) | NSW, QLD & WA | 7 | - |

| Active Ingredient (Trade Name) | Chemical group | Situation | Diseases / Comments | States | WHP Days | Regulatory risk |
|---|---|---|---|---|---|---|
| Metham Sodium | - | General pre-plant soil fumigation | Fungal diseases including *Rhizoctonia*, *Pythium*, *Fusarium*, *Phytophthora*, *Verticillium*, *Sclerotinia* and Club Root of crucifers. | ALL | NR | - |
| Metiram (Polyram) BASF | M3 | Cucurbits (field & protected) | Downy Mildew and Gummy Stem Blight | ALL | 7 | R2 |
| Metrafenone (Vivando) BASF | U8 | Cucurbits (field & protected) | Powdery Mildew (*Podosphaera xanthii*) | ALL | 7 | - |
| Oxathiapiprolin (Zorvec Enicade) Corteva | U15 | Cucurbits (field and protected) | Downy Mildew | ALL | 1 | - |
| Penthiopyrad (Fontelis) Corteva | 7 | Cucurbits (field and protected) | Grey Mould, Powdery Mildew, and Gummy Stem Blight | ALL | 1 | - |
| Phosphorous Acid | 33 | Cucurbits (field) | Downy Mildew | ALL | NR | - |
| Potassium Bicarbonate (EcoCarb) | M2 | Zucchini (field & protected) | Powdery Mildew | ALL | NR | - |
| Propamocarb Hydrochloride + Fluopicolide (Infinito) Bayer | 28+43 | Cucurbits (field & protected) | Downy Mildew | ALL | 1 | - |
| Propineb (Antracol) Bayer | M3 | Cucurbits (field & protected) | Downy Mildew | ALL | 3 | R2 |
| Propineb + Oxadixyl (Rebound) Kiwi Rural Trading | M3+4 | Cucurbits (field) | Downy Mildew, Anthracnose, and Gummy Stem Blight | ALL | 3 | R2 |
| Proquinazid (Talendo) Corteva | 13 | Cucurbits (field) | Powdery Mildew | ALL | 1 | - |

| Active Ingredient (Trade Name) | Chemical group | Situation | Diseases / Comments | States | WHP Days | Regulatory risk |
|---|---|---|---|---|---|---|
| Pyriofenone (Kusabi) AgNova | 50 | Cucurbits (field) | Powdery Mildew | ALL | NR | - |
| *Streptomyces lydicus* (Actinovate) | BM 02 | Cucurbits (field & protected) | Powdery Mildew | ALL | NR | - |
| | | Vegetables / Seed Treatment | Fusarium, Rhizoctonia, Pythium | | | |
| Sulphur | UN | Vegetables (field & protected) | Powdery Mildew, Rust, Tomato Russet Mite, Bean Spider Mite | VIC, TAS, SA, WA & NSW | NR | - |
| | | | Powdery Mildew, Rust, Tomato Russet Mite | QLD | | |
| Tea Tree Oil (Timorex) | 46 | Cucurbits (field & protected) | Powdery Mildew | ALL | NR | - |
| Triadimefon | 3 | Cucurbits (field) | Powdery Mildew | NSW & WA | 1 | R3 |
| Triadimenol (Bayfidan) | 3 | Cucurbits (field) | Powdery Mildew | ALL | 1 | R3 |
| Zineb | M3 | Cucurbits (field) | Downy Mildew & Anthracnose | ALL | 7 | R2 |

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

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| 1,3-dichloropropene + Chloropicrin (Telone C-35) | 8B | Field crops / Fumigant | Plant parasitic Nematodes, Symphylans, Wireworms, soil borne diseases (including Fusarium and Verticillium Wilts, Rhizoctonia, Pythium) & suppression of weeds. | ALL (Restricted use TAS, VIC & SA) | NR | - |
| Abamectin | 6 | Zucchini (field) | Two-Spotted Mite | ALL | 3 | - |
| Abamectin (Tervigo) Syngenta | 6 | Cucurbits (field & protected) | Root-Knot Nematode | ALL | NR | - |
| Abamectin PER14722 | 6 | Zucchini (field & protected) | Tomato Red Spider Mite | ALL (excl. VIC) | 3 G:3 | - |
| Abamectin PER81876 | 6 | Fruiting vegetables – Cucurbits (field) | Vegetable Leaf Miner (suppression only) | ALL (excl. VIC) | 7 NG | - |
| Afidopyropen (Versys) BASF | 9D | Cucurbits (field) | Green Peach Aphid, Cabbage Aphid, Currant Lettuce Aphid and Cotton/Melon Aphid; suppression of Silverleaf Whitefly | ALL | 1 | - |
| Alpha-Cypermethrin PER80138 | 3A | Cucurbit vegetables (field) | Cucumber Fruit Fly | ALL (excl. VIC) | 1 | - |
| *Bacillus thuringiensis subsp. kurstaki* (Dipel) | 11A | Vegetables (field & protected) | Armyworm, Cotton Bollworm, Native Budworm, Cabbage Moth, Cabbage White Butterfly, Green Looper, Lightbrown Apple Moth, Pear Looper, Soybean Looper, Vine Moth, and Tobacco Looper | ALL | NR | - |
| *Beauveria bassiana* (Velifer) BASF | UNF | Protected vegetables & 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 | - |
| Bifenazate (Acramite) UPL | 20D | Cucurbits (field) | Two-Spotted Mite and Bryobia Mite | ALL | 3 | - |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Bifenazate (Acramite) PER82341 | 20D | Zucchini (field & protected) | Red Tomato Spider Mite | ALL (excl. VIC) | 1 NG | - |
| Bifenthrin (Talstar) | 3A | Cucurbit vegetables (field) | Native Budworm, Corn Earworm, Cucumber Moth, and Silverleaf Whitefly Biotype B | Variable refer to label | 1 | R3 |
| Buprofezin (Applaud) Corteva PER82467 | 16 | Zucchini (field & protected) | Greenhouse Whitefly, Sweet Potato Whitefly, and Silverleaf Whitefly | ALL (excl. VIC) | 3 | - |
| Chlorantraniliprole (Coragen) FMC | 28 | Cucurbits (field & protected) | Cotton Bollworm, Native Budworm, and Cucumber Moth | ALL | 1 | - |
| Chlorantraniliprole (Coragen) FMC PER89259 | 28 | Fruiting vegetables including cucurbits (field) | Fall Armyworm (*Spodoptera frugiperda*) | ALL (excl. VIC) | 1 | - |
| Chlorpyrifos (Lorsban) | 1B | Cucurbits (field & protected) | Whitefly | NSW, WA & ACT | 5 | R1 |
| Clothianidin (Samurai) Sumitomo PER80101 | 4A | Cucurbit vegetables (field & protected) | Cucumber Fruit Fly | ALL | 7 NG | R2 |
| Cyantraniliprole (Benevia) FMC | 28 | Cucurbits (field) | Melon Aphid, Silverleaf Whitefly, Cotton Bollworm, Cucumber Moth, Native Budworm, and Western Flower Thrips (suppression only) | ALL | 1 | - |
| Cyantraniliprole (Benevia) FMC PER84805 | 28 | Fruiting vegetables (field) | Tomato Potato Psyllid | ALL (excl. VIC) | 1 NG | - |
| Cyantraniliprole (Benevia) PER90387 | 28 | Fruiting vegetables (field) | Liriomyza Leafminers | ALL (excl. VIC) | 1 NG | - |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Cyromazine (Diptex 150 WP) PER81867 | 17 | Cucurbits | *Liriomyza* spp. including Vegetable & Serpentine Leafminer | ALL | 7 NG | - |
| Diafenthiuron + Cyantraniliprole (Minecto Forte) Syngenta | 12A+28 | Cucurbits (field) | Silverleaf Whitefly (*Bemisia tabaci*), Melon Aphid (*Aphis gossypii*), Cotton Bollworm (*Helicoverpa armigera*), Native Budworm (*Helicoverpa punctigera*), Cucumber Moth (*Diaphania indica*), Cluster Caterpillar (*Spodoptera litura*), Green Peach Aphid (*Myzus persicae*), Two-Spotted Mite (*Tetranychus urticae*)<br>Suppression of:<br>Western Flower Thrips (*Frankliniella occidentalis*), Tomato Thrips (*Frankliniella schultzei*), Plague Thrips (*Thrips imaginis*) | ALL | 1 | - |
| Diazinon | 1B | Cucurbits (field) | Thrips | QLD, NSW, VIC, SA & WA | 14 | R3 |
| Dimethoate | 1B | Zucchini (field & protected) | Aphids, Jassids, Mites, Leafhoppers, Green Vegetable Bug, Thrips, and Wingless Grasshopper | ALL | 1 | R1 |
| | | | Cucumber Fly | QLD, NSW, WA & NT | | |
| Emamectin (Proclaim Opti) Syngenta | 6 | Cucurbits (field & protected) | Heliothis, Cluster Caterpillar, Cucumber Moth | ALL | 3 NG | - |
| Emamectin (Proclaim Opti) Syngenta PER89263 | 6 | Cucurbits (field & protected) | Fall Armyworm (*Spodoptera frugiperda*) | ALL (excl. VIC) | 3 | - |
| Emulsifiable Botanical Oil (Eco-Oil) | - | Vegetables | Greenhouse Whitefly | ALL | NR | - |
| Etoxazole PER82460 | 10B | Zucchini (field & protected) | Two-Spotted Mite and Tomato Red Spider Mite | ALL (excl. VIC) | 7 | - |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Flonicamid (Mainman) UPL | 9C | Cucurbits (field & protected) | Green Peach Aphid, Melon Aphid, & Silverleaf Whitefly | ALL | 1 NG | - |
| Flubendiamide (Belt) Bayer | 28 | Cucurbits (field & protected) | *Helicoverpa* spp. & Cucumber Moth | ALL | 1 | - |
| Fluensulfone (Nimitz) Adama | UN | Cucurbits / Transplanted Crops Only | Root-Knot Nematode | ALL | NR | - |
| Garlic + Chilli + Pyrethrins + Piperonyl Butoxide | 3A | Vegetables(field) | Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers | ALL | 1 | - |
| Helicoverpa NPV (Vivus Max) AgBiTech | 31 | Cucurbits (field & protected) | Cotton Bollworm, Corn Earworm, Tobacco Budworm and Native Budworm | ALL | NR | - |
| Hexythiazox (Calibre) PER14765 | 10A | Zucchini (field & protected) | Tomato Russet Mite, Broad Mite, Tomato Red Mite, and Two-Spotted Mite | ALL | 3 | - |
| Imidacloprid (formulations suitable for foliar application 200SC, 350SC) | 4A | Cucurbits (field) / Foliar Application | Green Peach Aphid | ALL | 1 NG | R2 |
| Imidacloprid (formulations suitable for soil application 350SC, 750WG) | 4A | Cucurbits (field) / Soil Application | Silverleaf Whitefly including biotype B | ALL | NR | R2 |
| Indoxacarb (Avatar eVo) FMC | 22A | Cucurbits (field) | Cotton Bollworm, Native Budworm, Cluster Caterpillar | ALL | 3 NG | R3 |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Maldison | 1B | Cucurbits | Pumpkin Beetle | NSW, ACT, VIC, SA & WA | 3 | R3 |
| | | Vegetables | Aphid, Green Vegetable Bug, Jassid, Leafhopper, Rutherglen Bug, Redlegged Earth Mite (excl. TAS), 28-Spotted Ladybird (excl. TAS) | ALL | | |
| Methomyl (Lannate) PER82428 | 1A | Zucchini (field) | *Helicoverpa* spp., Cucumber Moth, Cluster Caterpillar, Loopers, Webworm, Rutherglen Bug, Thrips including Western Flower Thrips | ALL | 3 | R2 |
| Methomyl (Lannate) PER89293 | 1A | Fruiting vegetables including cucurbits (field) | Fall armyworm (*Spodoptera frugiperda*) | ALL (excl. VIC) | 3 | R2 |
| Petroleum Oil | UN | Cucurbits (field) | Aphids, Mites, Thrips, and Leafhopper | ALL | 1 | - |
| | | | Silverleaf Whitefly | QLD | | |
| Petroleum Oil PER12221 | UN | Cucurbits (field & protected) | Greenhouse Whitefly, Sweet Potato White Fly, Silverleaf Whitefly biotype B, and Whitefly biotype Q | ALL (excl. VIC) | 1 | - |
| Pirimicarb (Aphidex) | 1A | Cucurbits (field) | Aphids | ALL | 2 | R3 |
| Potassium Salts of Fatty Acids (Natrasoap) | - | Cucurbits (field & protected) | Aphids, Thrips, Mealybug, Two Spotted Mites, Spider Mite, and Whitefly | ALL | 1 | - |
| Propargite (Omite) | 12C | Vegetables (field & protected) | Two-Spotted Mite | ALL | 7 | R3 |
| | | | Spider Mite | QLD & WA | | |
| Pymetrozine (Chess) Syngenta | 9B | Cucurbits (field & protected) | Melon Aphid, Green Peach Aphid, Potato Aphid and Cowpea Aphid; and for suppression of Silverleaf Whitefly and Greenhouse Whitefly | ALL | 3 | R3 |
| Pyriproxyfen (Admiral) Sumitomo | 7C | Cucurbits (field & protected) | Silverleaf Whitefly biotype B | ALL | 1 NG | - |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Spinetoram (Success Neo) Corteva | 5 | Cucurbits (field & protected) | Cucumber Moth, *Helicoverpa* Spp. & Western Flower Thrips | ALL | 3 | - |
| Spinetoram (Success Neo) PER89241 | 5 | Cucurbits (field) | Fall Armyworm (*Spodoptera frugiperda*) | ALL (excl. VIC) | 3 | |
| Spinosad (Naturalure) Corteva | 5 | Fruit trees, vegetables & ornamentals | Fruit Fly | ALL | NR | - |
| Spinosad (Entrust Organic) Corteva | 5 | Cucurbits (field & protected) | Cucumber Moth, Helicoverpa & Western Flower Thrips | ALL | 3 G:14 | - |
| Spinosad (Entrust Organic) Corteva PER89870 | 5 | Cucurbits (field & protected) | Fall Armyworm (*Spodoptera frugiperda*) | ALL (excl. VIC) | 3 G:14 | - |
| Spinosad (Entrust Organic) Corteva PER90928 | 5 | Cucurbits (field & protected) | Vegetable Leaf Miner (*Liriomyza sativae*), Pea Leaf Miner/Serpentine Leaf Miner (*Liriomyza huidobrensis*) American Serpentine Leaf Miner (*Liriomyza trifolii*). | ALL (excl. VIC) | 3 G:14 | - |
| Spirotetramat (Movento 240 SC) Bayer | 23 | Cucurbits (field and protected) | Cotton Aphid, Green Peach Aphid, and Silverleaf Whitefly biotype B | ALL | 1 | - |
| Sulfoxaflor (Transform) Corteva | 4C | Cucurbits (field grown only) | Green Peach Aphid, Melon Aphid, Greenhouse Whitefly and suppression of Rutherglen Bug | ALL | 1 | - |
| Sulfoxaflor (Transform) PER84743 | 4C | Fruiting vegetables (field) | Tomato Potato Psyllid | ALL (excl. VIC) | 1 NG | - |

| Active Ingredient (Trade Name) | Chemical. group | Situation | Pests / Comments | States | WHP | Regulatory risk |
|---|---|---|---|---|---|---|
| Sulphur | UN | Vegetables (field & protected) | Powdery Mildew, Rust, Tomato Russet Mite, Bean Spider Mite | VIC, TAS, SA, WA & NSW | NR | - |
| | | | Two-Spotted Mite | VIC, TAS, SA & WA | | |
| | | | Powdery Mildew, Rust, Tomato Russet Mite | QLD | | |
| Trichlorfon (Lepidex) | 1B | Vegetables (field & protected) | Cabbage White Butterfly, Cabbage Moth, Green Vegetable Bug, and Rutherglen Bug | ALL | 2 | R2 |

## Appendix 3. Products available for weed control in zucchini

| Active ingredient (Trade Name) | Chemical Group | Situation | Comment / Use / Weed | WHP (days) | States | Regulatory risk |
|---|---|---|---|---|---|---|
| Clomazone | Q** | Cucurbits / Pre-emergent residual | Apple of Peru, Blackberry Nightshade, Fat Hen, Pig Weed, Potato Weed, and Amaranth | NR | ALL | - |
| Fluazifop-P Butyl (Fusilade) | A*** | Cucurbits / Grass selective post-emergent | Grass weeds | 21 | ALL | - |
| Glyphosate (Roundup) | M** | General seed bed preparation | Grass and broadleaf weeds as a pre-crop spray | NR | ALL | R3 |
| Paraquat + Diquat (SpraySeed) | L** | General seed bed preparation | Grass and broadleaf weeds as a pre-crop spray | NR | ALL | R3 |
| Sethoxydim (Sertin) | A*** | Zucchini / Grass selective post-emergent | Grass weeds | 28 | ALL | - |

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

## Appendix 4. Current permits for use in zucchini

| Permit No. | Description | Issued Date | Expiry Date | Permit Holder |
|---|---|---|---|---|
| PER14722 Version 3 | Abamectin / Cucumber, Squash & Zucchini / Tomato red spider mite | 17-Feb-15 | 31-Jul-25 | Hort Innovation |
| PER81876 Version 4 | Abamectin / Cucurbits / Leaf miner including Vegetable & Serperntine Leafminer | 24-Jun-16 | 30-Apr-24 | Hort Innovation |
| PER80138 Version 3 | Alpha-cypermethrin / Cucurbit vegetables / Cucumber fruit fly | 26-Feb-15 | 31-Mar-25 | Hort Innovation |
| PER82341 Version 3 | Bifenazate (Acramite) / Various including Zucchini / Red tomato spider mite | 29-Mar-16 | 30-Apr-25 | Hort Innovation |
| PER82467 Version 3 | Buprofezin (Applaud) / Cucurbits / Greenhouse whitefly, Sweet potato whitefly, Silverleaf whitefly, & Whitefly | 07-Jul-17 | 30-Jun-25 | Hort Innovation |
| PER89259 | Chlorantraniliprole (Coragen) / Various including Cucurbits / Fall Armyworm | 06-Mar-20 | 31-Mar-23 | Hort Innovation |
| PER80101 Version 3 | Clothianidin (Samurai) / Cucurbit vegetables / Cucumber fruit fly | 10-Nov-15 | 30-Sep-23 | Hort Innovation |
| PER90387 | Cyantraniliprole (Benevia) / All Fruiting vegetables including cucurbits / Liriomyza Leafminers | 03-Dec-20 | 31-Dec-23 | Hort Innovation |
| PER81867 Version 2 | Cyromazine (Diptex 150 WP) / Various including Fruiting vegetables including cucurbits / *Liriomyza* species, including: Vegetable Leafminer (*Liriomyza sativa*) and Serpentine Leafminer (*Liriomyza huidobrensis*) | 2-Dec-19 | 30-Nov-23 | Hort Innovation |
| PER89263 Version 2 | Emamectin (Proclaim Opti) / Various including cucurbits / Fall Armyworm | 10-Mar-20 | 31-Mar-23 | Hort Innovation |
| PER82460 Version 2 | Etoxazole (Paramite) / Various vegetables, including cucurbits / Two-spotted mite & Tomato red spider mite | 26-Jul-17 | 31-Jul-23 | Hort Innovation |
| PER14765 Version 4 | Hexythiazox (Calibre) / Various including cucurbits / Tomato russet mite, Broad mite, Two spotted mite & Tomato red spider mite | 21-Feb-15 | 30-Sep-23 | Hort Innovation |

| Permit No. | Description | Issued Date | Expiry Date | Permit Holder |
|---|---|---|---|---|
| PER82428 Version 4 | Methomyl (Lannate) / Various including cucurbits / *Helicoverpa* spp., Cucumber moth, Cluster caterpillar, Loopers, Webworm, Rutherglen bug & Thrips including Western flower thrips | 22-Apr-16 | 31-Mar-24 | Hort Innovation |
| PER89293 | Methomyl (Lannate) / Various including cucurbits (field only) / Fall Armyworm | 10-Apr-20 | 30-Apr-23 | Hort Innovation |
| PER12221 Version 4 | Petroleum oil / Various including Cucurbits / Greenhouse whitefly, Sweet potato whitefly, Silverleaf whitefly biotype B, & whitefly biotype Q | 29-Jun-12 | 30-Nov-22 | Hort Innovation |
| PER89241 | Spinetoram (Success Neo) / Various Crops including cucurbits / Fall Armyworm | 06-Mar-20 | 31-Mar-23 | Hort Innovation |
| PER89870 | Spinosad (Entrust Organic) / Various including cucurbits / Fall Armyworm | 21-Jul-20 | 31-Jul-23 | Hort Innovation |
| PER90928 | Spinosad (Entrust Organic) / Various including Cucurbits / Leaf Miners | 23-Apr-2021 | 30-Apr-24 | Hort Innovation |

## Appendix 5. Zucchini Maximum Residue Limits (MRLs)

CODEX commodity groupings of fruiting vegetables and subgroups:

VC 0431 Squash, summer (Zucchini)
VC 0045 Fruiting vegetables, cucurbits
- Vegetables

Note: There are no exports recorded for Zucchini in Australia. Available information indicates that in the absence of specific limits in legislation that most countries defer to Codex, followed by EU MRL standards or apply a 0.01ppm default value. Food exported to New Zealand from Australia may be legally sold if it complies with Australian requirements. MRLs and legislation are subject to change; the values presented should not be relied on.

| Chemical | Codex | Description | APVMA MRL mg/kg | Codex MRL mg/kg |
|---|---|---|---|---|
| 1,3-dichloropropene | | Soil fumigant / MRLs not required | NR | |
| 2,2 DPA | - | Vegetables | *0.1 | - |
| 2,4-D | | | NA | NA |
| Abamectin | VC 0431 | Squash, summer | T0.05 | - |
| Acetamiprid | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Acibenzolar-S-methyl | VC 0431 | Squash, summer | T0.5 | 0.8 |
| Afidopyropen | VC0045 | Fruiting vegetables, cucurbits | 0.7 | - |
| Aldrin and Dieldrin | VC 0045 | Fruiting vegetables, cucurbits | E0.1 | E0.1 |
| Ametoctradin | VC 0045 | Fruiting vegetables, cucurbits | - | 3 |
| Azoxystrobin | VC 0045 | Fruiting vegetables, cucurbits | 2 | 1 |
| Benalaxyl | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| Bensulide | VC 0045 | Fruiting vegetables, cucurbits | *0.1 | - |
| Benzovindiflupyr | | | | 0.2 |
| Bifenazate | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Bifenthrin | VC 0045 | Fruiting vegetables, cucurbits | 0.1 | |
| Boscalid | VC 0045 | Fruiting vegetables, cucurbits | - | 3 |
| Bromide ion | VC 0431 | Squash, summer | - | 200 |
| Bromopropylate | VC 0431 | Squash, summer | - | 0.5 |
| Bupirimate | VC 0045 | Fruiting vegetables, cucurbits | 1 | |
| Buprofezin | VC 0045 | Fruiting vegetables, cucurbits | - | 0.7 |
| Carbaryl | VC 0045 | Fruiting vegetables, cucurbits | *0.01 | - |
| Carbendazim | VC 0431 | Squash, summer | - | 0.5 |
| Chlorantraniliprole | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | 0.3 |
| Chlordane | VC 0045 | Fruiting vegetables, cucurbits | E0.05 | - |
| Chloropicrin | | Soil fumigant / MRLs not required | NR | - |
| Chlorothalonil | VC 0045 | Fruiting vegetables, cucurbits | 5 | - |
| | VC 0431 | Squash, summer | - | 3 |
| Chlorpyrifos | - | Vegetables | T*0.01 | - |
| Chlorthal-dimethyl | - | Vegetables | 5 | - |
| Clomazone | VC 0045 | Fruiting vegetables, cucurbits | *0.05 | - |
| Clothianidin | VC 0045 | Fruiting vegetables, cucurbits | T0.5 | *0.02 |
| Cyantraniliprole | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | 0.3 |
| Cyazofamid | VC 0045 | Fruiting vegetables, cucurbits | - | 0.09 |
| Cyflufenamid | VC 0045 | Fruiting vegetables, cucurbits | 0.1 | - |

| Chemical | Codex | Description | APVMA MRL mg/kg | Codex MRL mg/kg |
|---|---|---|---|---|
| Cyhalothrin (includes lambda-cyhalothrin) | VC 0045 | Fruiting vegetables, cucurbits | - | 0.05 |
| Cypermethrins (including alpha- and zeta- cypermethrin) | VC 0045 | Fruiting vegetables, cucurbits | T0.3 | 0.07 |
| Cyprodinil | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Cyromazine | VC 0045 | Fruiting vegetables, cucurbits | T0.7 | |
| Deltamethrin | VC 0045 | Fruiting vegetables, cucurbits | 0.1 | 0.2 |
| Diafenthiuron | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | |
| Diazinon | - | Vegetables | 0.7 | - |
| | VC 0431 | Squash, summer | | 0.05 |
| Dichlobenil | VC 0045 | Fruiting vegetables, cucurbits | - | *0.01 |
| Dicofol | | Vegetables (some exceptions) | 5 | |
| Difenoconazole | VC 0431 | Squash, summer | | 0.2 |
| Dimethoate | VC 0431 | Squash, summer | 0.7 | - |
| Dimethomorph | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | 0.5 |
| Dinocap | VC 0045 | Fruiting vegetables, cucurbits | - | *0.05 |
| | VC 0431 | Squash, summer | - | 0.07 |
| Dinotefuran | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Dithiocarbamates | VC 0045 | Fruiting vegetables, cucurbits | 2 | - |
| | VC 0431 | Squash, summer | | 1 |
| Diquat | - | Vegetables | *0.05 | - |
| Emamectin benzoate | VC 0045 | Fruiting vegetables, cucurbits | - | 0.007 |
| Endrin | VC 0045 | Fruiting vegetables, cucurbits | - | E0.05 |
| Endosulfan | VC 0431 | Squash, summer | - | 0.5 |
| EPTC | - | Vegetables | *0.04 | - |
| Etoxazole | VC 0045 | Fruiting vegetables, cucurbits | T0.1 | - |
| Etridiazole | - | Vegetables | 0.2 | - |
| Famoxadone | VC 0431 | Squash, summer | - | 0.2 |
| Fenamidone | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Fenbuconazole | VC 0431 | Squash, summer | - | 0.05 |
| Fenhexamid | VC 0431 | Squash, summer | - | 1 |
| Fenpyroximate | VC 0431 | Squash, summer | | 0.06 |
| Flonicamid | VC 0045 | Fruiting vegetables, cucurbits | 0.7 | 0.2 |
| Fluazifop-p-butyl | VC 0045 | Fruiting vegetables, cucurbits | 0.1 | - |
| Flubendiamide | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | 0.2 |
| Fludioxonil | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Fluensulfone | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | - |
| | VC 0431 | Squash, summer | | 0.7 |
| Flumioxazin | VC 0045 | Fruiting vegetables, cucurbits | - | *0.02 |
| Fluopicolide | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | 0.5 |
| Flupyradifurone | VC 0431 | Squash, summer | | 0.2 |
| Flutriafol | VC 0045 | Fruiting vegetables, cucurbits | - | 0.3 |
| Fluxapyroxad | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Fosetyl Al | | | | 70 |
| Glyphosate | VC 0045 | Fruiting vegetables, cucurbits | *0.1 | - |
| Hydrogen peroxide | | MRLs not required | NR | |
| Heptachlor | - | Vegetables | E0.05 | - |
| Hexythiazox | VC 0045 | Fruiting vegetables, cucurbits | T0.05 | 0.05 |

| Chemical | Codex | Description | APVMA MRL mg/kg | Codex MRL mg/kg |
|---|---|---|---|---|
| Imidacloprid | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| | VC 0431 | Squash, summer | - | 1 |
| Indoxacarb | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Inorganic bromide | - | Vegetables | 20 | - |
| Kresoxim-Methyl | VC 0045 | Fruiting vegetables, cucurbits | 0.05 | - |
| Lindane | - | Vegetables | E2 | - |
| Linuron | - | Vegetables | *0.05 | - |
| Maldison | VC0045 | Fruiting vegetables, cucurbits | 2 | |
| Mancozeb | VC0045 | Fruiting vegetables, cucurbits | 2 | |
| Mandipropamid | VC 0431 | Squash, summer | - | 0.2 |
| Meptyldinocap | VC 0431 | Squash, summer | - | 0.07 |
| Metalaxyl | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| | VC 0431 | Squash, summer | - | 0.2 |
| Metaldehyde | - | Vegetables | 1 | - |
| Metham Sodium | VC0045 | Fruiting vegetables, cucurbits | 2 | |
| Methiocarb | - | Vegetables | 0.1 | - |
| Methomyl | VC 0045 | Fruiting vegetables, cucurbits | 0.1 | 0.1 |
| Methoxyfenozide | VC 0045 | Fruiting vegetables, cucurbits | - | 0.3 |
| Metiram | VC0045 | Fruiting vegetables, cucurbits | 2 | |
| Metolachlor | VC 0045 | Fruiting vegetables, cucurbits | *0.05 | - |
| Metrafenone | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | 0.5 |
| Myclobutanil | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Novaluron | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Omethoate | - | Vegetables | 2 | - |
| Oxadixyl | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | - |
| Oxamyl | | | | 0.04 |
| Oxathiapiprolin | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| Paraffinic oil | | MRLs not required | NR | |
| Paraquat | VC 0045 | Fruiting vegetables, cucurbits | - | 0.02 |
| | - | Vegetables | *0.05 | - |
| Penconazole | VC 0431 | Squash, summer | | 0.06 |
| Penthiopyrad | VC 0045 | Fruiting vegetables, cucurbits | 1 | 0.5 |
| | VC 0431 | Squash, summer | - | 0.5 |
| Permethrin | VC 0431 | Squash, summer | | 0.5 |
| Peroxyacetic acid | | MRLs not required | NR | |
| Petroleum oil | | MRLs not required | NR | |
| Phosphorous acid | VC 0045 | Fruiting vegetables, cucurbits | T100 | - |
| Piperonyl Butoxide | VC 0045 | Fruiting vegetables, cucurbits | - | 1 |
| | - | Vegetables | 8 | - |
| Pirimicarb | VC 0045 | Fruiting vegetables, cucurbits | - | 1 |
| | - | Vegetables | 1 | - |
| Potassium bicarbonate | | MRLs not required | NR | |
| Potassium salts of fatty acid | | MRLs not required | NR | |
| Prometryn | - | Vegetables | *0.1 | - |
| Propamocarb | VC 0045 | Fruiting vegetables, cucurbits | 5 | 5 |
| Propargite | - | Vegetables | 3 | - |
| Propazine | - | Vegetables | *0.1 | - |
| Propineb | VC 0045 | Fruiting vegetables, cucurbits | 2 | - |

| Chemical | Codex | Description | APVMA MRL mg/kg | Codex MRL mg/kg |
|---|---|---|---|---|
| Proquinazid | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| Prothioconazole | VC 0045 | Fruiting vegetables, cucurbits | - | 0.2 |
| Pymetrozine | VC 0045 | Fruiting vegetables, cucurbits | 1 | - |
| Pyraclostrobin | VC 0045 | Fruiting vegetables, cucurbits | - | 0.5 |
| Pyrethrins | VC 0045 | Fruiting vegetables, cucurbits | - | *0.05 |
| | - | Vegetables | 1 | - |
| Pyriofenone | VC 0045 | Fruiting vegetables, cucurbits | 0.7 | - |
| Pyriproxyfen | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | - |
| | VC 0431 | Squash, summer | | 0.04 |
| Rotenone | | MRLs not required | NR | |
| Sethoxydim | VC 0045 | Fruiting vegetables, cucurbits | *0.1 | - |
| Spinetoram | VC 0045 | Fruiting vegetables, cucurbits | 0.05 | - |
| Spinosad | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | 0.2 |
| Spiromesifen | | | | 0.09 |
| Spirotetramat | VC 0045 | Fruiting vegetables, cucurbits | 2 | 0.2 |
| Sulfoxaflor | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | 0.5 |
| Sulphur | | MRLs not required | NR | |
| Tea tree oil | | MRLs not required | NR | |
| Tebuconazole | VC 0431 | Squash, summer | - | 0.2 |
| Thiacloprid | VC 0431 | Squash, summer | - | 0.3 |
| Thiamethoxam | VC 0045 | Fruiting vegetables, cucurbits | T1 | 0.5 |
| Triadimefon | VC 0045 | Fruiting vegetables, cucurbits | 0.2 | 0.2 |
| Triadimenol | VC 0045 | Fruiting vegetables, cucurbits | 0.5 | 0.2 |
| Trichlorfon | - | Vegetables | 0.1 | - |
| Trifloxystrobin | VC 0045 | Fruiting vegetables, cucurbits | - | 0.3 |
| Trifluralin | - | Vegetables | 0.05 | - |
| Zineb | VC0045 | Fruiting vegetables, cucurbits | 2 | |
| Zoxamide | VC 0045 | Fruiting vegetables, cucurbits | - | 2 |

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

* Indicates that an MRL is at the Limit of Quantitation (LOQ)
NR - Uses of substances where MRLs are not necessary / required.
NA-MRLs are not in place.
T =Temporary MRL
E = The MRL is based on extraneous residues

Sources: APVMA MRLs: Agricultural and Veterinary Chemicals Code (MRL Standard) Instrument 2019. Compilation 17. Prepared 29 April 2021. CODEX MRLs: CODEX Alimentarius International Food Standards database (February 2021), http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/

## Appendix 6. Zucchini Agrichemical Regulatory Risk Assessment

# Zucchini
# Agrichemical Regulatory
# Risk Assessment

**October 2020**

Regulatory pressures on agrichemicals are increasing globally, with many being either restricted or withdrawn from use. For older agrichemicals these pressures are often the result of reconsiderations involving new or refined risk assessment methodologies 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 a MRL breach would adversely affect market access.

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

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

## Zucchini Agrichemical Regulatory Risk Assessment

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

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Insect and mite pests** | | | | |
| Ants | Pyrethrins (PER87918) | **3A** | | |
| | Chlorpyrifos (PER14575) | 1B | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| **Aphids** | | | | |
| Aphids | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| | Paraffinic oil (PER88171) | **UN** | | |
| | Pirimicarb | **1A** | Codex: JMPR Periodic re-evaluation 2022/23 | |
| | Pyrethrins (PER87918) | **3A** | | |
| Cabbage aphid | Afidopyropen | **9D** | | |
| Cotton /melon aphid | Afidopyropen | **9D** | | |
| | Cyantraniliprole | **28** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Flonicamid | **29** | | |
| | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| | Spirotetramat | **23** | | |
| | Sulfoxaflor | **4C** | USA: Pollinator concerns | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Cowpea aphid | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| Currant lettuce aphid | Afidopyropen | **9D** | | |
| Green peach aphid | Afidopyropen | **9D** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Flonicamid | **29** | | |
| | Imidacloprid | **4A** | APVMA: Under review<br>Canada: Under review<br>EU: Removal of all field uses<br>USA: Re-registration with new risk mitigation measures | |
| | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| | Spirotetramat | **23** | | |
| | Sulfoxaflor | **4C** | USA: Pollinator concerns | |
| Potato aphid | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| **Beetles** | | | | |
| Leaf eating ladybirds | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| Pumpkin beetle | Carbaryl | **1A** | | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| 28-spotted potato ladybird | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Caterpillars/Lepidoptera** | | | | |
| Armyworms | Carbaryl | **1A** | Canada: Review recently completed, retained with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| Cabbage white butterfly | Pyrethrins | **3A** | | |
| | Spinetoram | **5** | | |
| Caterpillars | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Pyrethrins (PER87918 Po) | **3A** | | |
| | Diazinon | **1B** | EU: Deregistered<br>Codex: To be reviewed by 2020/21. | |
| | Spinetoram | **5** | | |
| Cluster caterpillar | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Emamectin benzoate | **6** | | |
| | Flubendiamide | **28** | | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (Authorisation expired 31/8/19) | |
| Cucumber moth | Beta-cyfluthrin | **3A** | EU: No authorisation in place | |
| | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Chlorantraniliprole | **28** | | |
| | Cyantraniliprole | **28** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Cucumber moth | Emamectin benzoate | **6** | | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| | Spinetoram | **5** | | |
| | Spinosad | **5** | | |
| Cucurbit stem borer | Carbaryl | **1A** | Canada: Review recently completed, use acceptable<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| Cutworms | Carbaryl | **1A** | | |
| | Diazinon | **1B** | EU: Deregistered<br>Codex: To be reviewed by 2020/21.<br>JMPR Periodic re-evaluation 2020 | |
| | Trichlorfon | **1B** | APVMA: nominated for review<br>Codex: No MRLs<br>Europe: deregistered<br>US: No MRLs | |
| Diamondback (Cabbage) moth | Pyrethrins | **3A** | | |
| Fall armyworm | Chlorantraniliprole (PER89259) | **28** | | |
| | Chlorantraniliprole + thiamethoxam (PER89280) | **4A + 28** | Thiamethoxam:<br>APVMA: Under review<br>Canada: Proposal to deregister outdoor uses<br>Europe: Outdoor uses deregistered<br>USA: Re-registration with new risk mitigation measures | |
| | Emamectin benzoate (PER89263) | **6** | EU: Candidate for substitution | |
| | Methomyl (PER89293) | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (Authorisation expired 31/8/19) | |
| | Spinetoram (PER89241) | **5** | | |
| | Spinosad (PER89870) | **5** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Helicoverpa species<br>Native Budworm (*H. punctigera*)<br>Corn earworm/Cotton bollworm (*H. armigera*) | Beta-cyfluthrin | **3A** | EU: No authorisation in place | |
| | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| | Chlorantraniliprole | **28** | | |
| | Cyantraniliprole | **28** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Emamectin benzoate | **6** | EU: Candidate for substitution | |
| | Flubendiamide | **28** | | |
| | Helicoverpa NPV | **31** | | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| | Pyrethrins | **3A** | | |
| | Spinetoram | **5** | | |
| | Spinosad | **5** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Loopers | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| | Spinetoram | **5** | | |
| Potato moth (Leafminer) | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| Tomato grub | Emamectin benzoate | **6** | EU: Candidate for substitution | |
| Webworms | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| **Fruit fly** | | | | |
| Cucumber fly | Alpha-cypermethrin | **3A** | EU: Proposed restricted authorisation & Candidate for substitution | |
| | Clothianidin (PER80101) | **4A** | APVMA: Under review<br>Canada: Proposal to cancel foliar use in orchards strawberries and turf<br>Europe: Outdoor uses deregistered<br>USA: Re-registration with new risk mitigation measures[i] | |
| | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |
| Flies | Pyrethrins | **3A** | | |
| **Grasshoppers/Locusts** | | | | |
| Australian plague locust | Chlorpyrifos | 1B | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Field crickets | Chlorpyrifos | 1B | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| Migratory locust | Chlorpyrifos | **1B** | | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| Mole crickets | Chlorpyrifos | 1B | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| Spur-throated locust | Chlorpyrifos | **1B** | | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| Wingless grasshopper | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Jassids/Plant bugs** | | | | |
| Brown marmorated stink bug | Bifenthrin (PER82374) | **3A** | Canada: Registrations cancelled<br>EU: No authorisation in place | |
| Green vegetable bug | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| Jassids | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| Leafhoppers | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| | Petroleum oil | **UN** | | |
| | Pyrethrins (PER87918 Po) | **3A** | | |
| Rutherglen bug | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| Yellow spotted stink bug | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Mealybug/Scale** | | | | |
| Mealybugs | Pyrethrins | **3A** | | |
| | Chlorpyrifos | 1B | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| Scale insects | Pyrethrins | **3A** | | |
| **Mites** | | | | |
| Broad mite | Hexythiazox (PER14765) | **10A** | Codex: No MRLs | |
| Bryobia mite | Bifenazate | **20** | EU: Proposed non-renewal | |
| Mites | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Dimethoate | **1B** | Codex: MRL deletion recommended.<br>EU proposing to set all MRLs to < 0.01 mg/kg | |
| | Petroleum oil | **UN** | | |
| Redlegged earth mite | Malathion/Maldison | **1B** | APVMA: Under review: chemistry<br>Codex: Re-evaluation scheduled for 2022/23 | |
| Red tomato spider mite | Abamectin (PER14722) | **6** | | |
| | Bifenazate (PER82341) | **20** | EU: Proposed non-renewal | |
| | Etoxazole (PER82460) | **10B** | EU: Uses restricted to greenhouse ornamentals only & Candidate for substitution | |
| Tomato russet mite | Hexythiazox (PER14765) | **10A** | Codex: No MRLs | |
| Two-spotted (Red spider) mite | Abamectin | **6** | | |
| | Bifenazate | **20** | EU: Proposed non-renewal | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Etoxazole (PER82460) | **10B** | EU: Uses restricted to greenhouse ornamentals only & Candidate for substitution | |
| | Hexythiazox (PER14765) | **10A** | Codex: No MRLs | |
| | Pyrethrins | **3A** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Thrips** | | | | |
| Melon thrips | Spinetoram | **5** | | |
| Plague thrips | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| Thrips | Diazinon | **1B** | EU: Deregistered<br>Codex: To be reviewed by 2020/21. | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| | Paraffinic oil (PER88171) | **UN** | | |
| | Pyrethrins (PER87918 Po) | **3A** | | |
| Tomato thrips | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| Western flower thrips | Cyantraniliprole | **28** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Methomyl | **1A** | APVMA: nominated for review<br>Canada: Majority of uses cancelled<br>EU: No authorisations (expired 31/8/19) | |
| | Spinetoram | **5** | | |
| | Spinosad | **5** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **White fly** | | | | |
| Greenhouse whitefly | Buprofezin | **16** | Europe: In the process of deleting MRLs | |
| | Petroleum oil | **UN** | | |
| | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| | Sulfoxaflor | **4C** | USA: Pollinator concerns | |
| Silverleaf whitefly | Afidopyropen | **9D** | | |
| | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Buprofezin | **16** | Europe: In the process of deleting MRLs | |
| | Cyantraniliprole | **28** | | |
| | Diafenthiuron + cyantraniliprole | **12A + 28** | Diafenthiuron<br>Codex: No MRLs<br>EU: No authorisation in place | |
| | Flonicamid | **29** | | |
| | Imidacloprid | **4A** | APVMA: Under review<br>Canada: Under review<br>EU: Removal of all field uses<br>USA: Re-registration with new risk mitigation measures | |
| | Petroleum oil | **UN** | | |
| | Pymetrozine | **9B** | EU- Being phased out<br>Codex: No registrant support | |
| | Pyriproxyfen | **7C** | EU: Authorisation renewal assessment process underway | |
| | Spirotetramat | **23** | | |
| Whiteflies | Bifenthrin | **3A** | Canada: Subject to phase-out until 31/12/2020<br>EU: No authorisation in place | |
| | Chlorpyrifos | **1B** | APVMA: Under review. Potential issues w.r.t. environmental loading and worker exposure.<br>EU: Proposed cancellation of use<br>Canada: proposed cancellation of most uses.<br>USA: EPA decision to allow continued use | |
| | Pyrethrins (PER87918 Po) | **3A** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **Other** | | | | |
| Earwig | Pyrethrins | **3A** | | |
| European earwig | Carbaryl | **1A** | Canada: Review recently completed, retained but with a large number of uses deleted<br>Codex: Toxicology review scheduled 2020<br>Europe: Authorisation not renewed | |
| Vegetable leafminer | Abamectin | **6** | | |
| **Nematodes** | | | | |
| Root-knot nematodes | Abamectin | **6** | | |
| | Cyanogen (ethanedinitrile) | **-** | | |
| | Fluensulfone | **-** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **DISEASES** | | | | |
| Alternaria leaf blight | Benalaxyl | **4** | EU: Proposed non-renewal of authorisation | |
| | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| | Dimethomorph | **40** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |
| | Metalaxyl/metalaxyl-M | **4** | EU: Metalaxyl candidate for substitution<br>Metalaxyl-M restricted use approval | |
| Angular leaf spot | Copper | **M1** | EU: Candidate for substitution | |
| Anthracnose | Benalaxyl | **4** | EU: Proposed non-renewal of authorisation | |
| | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| | Copper | **M1** | EU: Candidate for substitution | |
| | Dimethomorph | **40** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |
| | Metalaxyl/metalaxyl-M | **4** | EU: Metalaxyl candidate for substitution<br>Metalaxyl-M restricted use approval | |
| | Oxadixyl | **4** | EU: No authorisation in place | |
| | Propineb | **M3** | APVMA: Nominated for review<br>EU: No authorisation in place<br>Codex: To be reviewed 2022/23 | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Anthracnose | Sulfur | **M2** | | |
| | Zineb | **M3** | APVMA: Nominated for review<br>Codex: To be reviewed 2022/23<br>EU: No authorisation in place | |
| Bacterial spot | Copper | **M1** | EU: Candidate for substitution | |
| Bactericide | Iodine | **M** | | |
| Botrytis | Iprodione | **2** | Europe: Deregistered<br>Canada: Majority of food crop uses deleted<br>Codex: Review scheduled for 2022/23 | |
| | Pyrimethanil | **9** | | |
| Damping off | Ethanedinitrile | **-** | EU: No authorisation in place | |
| | Metalaxyl/metalaxyl-M | **4** | EU: Metalaxyl candidate for substitution<br>Metalaxyl-M restricted use approval | |
| Downy mildew | Azoxystrobin | **11** | | Pending Label Registration (July 2021) as an outcome of Hort Innovation project ST17000 generated data to support a label registration for control of Downy Mildew in cucurbits. |
| | Benalaxyl | **4** | EU: Proposed non-renewal of authorisation | |
| | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| | Copper | **M1** | EU: Candidate for substitution | |
| | Dimethomorph | **40** | | |
| | Fluopicolide | **43** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Downy mildew | Metalaxyl/metalaxyl-M | **4** | EU: Metalaxyl candidate for substitution<br>Metalaxyl-M restricted use approval | |
| | Metiram | **M3** | APVMA: Nominated for review<br>Canada: Proposed cancelling of foliar uses<br>Codex: To be reviewed 2022/23 | |
| | Oxadixyl | **4** | EU: No authorisation in place | |
| | Oxathiapiprolin | **49** | | |
| | Phosphorous acid | **33** | | |
| | Propamocarb HCl | **28** | | |
| | Propineb | **M3** | APVMA: Nominated for review<br>EU: No authorisation in place<br>Codex: To be reviewed 2022/23 | |
| | Sulfur | **M2** | | |
| | Zineb | **M3** | APVMA: Nominated for review<br>Codex: To be reviewed 2022/23<br>EU: No authorisation in place | |
| Fungal diseases: Fusarium | Cyanogen (ethanedinitrile) | **-** | | |
| Fungal diseases: Rhizoctonia | Cyanogen (ethanedinitrile) | **-** | | |
| Fungi | Iodine | **M** | | |
| Fusarium wilt | Cyanogen (ethanedinitrile) | **-** | | |
| Grey mould | Penthiopyrad | **7** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Gummy stem blight | Azoxystrobin | **11** | | |
| | Benalaxyl | **4** | EU: Proposed non-renewal of authorisation | |
| | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| | Copper | **M1** | EU: Candidate for substitution | |
| | Dimethomorph | **40** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |
| | Metalaxyl/metalaxyl-M | **4** | EU: Metalaxyl candidate for substitution<br>Metalaxyl-M restricted use approval | |
| | Metiram | **M3** | APVMA: Nominated for review<br>Canada: Proposed cancelling of foliar uses<br>Codex: To be reviewed 2022/23 | |
| | Oxadixyl | **4** | EU: No authorisation in place | |
| | Penthiopyrad | **7** | | |
| Gummy stem blight | Propineb | **M3** | APVMA: Nominated for review<br>EU: No authorisation in place<br>Codex: To be reviewed 2022/23 | |
| Late (Irish) blight | Copper | **M1** | EU: Candidate for substitution | |
| Leaf diseases/spots | Copper | **M1** | EU: Candidate for substitution | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Phytophthora soil fungus (Dieback) | Metalaxyl | **4** | EU: Metalaxyl candidate for substitution | |
| Phytophthora trunk/collar rot | Cyanogen (ethanedinitrile) | - | | |
| Powdery mildew | Azoxystrobin | **11** | | |
| | Boscalid | **7** | | |
| | Bupirimate | **8** | | |
| | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| | Copper | **M1** | EU: Candidate for substitution | |
| | Cyflufenamid | **U6** | | |
| | Hydrogen peroxide +peroxyacetic acid | **M** | | |
| | Kresoxim-methyl | **7** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |
| | Melaleuca oil | | | |
| | Metrafenone | **50** | | |
| | Penthiopyrad | **7** | | |
| | Potassium bicarbonate | | | |
| | Proquinazid | **13** | | |
| | Pyriofenone | **50** | | |
| | *Streptomyces lydicus* | **BM02** | | |
| | Triadimefon | **3** | APVMA: Nominated for review<br>Europe: EU: Authorisation expired 31/08/2019 | |
| | Triadimenol | **3** | APVMA: Nominated for review<br>EU: No authorisation in place | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| Rhizoctonia ground rot | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| Rhizoctonia rot | Cyanogen (ethanedinitrile) | **-** | | |
| Root and collar rot | cyanogen (ethanedinitrile) | **-** | | |
| Rust | Copper | **M1** | EU: Candidate for substitution | |
| | Sulfur | **M2** | | |
| Sclerotium crown rot | Cyanogen (ethanedinitrile) | **-** | | |
| Septoria leaf spot | Copper | **M1** | EU: Candidate for substitution | |
| | Dimethomorph | **40** | | |
| | Mancozeb | **M3** | APVMA: Nominated for review<br>Canada: Many uses cancelled<br>Codex: To be reviewed 2022/23<br>EU: Authorisation not renewed | |
| | Sulfur | **M2** | | |
| Spot blotch | Cyanogen (ethanedinitrile) | **-** | | |
| Target leafspot | Chlorothalonil | **M5** | APVMA: Nominated for review<br>Canada: Review recently completed, continued use considered acceptable<br>Europe: Deregistered. | |
| Target spot (Early blight) | Copper | **M1** | EU: Candidate for substitution | |
| | Sulfur | **M2** | | |

| Problem | Active Constituents | Chemical Group | Comment | Activities |
|---|---|---|---|---|
| **WEEDS** | | | | |
| Broadleaf weeds and grasses | Clomazone | **Q** | | |
| | Fluazifop-P | **A** | | |
| | Sethoxydim | **A** | EU: No authorisation in place | |
| **Plant growth regulators** | | | | |
| | Paclobutrazol | | | |

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[i] Clothianidin: Berry fruit, fruiting vegetables, ornamentals, pome fruit, turf Reduction in yearly total rate