



# **Mushroom**

Strategic Agrichemical Review Process  
(SARP)

October 2022

Hort Innovation  
Project – MT21005

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

**Date of report:**

October 2022

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Strategic levy investment

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## **1. Summary**

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 custard apple 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 identified are:

<b>Common Name</b>	<b>Scientific Name</b>
Cobweb Disease	<i>Cladobotryum</i> spp.
Dry Bubble	<i>Lecanicillium fungicola</i>
Wet Bubble	<i>Mycogone</i> spp. (incl. <i>Mycogone perniciosa</i> )
Green Mould	<i>Trichoderma aggressivum</i>
La France Disease	Virus Complex
Mushroom Virus X	Virus Complex

## **1.2 Insects and mites**

The high priority insect and mite pests are:

<b>Common Name</b>	<b>Scientific Name</b>
Mushroom Phorids / Flies	<i>Megaselia halterata</i>
Mushroom Sciarids / Flies	<i>Lycoriella castanescens</i> , <i>Lycoriella ingenua</i> , <i>Bradysia ocellaris</i>

## **2. The Australian Mushroom Industry**

Mushrooms refer to a number of edible mushrooms grown for human consumption, including *Agaricus bisporus* (button, cup, flat and brown mushrooms), as well as a number of exotic varieties including shiimeji and oyster mushrooms. Mushrooms are grown in most states of Australia, close to population centres.

Total production for the year ending June 2021 was 69,936 tonnes<sup>1</sup>. Wholesale value of fresh supply was \$485 m, with \$360 m distributed into retail and \$125 m into food service.

### Mushroom Seasonality by State

State	20/21 t	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
New South Wales	21,577												
Victoria	25,655												
Queensland	4,283												
Western Australia	5,936												
South Australia	11,486												
Availability legend			High		Medium		Low		None				

Australia is a net importer of fresh mushrooms. Fresh exports account for less than 1% of annual production with 33% of that going to Brunei, 15% to PNG, 14% to Nauru and 9% to Fiji.

<sup>1</sup> Hort Innovation (2021). Australian Horticulture Statistics Handbook 2020/21. [online] Available at: <https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/grower-resources/ha18002-assets/australian-horticulture-statistics-handbook/>

## **3. Introduction**

### **3.1 Background**

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

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

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

In combination with cultural practices, pesticides are important tools in mushroom 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 mushroom 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 mushroom 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 mushroom 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 mushroom but attempts to prioritise the major problems.

Exotic plant pests, not present in Australia, are not addressed in this document.

### **3.2 Minor use permits and registration**

From a pesticide access perspective, the APVMA classifies Mushrooms as a major crop. The crop fits within the APVMA crop group 018: Edible Fungi. Therefore, access to minor use permits can be difficult unless a reasonable justification is provided in accordance with the APVMA's minor use guidance<sup>2</sup>.

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

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<sup>2</sup> Guide for Determining Minor Uses can be found at [www.apvma.gov.au/node/10931](http://www.apvma.gov.au/node/10931)



### **3.3 Methods**

The current update of the Mushroom Strategic Agrichemical Review Process (SARP), which was last updated in 2017, was conducted by desktop audit using industry information gathered during 2021-2022. The process included gathering, collating and confirming information:

<b>Process of Review</b>	<b>Activity</b>
Industry survey	Preparation and circulation of online industry survey to update priority pests and identify priority control gaps. Survey released: 17 November 2021 Survey closed: 21 April 2022 There was an additional industry consultation process undertaken to supplement feedback as the response to the online survey was limited.
SARP data updated via a desktop audit	Updated registrations and permits Updated MRL tables Updated available and potential pesticides against low, moderate and high priority pests, including an assessment of their suitability Included information on regulatory risks from MT20007
Captured industry input	Collated and analysed survey results Consolidated and incorporated industry needs and insights

## **3.4 Results and discussions**

### **3.4.1 Detail**

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

### **3.4.2 Appendices**

Refer to additional information in the appendices:

Appendix 1. Products available for disease control in mushrooms

Appendix 2. Products available as sanitisers and disinfectants in mushroom systems

Appendix 3. Products available for control of insects and mites in mushrooms

Appendix 4. Current permits for use in mushrooms

Appendix 5. Mushroom Maximum Residue Limits (MRLs)

Appendix 6. Mushroom Agrichemical Regulatory Risk Assessment

#### 4. Diseases, Pests and Weeds of Mushrooms

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<sup>3</sup>.

In Chapter 4 information on regulatory risk derived from project MT20007 (Regulatory support and coordination) has been incorporated.

Some of the suggested options have no overseas MRLs (see Appendix 5).

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.

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

## **4.1 Diseases of mushrooms**

### **4.1.1 Disease priorities**

<b>Common name</b>	<b>Scientific name</b>
<b>High</b>	
Cobweb Disease	<i>Cladobotryum</i> spp.
Dry Bubble	<i>Lecanicillium fungicola</i>
Wet Bubble	<i>Mycogone</i> spp. (incl. <i>Mycogone perniciosa</i> )
Green Mould	<i>Trichoderma aggressivum</i>
La France Disease	Virus Complex
Mushroom Virus X	Virus Complex
<b>Moderate</b>	
Internal Stem Necrosis	<i>Ewingella americana</i>
Bacterial Blotch	<i>Pseudomonas tolaasii</i>
Ginger Blotch	<i>Pseudomonas gingeri</i>
<b>Low</b>	
Smoky Mould	<i>Penicillium hermansii</i>
Aphanocladium Cap Spot	<i>Aphanocladium album</i>
Pythium	<i>Pythium oligandrum</i>
Drippy Gill	<i>Pseudomonas agarici</i>
Mummy Disease	<i>Pseudomonas</i> spp.

High priority diseases identified for the mushroom industry are Cobweb Disease, Dry Bubble, Wet Bubble, Green Mould, La France Disease and Mushroom Virus X. These priorities apply to all mushroom production regions. Available and potential products for control of diseases are listed in Section 4.1.2.

Cultural controls are a critical component of disease management, including hygiene in growing sheds and with equipment, environmental controls and the use of effective spot treatments to limit and control outbreaks when they occur.

Spot Treatments are an effective tool in disease management for mushrooms. The current technique is to remove any infected material and to treat the affected area with salt. Salt has proven to be unreliable in containing the spread of infection. There are more effective alternatives being used in mushroom production overseas, such as alcohol + fatty acids. These products may have some application in the Australian mushroom industry pending further research.

General hygiene is critical in mushroom production systems, particularly as there are limited fungicides available to control disease outbreaks. The use of sanitisers is a critical measure used to sterilise growing rooms and equipment, as well as in foot baths to prevent ingress of disease with people entering mushroom sheds. Sanitiser registrations usually don't list specific pathogens for control. There are some pathogens such as La France Disease and Mushroom X disease for which strict hygiene is critical and is the only control measure available to manage these diseases. Note that sanitisers are not able to be applied directly to mushrooms.

## **Resistance Management**

Resistance by fungal pathogens to fungicides usually evolves following the intensive use of fungicides for disease control. In any fungal population there are likely to be individuals that have some degree of natural resistance, and which are less susceptible to fungicides, even before the chemicals are used. Resistance arises mainly through the incorrect use of fungicides, which selects for the resistant individuals. Continued use of a fungicide or fungicide chemical group can result in a significant build-up of resistant individuals in the fungal population – to the point where that particular product, or other products from the same chemical group, is no longer effective. In some cases, removal of the selection pressure can result in the fungal population regaining its sensitivity to the fungicide group, but this is not always the case. The risk of fungicide resistance developing varies between different chemical groups and different fungal pathogens, such that specific strategies are recommended for those situations considered to carry the highest risk<sup>4</sup>.

In the absence of an established resistance management strategy for a particular crop/disease situation, it is recommended that the use of fungicides from any given activity group (excluding Group M and BM) be limited to a maximum of one-third of the total number of fungicide applications. The use of consecutive applications of fungicides from the same activity group should also be limited by alternating between products from different activity groups. The use of Group M and BM fungicides is not limited, as these fungicides carry an inherently low risk of fungicide resistance developing.

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<sup>4</sup> [www.croplife.org.au/resources/programs/resistance-management/fungicide-resistance-management-strategies1-draft-draft-3/](http://www.croplife.org.au/resources/programs/resistance-management/fungicide-resistance-management-strategies1-draft-draft-3/)

#### 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
<b>Cobweb Disease</b> ( <i>Cladobotryum</i> spp.)							
<b>Priority: High</b>							
Rated as a high priority disease. The pathogen grows rapidly over the casing surface and colonizes mushrooms at all stages of development with a white aerial mycelium, causing a destructive soft rot. Effective control of cobweb is built on a solid foundation of meticulous hygiene, effective exclusion, rigorous fly control and careful monitoring backed up with a speedy and appropriate response to any infection. Because Cobweb has rapid growth and produces large numbers of aerial spores, early detection and immediate action to contain the outbreak using spot treatment is essential.							
Metrafenone (Vivando) BASF PER90382	50	Protectant	10	A	ALL	Registered in mushrooms (protected only) for the control of <b>Cobweb Disease</b> ( <i>Cladobotryum</i> sp.) and Dry Bubble ( <i>Lecanicillium fungicola</i> ). Apply as a casing surface spray / drench after casing prior to first flush. Do not use more than 1 application per crop.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
Prochloraz (Octave)	3	Protectant & Curative	NR	A	ALL	Registered in mushrooms for the control of Dry Bubble ( <i>Verticillium fungicola</i> ), Wet Bubble ( <i>Mycogone pernicioso</i> ) and <b>Cobweb Disease</b> ( <i>Hypomyces rosellus</i> ). Can be applied either with the water used to wet the peat prior to casing, or as a spray application to the casing immediately after harvest of the first flush. Number of applications per crop not specified.	R3
Prochloraz (Octave) PER12645	3	Protectant & Curative	NR	A	ALL (excl. VIC)	Permitted in mushrooms for the control of <b>Cobweb Disease</b> ( <i>Hypomyces rosellus</i> ). If prochloraz has not been incorporated in the peat and cobweb disease becomes a problem, spray the casing immediately after the first or later flushes. Do not use more than 2 applications per crop.	R3
Sodium Chloride PER88212	-	Spot Treatment	NR	A	ALL	Permitted in mushrooms as a spot treatment for the suppression of Dry Bubble ( <i>Lecanicillium sp.</i> ) and <b>Cobweb Disease</b> ( <i>Cladobotryum sp.</i> ) To limit the risk of airborne dispersal of Cobweb spores, carefully cover the affected area with wet paper towel. Once paper towel is in place, apply salt to the affected area to a depth of 5-8mm.	-
Thiabendazole (Tecto)	1	Protectant	NR	P-A	ALL	Registered for use in peat moss for mushroom casing for the control of Wet Bubble. US registration for control of Dry Bubble, Wet Bubble, <b>Cobweb</b> and Green Mould.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Dry Bubble</b> ( <i>Lecanicillium fungicola</i> ) <b>Priority: High</b>							
Rated as a high priority disease. Dry Bubble infections show a range of symptoms, including undifferentiated masses of tissue forming on the bed, cap spotting, stipe blowout, warty cap and fluid production. Effective fly and mite control is a key to disease management in conjunction with spot treatment to prevent the early spread of infections.							
Carbendazim PER14949	1	Protectant & Curative	14	A	ALL (excl. VIC)	Permitted in mushrooms for the control of <b>Dry Bubble</b> ( <i>Verticillium</i> spp.), Wet Bubble ( <i>Mycogone</i> spp.) and Green Mould ( <i>Trichoderma</i> spp.) Apply as a low-pressure spray to the casing material or the bed surface during crop preparation. Do not use more than 1 application per crop.	R3
Metrafenone (Vivando) BASF PER90382	50	Protectant	10	A	ALL	Permitted in mushrooms for the control of Cobweb Disease ( <i>Cladobotryum</i> sp.) and <b>Dry Bubble</b> ( <i>Lecanicillium fungicola</i> ). Apply as a casing surface spray / drench after casing prior to first flush. Do not use more than 1 application per crop.	-
Prochloraz (Octave)	3	Protectant & Curative	NR	A	ALL	Registered in mushrooms for the control of <b>Dry Bubble</b> ( <i>Verticillium fungicola</i> ), Wet Bubble ( <i>Mycogone perniciososa</i> ) and Cobweb Disease ( <i>Hypomyces rosellus</i> ). Can be applied either with the water used to wet the peat prior to casing, or as a spray application to the casing immediately after harvest of the first flush. Number of applications per crop not specified.	R3



Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
Sodium Chloride PER88212	-	Spot Treatment	NR	A	ALL	Permitted in mushrooms as a spot treatment for the suppression of <b>Dry Bubble</b> ( <i>Lecanicillium sp.</i> ) and Cobweb Disease ( <i>Cladobotryum sp.</i> ) Apply by the single touch and bag approach. Place hand inside a plastic bag, grasp and carefully remove the infected area. Remove hand from bag, folding the plastic back over the diseased tissue. Tie bag and dispose of carefully. Upon removal of diseased area, apply salt to the bed where the infected area was removed, to a depth of 5-8 mm.	-
Thiabendazole (Tecto)	1	Protectant	NR	P-A	ALL	Registered for use in peat moss for mushroom casing for the control of Wet Bubble. US registration for control of <b>Dry Bubble</b> , Wet Bubble, Cobweb and Green Mould.	-
Hydrogen Peroxide + Peroxyacetic Acid	M	Protectant & Curative		P		US registration for control of <b>Verticillium Spot / Dry Bubble</b> , <i>Trichoderma</i> , Bacterial Blotch, <i>Mycogone</i> (Wet Bubble) and Necrotic Spot.	-
Natamycin (Zivion M)	-	Protectant		P		US registration for control of Dry Bubble in mushrooms.	-
Chlorothanoniil (Bravo)	M5	Protectant		P		US registration for control of Verticillium Brown Spot and <b>Dry Bubble</b> .	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Wet Bubble</b> ( <i>Mycogone</i> spp. incl. <i>Mycogone pernicios</i> )							
<b>Priority: High</b>							
Rated as a high priority disease. Wet Bubble is characterised by the development of distorted masses of mushroom tissue, which are initially white and fluffy but become brown as they age and decay. Contaminated casing material is a common primary source of infection so hygiene in the crop preparation stage is critical to manage the disease.							
Carbendazim PER14949	1	Protectant & Curative	14	A	ALL (excl. VIC)	Permitted in mushrooms for the control of Dry Bubble ( <i>Verticillium</i> spp.), <b>Wet Bubble</b> ( <i>Mycogone</i> spp.) and Green Mould ( <i>Trichoderma</i> spp.) Apply as a low-pressure spray to the casing material or the bed surface during crop preparation. Do not use more than 1 application per crop.	R3
Prochloraz (Octave)	3	Protectant & Curative	NR	A	ALL	Registered in mushrooms for the control of Dry Bubble ( <i>Verticillium fungicola</i> ), <b>Wet Bubble</b> ( <i>Mycogone pernicios</i> ) and Cobweb Disease ( <i>Hypomyces rosellus</i> ). Can be applied either with the water used to wet the peat prior to casing, or as a spray application to the casing immediately after harvest of the first flush. Number of applications per crop not specified.	R3
Thiabendazole (Tecto)	1	Protectant	NR	A	ALL	Registered for use in peat moss for mushroom casing for the control of <b>Wet Bubble</b> ( <i>Mycogone pernicios</i> ). Incorporate in water used to wet the peat moss at casing.	-
Hydrogen Peroxide + Peroxyacetic Acid	M	Protectant & Curative		P		US registration for control of <i>Verticillium</i> Spot / Dry Bubble, <i>Trichoderma</i> , Bacterial Blotch, <i>Mycogone</i> ( <b>Wet Bubble</b> ) and Necrotic Spot.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Green Mould</b> ( <i>Trichoderma aggressivum</i> ) <b>Priority: High</b>							
Rated as a high priority disease. Green Mould causes large yield losses. Initial symptoms are a dense white mycelial growth followed by extensive green sporulation of the fungus. Hygiene in crop preparation and with personnel and equipment during the growing phase are critical elements of disease management.							
<i>Bacillus amyloliquefaciens</i> MBI 600 (Serifel) BASF PER91265	BM 02	Biological	NR	A	ALL	Permitted in mushrooms for suppression of <b>Green Mould</b> ( <i>Trichoderma</i> spp.) Apply to mushroom compost, mushroom spawn or mushroom supplement, depending on growth system. Then apply at casing, before 1 <sup>st</sup> flush, between 1 <sup>st</sup> and 2 <sup>nd</sup> flush, and/or between 2 <sup>nd</sup> and 3 <sup>rd</sup> flush, according to disease pressure. Do not use more than 10 applications per crop.	-
Carbendazim PER14949	1	Protectant & Curative	14	A	ALL (excl. VIC)	Permitted in mushrooms for the control of Dry Bubble ( <i>Verticillium</i> spp.), Wet Bubble ( <i>Mycogone</i> spp.) and <b>Green Mould</b> ( <i>Trichoderma</i> spp.) Apply as a low-pressure spray to the casing material or the bed surface during crop preparation. Do not use more than 1 application per crop.	R3
Imazalil (Magnate)	3	Protectant	28	A	ALL	Registered in mushrooms for control of <b>Green Mould</b> ( <i>Trichoderma</i> spp.) Mix with dry gypsum and coat this on the grain spawn prior to mixing with the compost. Do not use more than 1 application per crop production cycle.	R3
Thiabendazole (Tecto)	1	Protectant	NR	P-A	ALL	Registered for use in peat moss for mushroom casing for the control of Wet Bubble. US registration for control of Dry Bubble, Wet Bubble, Cobweb and <b>Green Mould</b> .	-
Hydrogen Peroxide + Peroxyacetic Acid	M	Protectant & Curative		P		US registration for control of <i>Verticillium</i> Spot / Dry Bubble, <b>Trichoderma</b> , Bacterial Blotch, <i>Mycogone</i> (Wet Bubble) and Necrotic Spot.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>La France Disease</b> (Virus Complex)							
<b>Priority: High</b>							
Rated as a high priority disease. La France Disease is thought to be caused by a range of viruses. Severe infections will cause large yield losses and the disease is difficult to control and eradicate. Strict farm hygiene is critical for disease management. Infected mushroom spores are the most common source of infection and these should be killed by effective composting techniques to prevent carry over from previous crops, and the use of strict farm hygiene for equipment and personnel to eliminate ongoing infection risks.							
No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							
<b>Mushroom Virus X</b> (Virus Complex)							
<b>Priority: High</b>							
Rated as a high priority disease. This viral condition leads to occurrence of Patch Disease and Brown Cap Mushroom Disease. The viruses are spread by mushroom spores and mycelium. Stringent hygiene based on efficient cook out and effective cleaning is the most successful management tool. Dust management is also an important aspect of virus disease control. Reduce the amount of dust on the farm and protect vulnerable Phase II, Phase III and casing operations from dust contamination. Correct identification is important as the symptoms can express as similar to other mushroom diseases.							
No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							
<b>Internal Stem Necrosis</b>							
<b>Priority: Moderate</b>							
Rated as a moderate priority disease. Evidence suggests that Internal Stem Necrosis is caused by a water imbalance in the mushroom bed. The bacterial pathogen <i>Ewingella americana</i> is associated with the disorder but is not the causal organism. Symptoms display as browning and necrosis of affected stipe tissue. Impact can be reduced by managing the room environment. Ensure compost temperatures are regulated and there is always sufficient evaporation. Sanitisers play a role ensuring that growing surfaces are bacteria-free during the preparation phase.							
No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Bacterial Blotch</b> ( <i>Pseudomonas tolaasii</i> ) <b>Ginger Blotch</b> ( <i>Pseudomonas gingeri</i> ) <b>Priority: Moderate</b> Rated as moderate priority diseases. Bacterial blotch can develop on the outer surface of a mushroom - on cap or stem or both - at any stage of mushroom growth or development. Bacteria splashed onto a mushroom surface will reproduce in moist conditions, such as occur when water condenses or remains on the mushroom surface for several hours. Casing and air-borne dust are the primary means of introducing the blotch pathogen into a mushroom house. Ginger Blotch is a similar pathogen to Bacterial Blotch, with distinctive ginger-coloured symptoms. Hygiene and compost preparation are key disease management factors.							
<i>Bacillus amyloliquefaciens</i> MBI 600 (Serifel) BASF PER91265	BM 02	Biological	NR	P-A	ALL	Permitted in mushrooms for suppression of Green Mould ( <i>Trichoderma</i> spp.) US registration for control of <b><i>Pseudomonas</i> spp.</b> in berries, cucurbits, fruiting vegetables, leafy vegetables, stone fruit, tobacco and tree nuts.	-
<b>Smoky Mould</b> ( <i>Penicillium hermansii</i> ) <b>Priority: Low</b> Rated as a low priority disease. Smoky Mould infections can be highly destructive, but the disease is relatively rare and is generally prevented by producing a highly selective compost, effective physical exclusion and stringent hygiene. Should smoky mould express in a crop, the only control available is to reduce the temperature in the growing room to limit the spread of the disease and to reduce the water content of the compost, as infection worsens in wet compost. No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							
<b>Aphanocladium Cap Spot</b> ( <i>Aphanocladium album</i> ) <b>Priority: Low</b> Rated as a low priority disease. Cases of this pathogen are rare in mushrooms. Regular hygiene protocols used for the major diseases will reduce the incidence of infection. No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Pythium</b> ( <i>Pythium oligandrum</i> )							
<b>Priority: Low</b>							
Rated as a low priority disease. Cases of this pathogen are rare in mushrooms. Regular hygiene protocols used for the major diseases will reduce the incidence of infection.							
No control measures available. Refer to sanitisers and disinfectants for additional information about maintaining good hygiene in mushroom sheds.							
<b>Drippy Gill</b> ( <i>Pseudomonas agarici</i> )							
<b>Priority: Low</b>							
Rated as a low priority disease. Cases of this pathogen are rare in mushrooms. Regular hygiene protocols used for the major diseases will reduce the incidence of infection.							
<i>Bacillus amyloliquefaciens</i> MBI 600 (Serifel) BASF PER91265	BM 02	Biological	NR	P-A	ALL	Permitted in mushrooms for suppression of Green Mould ( <i>Trichoderma</i> spp.) US registration for control of <b><i>Pseudomonas</i> spp.</b> in berries, cucurbits, fruiting vegetables, leafy vegetables, stone fruit, tobacco and tree nuts.	-
<b>Mummy Disease</b> ( <i>Pseudomonas</i> spp.)							
<b>Priority: Low</b>							
Rated as a low priority disease. Cases of this pathogen are rare in mushrooms. Regular hygiene protocols used for the major diseases will reduce the incidence of infection.							
<i>Bacillus amyloliquefaciens</i> MBI 600 (Serifel) BASF PER91265	BM 02	Biological	NR	P-A	ALL	Permitted in mushrooms for suppression of Green Mould ( <i>Trichoderma</i> spp.) US registration for control of <b><i>Pseudomonas</i> spp.</b> in berries, cucurbits, fruiting vegetables, leafy vegetables, stone fruit, tobacco and tree nuts.	-

### 4.1.3 Available and potential sanitisers and disinfectants 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
<b>General Sanitation and Hygiene</b>							
<b>Priority: High</b>							
General hygiene is critical in mushroom production systems, particularly as there are limited fungicides available to control disease outbreaks. The use of sanitisers is a critical measure used to sterilise growing rooms and equipment, as well as in foot baths to prevent ingress of disease with people entering mushroom sheds. Sanitiser registrations usually don't list specific pathogens for control. There are some pathogens such as La France Disease and Mushroom X disease for which strict hygiene is critical and is the only control measure available to manage these diseases. Note that sanitisers are not able to be applied directly to mushrooms.							
Chlorine Dioxide	M	Sanitiser	NR	A	ALL	Registered as a sanitiser for mushroom growing surfaces for the control of Bacteria. Drench, spray or fog a 1000 ppm solution onto the walls, floors, ceiling, and post-crop mushroom growing surfaces. Ventilate the room for 1 hour after treatment before re-populating.	-
Orthophenylphenol (Bacrasan)	-	Sanitiser	NR	A	ALL	Registered as a sanitiser for mushroom growing surfaces and equipment for the control of Bacteria, Fungi and Moulds. Apply to clean surfaces and equipment. Do not use in or around spawning or other mushrooms.	-
Polyglycol Ether Iodine Complexes + Phosphoric Acid (San-I-Mush)	-	Sanitiser	NR	A	ALL	Registered as a sanitiser for mushroom growing trays, sheds and service areas, misting of walls, ceilings, fixtures, etc, foot baths and hand baths for the control of Bacteria and Fungi.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory Risk
<b>Green Mould</b> ( <i>Trichoderma aggressivum</i> ) <b>Priority: High</b> Rated as a high priority disease. Green Mould causes large yield losses. Initial symptoms are a dense white mycelial growth followed by extensive green sporulation of the fungus. Hygiene in crop preparation and with personnel and equipment during the growing phase are critical elements of disease management.							
Didecyl Dimethyl Ammonium Chloride	-	Sanitiser	NR	A	ALL	Registered as a sanitiser in mushroom growing sheds for control of <b>Green Mould</b> ( <i>Trichoderma atroviridae</i> ). Apply to the mushroom shed with a cold fogging or misting machine. Close the room and leave closed for at least 6 hours. Ventilate the room for at least 30 minutes after treatment and before entry. Hose down all hard surfaces prior to using the treated facility.	-
<b>Bacterial Blotch</b> ( <i>Pseudomonas tolaasii</i> ) <b>Ginger Blotch</b> ( <i>Pseudomonas gingeri</i> ) <b>Priority: Moderate</b> Rated as moderate priority diseases. Bacterial blotch can develop on the outer surface of a mushroom - on cap or stem or both - at any stage of mushroom growth or development. Bacteria splashed onto a mushroom surface will reproduce in moist conditions, such as occur when water condenses or remains on the mushroom surface for several hours. Casing and air-borne dust are the primary means of introducing the blotch pathogen into a mushroom house. Ginger Blotch is a similar pathogen to Bacterial Blotch, with distinctive ginger-coloured symptoms. Hygiene and compost preparation are key disease management factors.							
Calcium Hypochlorite (Hypochlor Chlorine Cartridge)	-	Sanitiser / Water Treatment	NR	A	ALL	Registered in mushroom houses as a water treatment to control <b>Bacterial Blotch</b> ( <i>Pseudomonas tolaasii</i> ). First application when pins form, and thereafter between breaks dependant on disease incidence. Maximum number of applications not specified.	-



## **4.2 Insect and mite pests of mushrooms**

### **4.2.1 Insect and mite pest priorities**

<b>Common name</b>	<b>Scientific name</b>
<b>High</b>	
Mushroom Phorids / Flies	<i>Megaselia halterata</i>
Mushroom Sciarids / Flies	<i>Lycoriella castanescens, Lycoriella ingenua, Bradysia ocellaris</i>
<b>Moderate</b>	
Saprophagous Nematodes	<i>Rhabditis</i> spp.
Red Pepper Mite	<i>Siteroptes mesembrinae, Bakerdania mesembrinae</i>
<b>Low</b>	
Mushroom White Cecid	<i>Heteropeza pygmaea</i>
Mushroom Yellow (Orange) Cecid	<i>Mycophila barnesi</i>
Mushroom Pygmy Mite	<i>Microdispus lambi</i>
Bacteria Feeding Mite	<i>Histiostoma feroniarum</i>
Mycophagous Nematodes	<i>Aphelenchoides composticola, Ditylenchus myceliophagus, Amidostomum</i> spp.
Black Compost Fly	<i>Scatopse notate</i>
Sphaerocerid Flies	Sphaeroceridae

The high priority insect pests identified were Mushroom Phorids and Mushroom Sciarids. These flies are pests due to being highly effective vectors of disease. A holistic and integrated approach to fly management is critical for protection of mushrooms from infestations. Available and potential products for insect, mite and other pests are listed in Section 4.2.2.

Wall Sprays are an important technique used to prevent flies from entering the grow room. There are products available for use in farm buildings, but the APVMA has indicated that registration needs to be stipulated specifically for mushroom farms. There is also work out of the US using electrostatic screens in conjunction with a product called Eco Via WD (Thyme Oil based) for the exclusion of flies. Further research is required to investigate what other treatments would be of value, including biological treatments.

## Resistance Management

Insecticide resistance is a risk to effective control for some insect groups, particularly if there is an over-reliance on a limited number of insecticides. Growers should adhere to the resistance management strategies outlined on the CropLife website<sup>5</sup>. Growers should not exceed the maximum number of applications permitted on the insecticide label.

The objective of Insecticide Resistance Management is to prevent or delay resistance developing to insecticides, or to help regain susceptibility in insect pest populations in which resistance has already arisen. IRM is important in maintaining the efficacy of valuable insecticides. It is usually easier to prevent resistance occurring than it is to reactively regain susceptibility.

Insecticide applications are often arranged into Mode of Action (MoA) spray windows or blocks that are defined by the stage of crop development and the biology of the pest(s) of concern. Local expert advice should always be followed with regard to spray windows and timings. Several sprays of a compound may be possible within each spray window, but it is generally essential to ensure that successive generations of the pest are not treated with compounds from the same MoA group.

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<sup>5</sup> [www.croplife.org.au/resources/programs/resistance-management/insecticide-resistance-management-strategies-3-draft/](http://www.croplife.org.au/resources/programs/resistance-management/insecticide-resistance-management-strategies-3-draft/)

## 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 2022-23 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
<b>Mushroom Phorids / Flies (<i>Megaselia halterata</i>)</b>								
<b>Priority: High</b>								
Rated as a high priority insect pest. Phorids are effective vectors of disease, and an integrated approach is required to prevent them impacting on production. Fly control should be controlled at the start of the production cycle on filling and casing days, followed by a rigorous program of physical exclusion, ongoing insecticide treatment in the casing, and the timely removal of picking waste and spent mushroom compost off site.								
Cyrozamine (Diptex)	17	Insect Growth Regulator	NR	A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and <b>Phorids</b> ). Application can be made at compost preparation phase, or at spawning phase, or after casing. Best results are achieved if product is applied at spawning phase. Do not use more than 1 application per production cycle.	L Bee:L	-
Diazinon	1B	Contact	14	A	ALL	Registered in mushrooms for control of Mushroom Pests. Can be applied either by mixing with the compost at spawning or by spraying over the top of the casing soil immediately after casing. Number of applications not specified.	H Bee:VH	R2
Fipronil (Regent)	2B	Contact & Ingestion	14	A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids, <b>Phorids</b> and Cecids). Apply a diluted mixture to peatmoss during preparation of casing.	M Bee:VH	R2

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
Pyrethrins + Piperonyl Butoxide	3A	Contact	NR	A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and <b>Phorids</b> ). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-
Pyrethrins + Piperonyl Butoxide (Pyzap) PER12172	3A	Contact	NR	A	ALL (excl. VIC)	Permitted in mushrooms for control of Mushroom Flies (Sciarids and <b>Phorids</b> ). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-
Azadirachtin (Azaguard)	UN	IGR	NR	P		US registration for control of Mushroom Flies, Nematodes and <b>Phorid Flies</b> in mushroom houses.	L Bee:L	-
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Biological	NR	P		US registration for control of <b>Phorids</b> in mushrooms.	L Bee:L	-
Dichlorvos	1B	Contact		P		US registration for control of <b>Phorid Flies</b> in mushroom houses.	H Bee:H	-
Rosemary Oil + Geraniol + Peppermint Oil (Brandt Ecotec Plus)	-	Contact		P		US registration for surface protection from Flies in mushroom houses.	L Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
<b>Mushroom Sciarids / Flies</b> ( <i>Lycoriella castanescens</i> , <i>Lycoriella ingenua</i> , <i>Bradysia ocellaris</i> )								
<b>Priority: High</b>								
Rated as a high priority insect pest. Sciarids are effective vectors of disease, and an integrated approach is required to prevent them impacting on production. Fly control should be controlled at the start of the production cycle on filling and casing days, followed by a rigorous program of physical exclusion, ongoing insecticide treatment in the casing, and the timely removal of picking waste and spent mushroom compost off site.								
<i>Bacillus thuringiensis subsp. israelensis</i> Serotype H14 (VectoBac WG) PER87515	11	Biological	NR	A	ALL (excl. VIC)	Permitted in mushrooms for control of <b>Sciarids</b> . Apply as a soil drench, wetting to a depth of 3-4 cm and targeting the larval stage of the insect. Reapply as needed. Number of applications not specified.	VL Bee:L	-
Cyrozamine (Diptex)	17	Insect Growth Regulator	NR	A	ALL	Registered in mushrooms for control of Mushroom Flies ( <b>Sciarids</b> and Phorids). Application can be made at compost preparation phase, or at spawning phase, or after casing. Best results are achieved if product is applied at spawning phase. Do not use more than 1 application per production cycle.	L Bee:L	-
Diazinon	1B	Contact	14	A	ALL	Registered in mushrooms for control of Mushroom Pests. Can be applied either by mixing with the compost at spawning or by spraying over the top of the casing soil immediately after casing. Number of applications not specified.	H Bee:VH	R2
Diflubenzuron (Dimilin)	15	Insect Growth Regulator	NR	A	ALL	Registered in mushrooms for the control of <b>Sciarids</b> . Treatment should be applied to the casing, compost or as a drench, targeting the larval stages of the pest. Do not use drenching if the casing has been treated previously in the production cycle.	L Bee:L	-
Fipronil (Regent)	2B	Contact & Ingestion	14	A	ALL	Registered in mushrooms for control of Mushroom Flies ( <b>Sciarids</b> , Phorids and Cecids). Apply a diluted mixture to peatmoss during preparation of casing.	M Bee:VH	R2
Permethrin	3A	Contact	3	A	ALL	Registered in mushroom beds for the control of <b>Sciarids</b> . Apply as a dust to mushroom beds, no more frequently than twice a week. Discontinue dusting when mushrooms reach the size of a 10-cent piece.	VH Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
Pyrethrins + Piperonyl Butoxide	3A	Contact	NR	A	ALL	Registered in mushrooms for control of Mushroom Flies ( <b>Sciarids</b> and Phorids). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-
Pyrethrins + Piperonyl Butoxide (Pyzap) PER12172	3A	Contact	NR	A	ALL (excl. VIC)	Permitted in mushrooms for control of Mushroom Flies ( <b>Sciarids</b> and Phorids). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-
Triflumuron (Alsystin) Bayer	15A	Insect Growth Regulator	NR	A	ALL	Registered in mushroom beds for the control of <b>Sciarids</b> . Incorporate either into the casing or as a compost treatment if there is a Sciarid infestation during spawn run.		-
Diflubenzuron (Dimilin / Tide)	15	Insect Growth Regulator		P		US registration for control of <b>Sciarid Flies</b> .	M Bee:M	-
Methoprene (Apex)	7	Insect Growth Regulator		P		US registration for control of Sciarid Flies in mushrooms.		
Rosemary Oil + Geraniol + Peppermint Oil (Brandt Ecotec Plus)	-	Contact		P		US registration for surface protection from Flies in mushroom houses.	L Bee:L	-
<i>Steinernema feltinae</i> Beneficial Nematodes (Nemasys M)	-	Biological		P		US registration for control of Sciarid Flies in mushrooms.	L Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
<b>Saprophagous Nematodes</b> ( <i>Rhabditis</i> spp.)								
<b>Priority: Moderate</b>								
Rated as a moderate priority pest. These nematodes are frequently found in mushroom composts. They can be associated with sporadic but sudden drops in production, usually in mid to late summer. Saprophagous Nematodes feed on bacteria and organic matter in the compost, not on the mushroom mycelium.								
Abamectin	6	Contact	3	A	ALL	Registered in mushrooms for control of Red Pepper Mite ( <i>Siteroptes mesembrinae</i> ), Mushroom Pygmy Mite ( <i>Microdispus lambi</i> ) and <b>Nematodes</b> (Rhabditidae). Apply as a casing drench or if in-crop over beds. Do not use more than 2 applications per crop, with a minimum retreatment interval of 14 days.	M Bee:H	-
Azadirachtin (Azaguard)	UN	IGR	NR	P		US registration for control of Mushroom Flies, <b>Nematodes</b> and Phorid Flies in mushroom houses.	L Bee:L	-
Cyclobutrifluram (Vaniva) Syngenta	N-3			P		New nematicide in development from Syngenta	-	-
Fluazaindolizine (Reklemel, Salibro) Corteva	N-UN	Contact		P		Registered for control of nematodes in cucurbits, fruiting vegetables and root and tuber vegetables. Approval for use in mushrooms could be complex depending on cost of development and potential contribution of use pattern to dietary exposure.	-	-
Fluensulfone (Nimitz) Adama	N-UN	Contact		P		Registered for control of Root-Knot Nematode in peppers, carrot, chilli, cucurbits, eggplant, okra, potato, sugarcane, sweet potato and tomato.	L Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
<b>Red Pepper Mite</b> ( <i>Siteroptes mesembrinae</i> , <i>Bakerdania mesembrinae</i> )								
<b>Priority: Moderate</b>								
Rated as a moderate priority pest. These are a frequent pest in mushroom production, although the losses from the pest are not clearly evident. Damage to the mushrooms can make them unsaleable and they are often associated with Green Mould outbreaks.								
Abamectin	6	Contact	3	A	ALL	Registered in mushrooms for control of <b>Red Pepper Mite</b> ( <i>Siteroptes mesembrinae</i> ), Mushroom Pygmy Mite ( <i>Microdispus lambi</i> ) and Nematodes (Rhabditidae). Apply as a casing drench or if in-crop over beds. Do not use more than 2 applications per crop, with a minimum retreatment interval of 14 days.	M Bee:H	-
Etoxazole (Paramite)	10B	Contact & Ingestion		P		Registered for control of <b>Mites</b> in bananas, citrus, pome fruit, stone fruit, grapes, tomatoes, capsicum, cotton, almonds and turf.	L Bee:VL	-
Potassium Salts of Fatty Acid (Natrasoap)	UNE	Contact		P		Registered for control of Aphids, Thrips, Mealybug, <b>Two Spotted Mites, Spider Mite</b> , and Whitefly in fruit trees.	L Bee:L	-
Petroleum Oil	UNM	Contact		P		Registered for control of <b>Mites</b> in pome fruit, stone fruit and pecans.	VL Bee:L	-
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Biological		P		Registered for suppression of <b>Two Spotted Spider Mite</b> in protected vegetables. US registration for control of Phorids in mushrooms.	L Bee:L	-
Bifenazate (Acramite) UPL	20D	Contact & Ingestion		P		Registered for control of various <b>Mites</b> in almonds, pome fruit, stone fruit, fruiting vegetables, cucurbits, pawpaw and strawberries.	L Bee:H	-
Clofentezine (Apollo)	10A	IGR / Contact				Registered for control of various <b>Mite</b> species in pome fruit, stone fruit, bananas, hops, tomatoes, almonds and ornamentals.	L Bee:L	-
Isocycloseram (Simodis) Syngenta	30	Ingestion		P		First global application is proposed for 2023 for Thrips, Bugs, Mites and Caterpillars. Registration submitted May 2021 for Simodis to control <b>Mites</b> , Thrips and Helicoverpa in fruiting vegetables.	-	-



Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
Spiromesifen (Oberon) Bayer	23	Ingestion		P		Not currently registered in AU but under development with Bayer and Hort Innovation for multiple commodities. US registrations for <b>Mites</b> in various crops.	M Bee:VL	-
<b>Mushroom White Cecid</b> ( <i>Heteropeza pygmaea</i> ) <b>Mushroom Yellow (Orange) Cecid</b> ( <i>Mycophila barnesi</i> ) <b>Priority: Low</b> Rated as low priority pests. Cecids flies are an infrequent pest of mushrooms. When present they feed on the mushroom stems or gills, reducing marketable yield. Exclusion of flies from growing rooms is the most effective control measure.								
Diazinon	1B	Contact	14	A	ALL	Registered in mushrooms for control of Mushroom Pests. Can be applied either by mixing with the compost at spawning or by spraying over the top of the casing soil immediately after casing. Number of applications not specified.	H Bee:VH	R2
Fipronil (Regent)	2B	Contact & Ingestion	14	A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids, Phorids and <b>Cecids</b> ). Apply a diluted mixture to peatmoss during preparation of casing.	M Bee:VH	R2
Azadirachtin (Azaguard)	UN	IGR	NR	P		US registration for control of <b>Mushroom Flies</b> , Nematodes and Phorid Flies in mushroom houses.	L Bee:L	-
Cyrozamine (Diptex)	17	Insect Growth Regulator	NR	P-A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and Phorids).	L Bee:L	-
Pyrethrins + Piperonyl Butoxide	3A	Contact	NR	P-A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and Phorids). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-
Pyrethrins + Piperonyl Butoxide (Pyzap) PER12172	3A	Contact	NR	P-A	ALL (excl. VIC)	Permitted in mushrooms for control of Mushroom Flies (Sciarids and Phorids). Spray into air space after mushroom picking has ceased for the day. Apply at filling the newly spawned compost, at the end of casing and as required during picking. Do not use more than 5 applications per crop, with a minimum retreatment interval of 24 hours.	VH Bee:H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
Rosemary Oil + Geraniol + Peppermint Oil (Brandt Ecotec Plus)	-	Contact		P		US registration for surface protection from Flies in mushroom houses.	L Bee:L	-
<b>Mushroom Pygmy Mite</b> ( <i>Microdispus lambi</i> ) <b>Bacteria Feeding Mite</b> ( <i>Histiostoma feroniarum</i> ) <b>Priority: Low</b> Rated as low priority pests. These mite species are rarely seen in mushrooms. Control measures used for Red Pepper Mite will be effective on these species if they are present.								
Abamectin	6	Contact	3	A	ALL	Registered in mushrooms for control of Red Pepper Mite ( <i>Siteroptes mesembrinae</i> ), <b>Mushroom Pygmy Mite</b> ( <i>Microdispus lambi</i> ) and Nematodes (Rhabditidae). Apply as a casing drench or if in-crop over beds. Do not use more than 2 applications per crop, with a minimum retreatment interval of 14 days.	M Bee:H	-
Etoxazole (Paramite)	10B	Contact & Ingestion		P		Registered for control of <b>Mites</b> in bananas, citrus, pome fruit, stone fruit, grapes, tomatoes, capsicum, cotton, almonds and turf.	L Bee:VL	-
Potassium Salts of Fatty Acid (Natrasoap)	UNE	Contact		P		Registered for control of Aphids, Thrips, Mealybug, <b>Two Spotted Mites</b> , <b>Spider Mite</b> , and Whitefly in fruit trees.	L Bee:L	-
Petroleum Oil	UNM	Contact		P		Registered for control of <b>Mites</b> in pome fruit, stone fruit and pecans.	VL Bee:L	-
<i>Beauveria bassiana</i> (Velifer) BASF	UNF	Biological		P		Registered for suppression of <b>Two Spotted Spider Mite</b> in protected vegetables. US registration for control of Phorids in mushrooms.	L Bee:L	-
Bifenazate (Acramite) UPL	20D	Contact & Ingestion		P		Registered for control of various <b>Mites</b> in almonds, pome fruit, stone fruit, fruiting vegetables, cucurbits, pawpaw and strawberries.	L Bee:H	-
Clofentezine (Apollo)	10A	IGR / Contact				Registered for control of various <b>Mite</b> species in pome fruit, stone fruit, bananas, hops, tomatoes, almonds and ornamentals.	L Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
Isocycloseram (Simodis) Syngenta	30	Ingestion		P		First global application is proposed for 2023 for Thrips, Bugs, Mites and Caterpillars. Registration submitted May 2021 for Simodis to control <b>Mites</b> , Thrips and Helicoverpa in fruiting vegetables.	-	-
Spiromesifen (Oberon) Bayer	23	Ingestion		P		Not currently registered in AU but under development with Bayer and Hort Innovation for multiple commodities. US registrations for <b>Mites</b> in various crops.	M Bee:VL	-
<b>Mycophagous Nematodes</b> ( <i>Aphelenchoides composticola</i> , <i>Ditylenchus myceliophagus</i> , <i>Amidostomum</i> spp.)								
<b>Priority: Low</b>								
Rated as a low priority pest. These nematodes will feed directly on mushrooms, but they have rarely been seen in recent years.								
Abamectin	6	Contact	3	A	ALL	Registered in mushrooms for control of Red Pepper Mite ( <i>Siteroptes mesembrinae</i> ), Mushroom Pygmy Mite ( <i>Microdispus lambi</i> ) and <b>Nematodes</b> (Rhabditidae). Apply as a casing drench or if in-crop over beds. Do not use more than 2 applications per crop, with a minimum retreatment interval of 14 days.	M Bee:H	-
Cyclobutrifluram (Vaniva) Syngenta	N-3			P		New nematicide in development from Syngenta	-	-
Fluazaindolizine (Reklemel, Salibro) Corteva	N-UN	Contact		P		Registered for control of nematodes in cucurbits, fruiting vegetables and root and tuber vegetables. Approval for use in mushrooms could be complex depending on cost of development and potential contribution of use pattern to dietary exposure.	-	-
Fluensulfone (Nimitz) Adama	N-UN	Contact		P		Registered for control of Root-Knot Nematode in peppers, carrot, chilli, cucurbits, eggplant, okra, potato, sugarcane, sweet potato and tomato.	L Bee:L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory Risk
<b>Black Compost Fly</b> ( <i>Scatopse notate</i> ) <b>Sphaerocerid Flies</b> (Sphaeroceridae) <b>Priority: Low</b> Rated as low priority pests. Rarely seen in mushrooms and will be controlled incidentally by control measures used for control of Sciarids and Phorids.								
Cyrozamine (Diptex)	17	Insect Growth Regulator	NR	P-A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and Phorids).	L Bee:L	-
Diazinon	1B	Contact	14	P-A	ALL	Registered in mushrooms for control of Mushroom Pests.	H Bee:VH	R3
Fipronil (Regent)	2B	Contact & Ingestion	14	P-A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids, Phorids and Cecids).	M Bee:VH	R3
Pyrethrins + Piperonyl Butoxide	3A	Contact	NR	P-A	ALL	Registered in mushrooms for control of Mushroom Flies (Sciarids and Phorids).	VH Bee:H	-
Pyrethrins + Piperonyl Butoxide (Pyzap) PER12172	3A	Contact	NR	P-A	ALL (excl. VIC)	Permitted in mushrooms for control of Mushroom Flies (Sciarids and Phorids).	VH Bee:H	-
Azadirachtin (Azaguard)	UN	IGR	NR	P		US registration for control of <b>Mushroom Flies</b> , Nematodes and Phorid Flies in mushroom houses.	L Bee:L	-
Rosemary Oil + Geraniol + Peppermint Oil (Brandt Ecotec Plus)	-	Contact		P		US registration for surface protection from Flies in mushroom houses.	L Bee:L	-

## 5. References

### 5.1 Information:

AgChem Access Priority Access Forum	<a href="https://www.agrifutures.com.au/national-rural-issues/agvet-chemicals/">https://www.agrifutures.com.au/national-rural-issues/agvet-chemicals/</a>
Australian Pesticide and Veterinary Medicines Authority	<a href="http://www.apvma.gov.au">www.apvma.gov.au</a>
APVMA Chemical review	<a href="https://apvma.gov.au/chemicals-and-products/chemical-review/listing">https://apvma.gov.au/chemicals-and-products/chemical-review/listing</a>
APVMA MRLs	<a href="http://www.legislation.gov.au/Details/F2021C00634">www.legislation.gov.au/Details/F2021C00634</a>
APVMA Permit search	<a href="https://productsearch.apvma.gov.au/permits">https://productsearch.apvma.gov.au/permits</a>
APVMA Product search	<a href="https://productsearch.apvma.gov.au/products">https://productsearch.apvma.gov.au/products</a>
Codex MRL database	<a href="http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/">http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/</a>
Cotton Pest Management Guide 2022-23	<a href="https://www.cottoninfo.com.au/publications/cotton-pest-management-guide">https://www.cottoninfo.com.au/publications/cotton-pest-management-guide</a>
CropLife Australia (Resistance Management)	<a href="https://www.croplife.org.au/resources/programs/resistance-management/">https://www.croplife.org.au/resources/programs/resistance-management/</a>
Growcom – Infopest Database	<a href="http://www.infopest.com.au">www.infopest.com.au</a>
Hort Innovation	<a href="http://www.horticulture.com.au">www.horticulture.com.au</a>

### 5.2 Abbreviations and Definitions:

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

Appendix 2. Products available as sanitisers and disinfectants in mushroom systems

Appendix 3. Products available for control of insects and mites in mushrooms

Appendix 4. Current permits for use in mushrooms

Appendix 5. Mushroom Maximum Residue Limits (MRLs)

Appendix 6. Mushroom Agrichemical Regulatory Risk Assessment

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

Active Ingredient (Trade Name)	Chem. group	Situation	Diseases / Comments	States	WHP Days	Regulatory risk
<i>Bacillus amyloliquefaciens</i> MBI 600 (Serifel) BASF PER91265	BM 02	Mushrooms	Suppression of: Green Mould ( <i>Trichoderma</i> spp.)	ALL	NR	-
Carbendazim PER14949	1	Mushrooms	Dry Bubble ( <i>Verticillium</i> spp.) Wet Bubble ( <i>Mycogone</i> spp.) Green Mould ( <i>Trichoderma</i> spp.)	ALL (excl. VIC)	14	R3
Imazalil (Magnate)	3	Mushrooms	Green Mould ( <i>Trichoderma</i> spp.)	ALL	28	R3
Metrafenone (Vivando) BASF PER90382	50	Mushrooms / Protected Only	Cobweb Disease ( <i>Cladobotryum</i> sp.) Dry Bubble ( <i>Lecanicillium fungicola</i> )	ALL	10	-
Prochloraz (Octave)	3	Mushrooms	Dry Bubble ( <i>Verticillium fungicola</i> ) Wet Bubble ( <i>Mycogone perniciosa</i> ) Cobweb Disease ( <i>Hypomyces rosellus</i> )	ALL	NR	R3
Prochloraz (Octave) PER12645	3	Mushrooms	Cobweb Disease ( <i>Hypomyces rosellus</i> )	ALL (excl. VIC)	NR	R3
Propiconazole (Ezi-Tip)	3	Mushroom Trays and Beds	Control of adhesion and penetration of mushroom mycelium in timber trays.	ALL	NR	R3
Sodium Chloride PER88212	-	Mushrooms / Spot Treatment	Suppression of: Dry Bubble ( <i>Lecanicillium</i> sp.) Cobweb Disease ( <i>Cladobotryum</i> sp.)	ALL	NR	-
Thiabendazole (Tecto)	1	Mushrooms / Peat Moss for Mushroom Casing	Wet Bubble ( <i>Mycogone perniciosa</i> )	ALL	NR	-

## **Appendix 2. Products available as sanitisers and disinfectants in mushroom systems**

<b>Active Ingredient (Trade Name)</b>	<b>Chem. group</b>	<b>Situation</b>	<b>Diseases / Comments</b>	<b>States</b>	<b>WHP Days</b>	<b>Regulatory risk</b>
Calcium Hypochlorite (Hypochlor Chlorine Cartridge)	-	Mushrooms / Water Treatment	Bacterial Blotch ( <i>Pseudomonas tolaatsi</i> )	ALL	NR	-
Chlorine Dioxide	M	Mushroom Growing Surfaces / Sanitiser	Bacteria	ALL	NR	-
Didecyl Dimethyl Ammonium Chloride	-	Mushroom Sheds / Sanitiser	Green Mould ( <i>Trichoderma atroviridae</i> )	ALL	NR	-
Orthophenylphenol (Bacrasan)	-	Mushroom Growing Surfaces & Equipment / Sanitiser	Bacteria, Fungi and Moulds	ALL	NR	-
Polyglycol Ether Iodine Complexes + Phosphoric Acid (San-I-Mush)	-	Sanitiser	Bacteria and Fungi	ALL	NR	-



### **Appendix 3. Products available for control of insects and mites in mushrooms**

<b>Active Ingredient (Trade Name)</b>	<b>Chem. group</b>	<b>Situation</b>	<b>Pests / Comments</b>	<b>States</b>	<b>WHP Days</b>	<b>Regulatory risk</b>
Abamectin	6	Mushrooms	Red Pepper Mite ( <i>Siteroptes mesembrinae</i> ) Mushroom Pygmy Mite ( <i>Microdispus lambi</i> ) Nematodes (Rhabditidae)	ALL	3	-
<i>Bacillus thuringiensis</i> <i>subsp. israelensis</i> Serotype H14 (VectoBac WG) PER87515	11	Mushrooms	Sciarids	ALL (excl. VIC)	NR	-
Cyrozamine (Diptex)	17	Mushrooms	Mushroom Flies (Sciarids and Phorids)	ALL	NR	-
Diazinon	1B	Mushrooms	Mushroom Pests	ALL	14	R2
Diflubenzuron (Dimilin)	15	Mushrooms	Sciarids	ALL	NR	-
Fipronil (Regent)	2B	Mushrooms	Mushroom Flies (Sciarids, Phorids and Cecids)	ALL	14	R2
Permethrin	3A	Mushroom Beds	Sciarids	ALL	3	-
Pyrethrins + Piperonyl Butoxide	3A	Mushrooms	Mushroom Flies (Sciarids and Phorids)	ALL	NR	-
Pyrethrins + Piperonyl Butoxide (Pyzap) PER12172	3A	Mushrooms	Mushroom Flies (Sciarids and Phorids)	ALL (excl. VIC)	NR	-
Triflumuron (Alsystin) Bayer	15A	Mushrooms	Sciarids	ALL	NR	-

#### **Appendix 4. Current permits for use in mushrooms**

<b>Permit No.</b>	<b>Description</b>	<b>Issued Date</b>	<b>Expiry Date</b>	<b>Permit Holder</b>
PER12645 Version 3	Prochloraz (Octave) / Mushrooms / Cobweb Disease	1-Apr-12	31-Dec-26	Hort Innovation
PER91265	Bacillus amyloliquefaciens MBI 600 (Serifel) / Mushrooms / Green Mould	22-Nov-21	30-Nov-24	Hort Innovation
PER14949 Version 4	Carbendazim / Mushrooms / Dry Bubble, Wet Bubble & Green Mould	16-Mar-16	30-Jun-26	Hort Innovation
PER90382	Metrafenone (Vivando) / Mushrooms / Cobweb Disease, Dry Bubble	27-Jan-22	31-Jan-25	Hort Innovation
PER88212	Salt / Mushrooms / Dry Bubble, Cobweb Disease	7-Nov-19	30-Nov-24	Hort Innovation
PER87515	Bacillus thuringiensis subsp. israelensis Serotype H14 (VectoBac WG) / Mushrooms / Fungus gnats and Sciarids	15-Mar-19	30-Jun-24	Hort Innovation
PER12172 Version 5	Pyrethrins + Piperonyl Butoxide (Pyzap) / Mushrooms / Mushroom Flies	1-Jul-10	30-Jun-27	AMGA

## **Appendix 5. Mushroom Maximum Residue Limits (MRLs)**

CODEX commodity grouping of edible fungi and subgroups:

VF 2084	Edible Fungi
VF 0450	Mushrooms
VO 0450	Mushrooms
	Vegetables

Note: Australia's exports less than 1% of production for mushrooms, with most of this going to Brunei, PNG, Nauru and Fiji. Available information indicates that in the absence specific limits in legislation that most countries defer to Codex, followed by EU MRL standards or apply a 0.01 ppm 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.

<b>Chemical</b>	<b>Codex</b>	<b>Description</b>	<b>APVMA MRL mg/kg</b>	<b>Codex MRL mg/kg</b>
2,2-DPA		Vegetables	*0.1	-
Abamectin	VO 0450	Mushrooms	0.05	-
Carbendazim	VF 0450	Mushrooms	T1	-
Chlorothalonil		Vegetables	T7	-
Chlorpyrifos		Vegetables	T*0.01	-
Chlorthal-Dimethyl		Vegetables	5	-
Cyromazine	VO 0450	Mushrooms	10	7
Deltamethrin	VO 0450	Mushrooms	-	0.05
Diazinon		Vegetables	0.7	-
Dicofol		Vegetables	5	-
Diflubenzuron	VO 0450	Mushrooms	0.1	0.3
Diquat		Vegetables	*0.05	-
EPTC		Vegetables	*0.04	-
Fipronil	VO 0450	Mushrooms	0.02	-
Heptachlor		Vegetables	E0.05	-
Imazalil	VO 0450	Mushrooms	1	-
Inorganic Bromide		Vegetables	20	-
Lindane		Vegetables	E2	-
Linuron		Vegetables	*0.05	-
Metalaxyl		Vegetables	T0.1	-
Metaldehyde		Vegetables	1	-
Methiocarb		Vegetables	0.1	-
Methyl Bromide		Vegetables	T*0.05	-
Metrafenone	VF 0450	Mushrooms	T0.5	0.5
		Vegetables	*0.05	-
Permethrin	VO 0450	Mushrooms	2	0.1
Piperonyl Butoxide		Vegetables	8	-
Pirimicarb		Vegetables	1	-
Prochloraz	VO 0450	Mushrooms	3	3
Prometryn		Vegetables	*0.1	-
Propargite		Vegetables	3	-
Propiconazole	VO 0450	Mushrooms	*0.05	-
Pyrethrins		Vegetables	1	-
Thiabendazole	VO 0450	Mushrooms	0.5	60

<b>Chemical</b>	<b>Codex</b>	<b>Description</b>	<b>APVMA MRL mg/kg</b>	<b>Codex MRL mg/kg</b>
Trichlorfon		Vegetables	0.1	-
Triflumuron	VO 0450	Mushrooms	0.1	-
Trifluralin		Vegetables	0.05	-

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

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

T =Temporary MRL

E = The MRL is based on extraneous residues

Sources: APVMA MRLs: Agricultural and Veterinary Chemicals Code (MRL Standard) Instrument 2019. Compilation 28. Prepared 20 August 2022. CODEX MRLs: CODEX Alimentarius International Food Standards database (September 2022), <http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/>

## **Appendix 6. Mushroom Agrichemical Regulatory Risk Assessment**

### **Mushroom Agrichemical Regulatory Risk Assessment**

**September 2022**

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 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 mushrooms as well as current initiatives aimed at addressing identified pest management deficiencies.

## Mushroom Agrichemical Regulatory Risk Assessment

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

Active Constituents	Chemical Group	Problem	Comment
<b>INSECT AND OTHER PESTS</b>			
Abamectin	6	Mushroom pygmy mite	EU: Restricted use to permanent greenhouses
		Nematodes - Rhabditidae	
		Red pepper mite	
<i>Bacillus thuringiensis</i>	11A	Mushroom Sciarids (PER87515)	EU: Under review for authorisation renewal
Bioresmethrin	3A	Mushroom Sciarids (PER12782)	EU: No Authorisation
		Mushroom Phorids (PER12847)	
Cyromazine	17	Mushroom Phorids	EU: No Authorisation
		Mushroom Sciarids	
Diazinon	1B		APVMA: <a href="#">Under review</a> EU: No authorisation in place Codex: Withdrawal of Codex MRLs recommended
Diflubenzuron	15	Mushroom Sciarids	EU: No Authorisation
Fipronil	2B	Mushroom Cecids	APVMA: <a href="#">Under review</a> Codex: Re-evaluation scheduled EU: No authorisation in place USA: Under review
		Mushroom flies	
		Mushroom Phorids	
		Mushroom Sciarids	
Permethrin	3A	Mushroom sciarids	EU: No Authorisation
Pyrethrins	3A	Mushroom flies	Canada: Under review
		Mushroom Phorids (PER12172)	
		Mushroom sciarids (PER12172)	
Triflumuron	15	Mushroom sciarids	EU: No Authorisation

Active Constituents	Chemical Group	Problem	Comment
<b>DISEASES</b>			
<i>Bacillus amyloliquefaciens</i> MBI 600		Green Mould (PER91265)	
Carbendazim	<b>1</b>	Wet bubble	Codex: Periodic re-evaluation scheduled EU: No Authorisation
		Dry bubble (PER14949)	
		Green mould (PER14949)	
Chlorine dioxide	<b>M</b>	Bacterial blotch	
		Sanitizer (growing facilities/equipment)	
Chloroxylenol + ethanol + quaternary ammonium	-	Sanitizer (growing facilities/equipment)	
DDAC	-	Trichoderma (mushroom sheds)	EU: No authorisation
Imazalil	<b>3</b>	Green mould	EU: Under review. Withdrawal of many EU MRLs proposed
Metrafenone		Cobweb disease (PER90382)	
		Dry bubble (PER90382)	
Ortho-phenylphenol	-	Sanitizer (growing facilities/equipment)	
Phosphoric acid + Iodine	<b>M</b>	Sanitizer (growing facilities/equipment)	
Prochloraz	<b>3</b>	Cobweb disease (PER12645)	Codex: Periodic re-evaluation scheduled EU: Not authorised
		Cobweb disease (Pre-casing)	
		Dry bubble	
		Wet bubble	
Propiconazole	<b>3</b>	Timber tray treatment	<a href="#">APVMA: nominated for review</a> EU: No authorisation USA: Under review
Sodium chloride	-	Cobweb disease (PER88212)	
Thiabendazole	<b>1</b>	Wet bubble	

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