Leek

Strategic Agrichemical Review Process (SARP)

August 2020

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

Date of report:
August 2020

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Hort Innovation Strategic levy investment | VEGETABLE FUND

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1. Summary

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

(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 Leek 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
Fusarium foot rot	*Fusarium avenacium & F. oxysporum*

1.2 Insects and mites

The high priority insect pest is:

Common name	Scientific name
Onion Thrips	*Thrips tabaci*

1.3 Weeds

The moderate priority weeds are:

Common name	Scientific name
Groundsel (VIC)	*Senecio vulgaris*
Nutgrass (VIC & WA)	*Cyperus rotundus*
Oxalis (VIC)	*Oxalis pes-caprae*
Potato weed (VIC)	*Galinsoga* spp.
Stinging nettles (VIC)	*Urtica spp.*
Marshmallow (VIC)	*Malva parviflora*
Winter grass (VIC)	*Poa annua*

2. The Australian Leek Industry

The Australian Leek industry is a small horticultural industry. Consumption of Leek has risen in recent years with the growth in healthier lifestyles and moves to fresh food. For the year ending June 2019, 10,809 t was produced with 1% export. The value of production was $25.7 m while the wholesale value of the fresh supply was $29.7 m.

Leeks are grown in most states of Australia, with the majority of production occurring in Victoria (57%). The major production area is the Devon Meadows region in Victoria.

Fresh Leek Seasonality by State

State	18/19 t	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
New South Wales (3%)	272												
Victoria (57%)	6,110												
Queensland (7%)	800												
Western Australia (22%)	2,421												
South Australia (9%)	980												
Tasmania (2%)	226												
Availability legend			High			Medium			Low			None	

Almost all of the Leeks grown in Australia are destined for the fresh market.

Australia has a small trade in Leeks. For the year ending June 2019, Australia exported 156 tonnes of fresh Leeks. Of this export, 28% was destined for Singapore, followed by Japan (26%), UAE (12%), New Caledonia (10%), Malaysia (7%) and others (17%).

Due to Australia's varying weather conditions and the introduction of different varieties of Leeks, the Australian industry is now able to supply domestic markets with fresh Leek throughout the year.

A Leek crop takes 21 to 30 weeks to reach maturity from transplanting and plants also spend 8 to 16 weeks in the nursery before transplanting.

Leeks (*Allium porrum*) are of the onion family, Amaryllidaceae. The Leek species referred to in this report is *Allium ampeloprasum var. porrum*.
Leeks are very adaptable and can be grown under a wide range of conditions.

Reference: 2018/19 Australian Horticulture Statistics Handbook. [online] Available at: https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/grower-resources/ha18002-assets/australian-horticulture-statistics-handbook/

3. Introduction

3.1 Background

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

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

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

In combination with cultural practices, pesticides are important tools in Leek 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 Leek 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 Leek 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 Leek 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 Leek 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 Leeks 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 Leek as a minor crop. The crop fits within the APVMA crop group 009 Bulb Vegetables Therefore, access to minor use permits can be relatively straight forward as long as a reasonable justification is provided. Possible justification for future permit applications could be based on:

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

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

3.3 Methods

The current update of the Leek 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. Collation of information collected by commodity on applicable pests, diseases and weeds in order of priority.
MT17019 – Regulatory Support & Co-ordination (AKC)	**Leek Agrichemical Regulatory Risk Assessment Document** 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 Leek 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:** • Review list of priorities ranked as high, moderate and low for each plant pest groups (disease, insects and weeds) – provided by VG16060 • Identify industries pest priority gaps in order of importance • Update current pesticides available via label registrations or minor use permits • Update available pesticide use patterns, IPM ranking/compatibility, mode of action and chemical group. • Identify pesticides at risk (under review and/or limited uses) via MT17019 Regulatory Support & Co-ordination – AKC consulting. • 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). • Include known pesticide solutions that are currently under development with registrants for new uses in the nominated crops or in current Hort Innovation projects. • 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 Leek
Appendix 2. Products available for control of insects and mites in Leek
Appendix 3. Products available for weed control in Leek
Appendix 4. Current permits for use in Leek
Appendix 5. Leek Maximum Residue Limits (MRLs)
Appendix 6. Leek regulatory risk assessment

4. Diseases, Pests and Weeds of Leeks

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

Information on regulatory risk derived from project MT17019 (Chapter 4) - Regulatory support and coordination (Appendix 6) has been incorporated.

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

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

4.1 Diseases of Leeks

4.1.1 Disease priorities

Common name	Scientific name
High	
Fusarium foot rot	*Fusarium avenacium & F. oxysporum*
Moderate	
Bacterial blight / Bacterial soft rots	*Pseudomonas syringae* pv. *porri.*
Downy mildew	*Peronospora destructor*
Purple blotch	*Alternaria porri*
Stemphylium Leaf blight	*Stemphylium botryosum & S. vesicarium*
White rot	*Sclerotium cepivorum*
Low	
Black mould	*Aspergillus niger*
Blue mould	*Penicillium* spp.
Botrytis leaf spot / Grey mould	*Botrytis cinerea*
Rust	*Puccinia allii*
Viruses	*Iris yellow spot virus & Mosaic*

The most important disease issues based on the feedback received was Fusarium basal rot with moderate priority for Bacterial blight, Downy mildew, Purple blotch, Leaf blight and White rot.
https://ausveg.com.au/app/data/technical-insights/docs/VG00013.pdf
https://www.horticulture.com.au/globalassets/hort-innovation/resource-assets/vg15010-managing-fusarium-diseases-in-vegetable-crops-fact-sheet.pdf

Fusarium basal rot (*Fusarium* spp.) can be a problem with continuous cropping. Rotation with other crops is the only way to minimise the impact of this disease.

Bacterial soft rots caused by *Pseudomonas* is a common disease on many vegetables. Bacterial soft rot is sometimes a problem in cooler months, especially in leaves and shanks below ground. There are often physical causes for this condition, such as plant damage from hot weather or mechanical operations, allowing the bacteria entry points to the stem. The seed-borne disease, bacterial blight, caused by the organism *Pseudomonas syringae* pv. porri, has been identified in South Australia and Victoria. There are no products registered or permitted for the control of Bacterial rots in Leeks. Seed treatment is also an option to keep infections out.

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

In controlling fungal and bacterial diseases, the industry should be mindful of resistance management. CropLife Australia has a resistance management strategy and users must refer to it before using any product.
http://www.croplife.org.au/industry-stewardship/resistance-management

CropLife Australia recommends that in the absence of a specific resistance management strategy the use of fungicides from a specific mode of action be limited to a maximum of one-third of the total. The number of consecutive applications of the same group should also be limited by rotating/alternating between products from different activity groups. An exception is the use of Group M fungicides as they have a low risk of resistance development.
https://www.croplife.org.au/resources/programs/resistance-management/fungicide-resistance-management-strategies1/fungicide-resistance-management-strategies1-draft/

4.1.2 Available and potential products for 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
Fusarium foot rot (*Fusarium avenacium & F. oxysporum*) **Priority: High**							
Fusarium was ranked as a moderate priority in VIC, QLD, NSW & WA and as a low priority in TAS. The fungus is seed-borne and can survive in soil and plant material. The disease can cause economic loss in leeks, particularly in tropical areas. Cultural controls should be employed and include: The use of resistant varieties, Rotating leeks with other less susceptible crops, crop and farm hygiene and remove, bury infected plant waste.							
Chlorpicrin (Tripicrin)	8	General pre-plant soil fumigation	NR	A	ALL	Registered as a general fumigant to control Nematodes, insects, *Pythium, Phytophthora, **Fusarium**, and Verticillium.* Do not plant for 10 d after soil treatment.	-
Dazomet (Cerlong)	8F	Soil fumigant	NR	A	ALL	Registered in various situations for control of **soil fungi**, nematodes, soil insects and weeds. Soil moisture is essential for release of gas and plastic cover brings optimum results. See label for details.	-
Mancozeb + Sulphur (Amgrow)	M3+UN	Protective	7	A	ALL	Registered in vegetable seedlings for control of **Damping off**. [Max. no. of applications not specified; re-treatment interval 10 d]	R2
Metham sodium (Imtrade)	-	Soil fumigant	NR	A	ALL	Registered for control of nematodes, various weeds and **fungal diseases** in field crops.	-
Thiabendazole (Sharda)	1	Protective	NR	A	ALL	Registered in bulbs and corms for post-harvest control of **Fusarium basal rot** and Blue mould. Dip for 15-30 miniutes within 24 h of digging.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fludioxonil + Sedaxane (Vibrance Premium) Syngenta	7+12	Systemic & protective		P		Registered as a seed treatment for control of Black scurf (***Rhizoctonia***), Silver surf, Black dot, Gangrene, **Fusarium** dry rot and suppression of Common scab in potatoes.	R3
Streptomyces lydicus WYEC108 (Actinovate) Novozymes BioAg	BM02	Protective Biofungicide		P		Registered in strawberries and tomato for control of Phytophthora and as a seed treatment in vegetables for control of *Pythium,* ***Fusarium*** & *Rhizoctonia*. Apply prior to onset of disease season. [Max. no. of applications and retreatment interval not specified].	-
Bacterial blight (*Pseudomonas syringae*) **Priority: Moderate**							
Bacterial blight was ranked as a moderate priority in VIC, QLD, NSW & WA and as a low priority in TAS. Bacterial pathogen favoured by wet, cool conditions. Tends to be seed-borne and are dispersed between plants by rain splash. Seed and soil treatment can be options.							
1,3-dichloropropene (Tri-Form)	-	General pre-plant soil fumigation	NR	A	ALL	Soil borne diseases, plant parasitic nematodes. Restricted chemical.	-
Copper-oxychloride +hydroxide (Relyon Airone) Isagro Australia	M1	Protective		P		Registered in Brassica vegetables for control of ***Pseudomonas*** *syringae*. [Max. no. of applications not specified; re-treatment interval 10-14 d]	-
Downy mildew (*Peronospora destructor*) **Priority: Moderate**							
Downy mildew was ranked as a high priority in WA, as a moderate priority in VIC, QLD & NSW and as a low priority in TAS.							
Azoxystrobin (Amistar 250 SC Fungicide)	11	Protective & curative	7	A	ALL	Registered in leeks for control of **Downy mildew** and suppression of White rot. Apply when first signs of disease appear. [Max. 3 applications per crop; re-treatment interval 7-14 d]	-
Dimethomorph (Acrobat) + Mancozeb (Penncozeb) PER14473	40+M3	Protective & systemic	H:7 NG	A	ALL (excl. VIC)	PER14473 for control of **Downy mildew**, Purple blotch and Botrytis rots for leeks. Use in a tank mix or mancozeb alone. [Max. 2 applications per crop; re-treatment interval 7-14 d]	R2

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fluopicolide + Propamocarb hydrochloride (Infinitio)	28+43	Systemic fungicide affecting oomycetes	7	A	ALL	Registered in bulb vegetables for control of **Downy mildew**. Use subject to CropLife resistance management strategy. [Max. 3 applications per crop; re-treatment interval 7-10 d]	-
Hydrogen peroxide + peroxyacetic acid (Peratec Plus)	M	Non-selective surface sterilant	1	A	ALL	Registered in leeks for control of *Botrytis* neck & bulb rot and **Downy mildew**. [Max. 4 applications per crop; re-treatment interval 5-7 d]	-
Metalaxyl + copper as hydroxide (Ridomil Gold Plus)	4+M1	Systemic, protective & curative	7	A	ALL	Registered in leeks for control of **Downy mildew** and Purple blotch. Use subject to CropLife resistance management strategy. [Max. 2 applications per crop; re-treatment interval 7-10 d]	-
Oxathiapiprolin (Zorvec)	49	Systemic	10 NG	A	ALL	Registered in leeks for control of **Downy mildew**. [Max. 3 applications per crop; 2 consecutive; re-treatment interval 10 d]	-
Phosphorous acid (various) PER13698	33	Protective & systemic	H:1	A	ALL (excl. VIC)	PER13698 for leeks for suppression only of **Downy mildew**. Apply as required when conditions favour disease development. [Max. no. of applications and re-treatment interval not specified.]	-
Propamocarb + Fluopicolide (Infinito)	28+43	Protective, curative & systemic	NR NG	A	ALL	Registered in Bulb vegetables for control of **Downy mildew**. Apply when conditions favour disease development. Use pattern is subject to CropLife Resistance Management Strategy. [Max 3 applications per crop; re-treatment interval 7-10 d]	-
Acibenzolar-S-methyl (Actigard Plant Activator) Syngenta	P01	Protective		P		Registered in the USA for the control of **Downy mildew** in Brassica vegetables Registered in Australia for use in tomatoes for the suppression of Powdery mildew.	
Cyazofamid (Ranman) ISK	21	Contac & residual		P		Registered for late blight in potatoes and **Downy mildew** in Brassica seedlings.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Dimethomorph + Amitoctradin (Zampro) AgNova/BASF	45+40	Protective		P		Registered by BASF via AgNova in Australia for control of **Downy mildew** in grape vines. Registration in Brassica leafy vegetables, Cucurbits, Onions & Beetroot is being pursued by Hort Innovation under grant funded projects.	
Purple blotch (*Alternaria porri*) **Priority: Moderate**							
Purple blotch was ranked as a high priority in NSW, as a moderate priority in VIC, QLD & WA and as a low priority in TAS.							
Chlorothalonil (Sabakem)	M5	Protective & curative	1	A	ALL	Registered for leeks for the control of **Purple blotch**. Apply first when conditions favour disease development. [Max. no. of applications not specified; re-treatment interval 7-10 d]	R3
Dimethomorph (Acrobat) + Mancozeb (Penncozeb) PER14473	40+M3	Protective & systemic	H:7 NG	A	ALL (excl. VIC)	PER14473 for control of Downy mildew, **Purple blotch** and Botrytis rots in leeks. Use in a tank mix or mancozeb alone. [Max. 2 applications per crop; re-treatment interval 7-14 d]	R2
Metalaxyl + copper as hydroxide (Ridomil Gold Plus)	4+M1	Systemic, protective & curative	7	A	ALL	Registered in leeks for control of Downy mildew and **Purple blotch**. Use subject to CropLife resistance management strategy. [Max. 2 applications per crop; re-treatment interval 7-10 d]	-
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. The US label is for use in almond, Brassica leafy vegetables, legume vegetables, melons and various fruit crops for control of a variety of diseases including Powdery mildew, Alternaria leaf spot, Gummy stem blight, Septoria, Cladosporium, Cercospora, Sclerotinia, Botrytis leaf blight, Neck rot (*Botrytis allii* & *B. porri*), **Purple blotch** (*Alternaria porri*), Rusts (*Puccinia alli* and *P. porri*) Anthracnose and suppression of Rhizoctonia.	R3
Penthiopyrad (Fontelis) Production Agriscience Aust	7	Systemic		P		Registered for **Purple blotch** in onions, shallots and spring onions and various other vegetable crop groups.	-

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Stemphylium Leaf blight (*Stemphylium botryosum*) **Priority: Moderate**							
Leaf blight did not get a ranking in the survey, but other industry sources have confirmed that it is a significant disease in leeks.							
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. The US label allows use in onions and bulb sub-group (including leek) for control of a variety of diseases including **Stemphylium leaf blight** (*Stemphylium vesicarium*), Cladosporium leaf blotch (*Cladosporium allii*) and suppression of White rot (*Sclerotium cepivorum*).	R3
Florylpicoxamid (Adavelt) Corteva	21	Protectant & curative		P		New Mode of Action fungicide being developed for use in Australia; activity on *Mycosphaerella* spp. and other leaf diseases. Due for registration in 2023.	-
White rot (*Sclerotium cepivorum*) **Priority: Moderate**							
White rot was ranked as a high priority in NSW, a moderate priority in VIC & QLD & WA and as a low priority in TAS.							
Azoxystrobin (Amistar 250 SC Fungicide)	11	Protective & curative	7	A	ALL	Registered in leeks for control of Downy mildew and suppression of **White rot**. Apply when first signs of disease appear. [Max. 3 applications per crop; re-treatment interval 7-14 d]	-
Triadimenol (Allitron) PER14906	3	Systemic	28	A	ALL (excl. VIC)	PER14906 for control of **White rot** in leeks. Apply initial foliar spray 6 – 8 weeks after planting. [Max. 3 applications per crop; re-treatment interval 21-28 d]	R3
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label allows use in onions and bulb sub-group (including leek) for control of a variety of diseases including Stemphylium leaf blight (*Stemphylium vesicarium*), Cladosporium leaf blotch (*Cladosporium allii*) and suppression of White rot (***Sclerotium*** *cepivorum*).	R3
Mefentrifluconazole (Belanty) BASF	3	Protectant & Curative		P		Registered on Apples and Grapes for Black Spot and Powdery Mildew. BASF claims wide range of diseases controlled by this active. No MRLs for AU or Codex.	

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Black mould (*Aspergillus niger*) **Priority: Low**							
Black mould was not ranked in the recently conducted survey, but other industry sources have indicated that it is a significant disease in Leeks. Infection of leaf bases greatly increases in the month prior to harvest. This is influenced by the timing of irrigation, humidity, and the prevailing temperatures. A range of effective control strategies included improvement in irrigation scheduling, crop density, and harvest timing. Postharvest fungicide treatments and improved ventilation also proved effective in reducing storage rot due to black mould.							
Cyprodinil+ Fludioxonil (Switch) PER80501	9+12	Protective & curative	7	A	ALL	PER80501 for suppression of **Black mould** & Grey mould in Leeks. [Max 2 applications per crop; re-treatment interval 7-14 d]	R3
Fludioxonil + Metalaxyl-M + Azoxystrobin (Dynasty) Syngenta	4+11 +12	Systemic, protective & curative		P		Registered in peanuts as a seed treatment for control of Yellow mould (***Aspergillus*** spp.).	R3
Blue mould (*Penicillium* spp.) **Priority: Low**							
Blue mould was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS. Usually this organism is associated with post-harvest infections in crops. Farm hygiene is considered important in containing this disease.							
Thiabendazole (Sharda)	I	Protective	NR	A	ALL (excl. VIC)	Registered in bulbs and corms for post-harvest control of Fusarium basal rot and **Blue mould**. Dip for 15-30 miniutes within 24 h of digging.	-
Fludioxonil (Campbell) Colin Campbell Chemicals	12	Systemic		P		Registered as a post-harvest dip for control of **Blue mould**, Green mould, Grey mould and Bacterial rots in various fruits including citrus, kiwi fruit, pomegranate, pome and stone fruits.	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Grey mould / Botrytis leaf spot (*Botrytis cinerea*) **Priority: Low**							
Grey mould was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.							
Cyprodinil+ Fludioxonil (Switch) PER80501	9+12	Protective & curative	7	A	ALL	PER80501 for suppression of Black mould & **Grey mould** in leeks. [Max 2 applications per crop; re-treatment interval 7-14 d]	R3
Hydrogen peroxide + peroxyacetic acid (Peratec Plus)	M	Non-selective surface sterilant	1	A	ALL	Registered in leeks for control of ***Botrytis*** neck & bulb rot and Downy mildew. [Max. 4 applications per crop; re-treatment interval 5-7 d]	-
Bacillus amyloliquefaciens (Serenade Opti) Bayer	44	Protective Biofungicide		P		Registered for control **Botrytis** in strawberries and grapes, suppression of Bacterial spot in tomato, chili and capsicum and control of Anthracnose and suppression of Stem end rot in tropical fruits. Registered in US for control of **Botrytis**, Sclerotinia, Xanthomonas and Erwinia in grapes, strawberries, pome fruits, tree nuts, leafy vegetables and potatoes.	
Bacillus amyloliquefaciens (Serifel) strain MBI 600 BASF	44	Protective Biofungicide		P		Registered for control of ***Botrytis*** in grapes and strawberries in Australia. Registered in the USA in peppers for the management of *Pythium* spp., *Phytophthora* spp., *Fusarium* spp., *Rhizoctonia* spp.	-
BLAD (Banda de Lupinus albus doce) (Problad) Cev S. A.	BM01	Protective		P		Registered for control of Brown rot and blossom blight in stone fruit. The US label is for use in Brassica leafy greens, bulb vegetables and grapes for **Botrytis** control.	
Fludioxonil (Campbell) Colin Campbell Chemicals	12	Systemic		P		Registered as a post-harvest dip for control of Blue mould, Green mould, **Grey mould** and Bacterial rots in various fruits including citrus, kiwi fruit, pomegranate, pome and stone fruits.	R3

Disease / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Regulatory risk
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. Registered overseas as Luna Experience. The US label allows use in onions and bulb sub-group (including leek) for control of a variety of diseases including Stemphylium leaf blight (*Stemphylium vesicarium*), Cladosporium leaf blotch (*Cladosporium allii*), Botrytis leaf blight & Neck rot (***Botrytis allii* & *B. porri***), Purple blotch (*Alternaria porri*), Rusts (*Puccinia alli* and *P. porri*) and suppression of White rot (*Sclerotium cepivorum*).	R3
Penthiopyrad (Fontelis) Production Agriscience Aust	7	Systemic		P		Registered for control of **Grey mould** in Cucurbits and leafy vegetables. [Max 2 sequential treatments; re-treatment interval 7-14 d]	-
Rust (*Puccinia allii*) **Priority: Low**							
Rust was not ranked in the recently conducted survey, but other industry sources have indicated that it can be an issue in Leeks.							
Fluopyram + Tebuconazole (Luna Experience) Bayer	3+7	Protective		P		Registered in Australia for control of Yellow sigatoka, Leaf speckle and Cordana leaf spot in bananas. The US label allows use in onions and bulb sub-group (including leek) for control of a variety of diseases including Stemphylium leaf blight (*Stemphylium vesicarium*), Cladosporium leaf blotch (*Cladosporium allii*), Botrytis leaf blight and neck rot (*Botrytis allii* & *B. porri*), Purple blotch (*Alternaria porri*), **Rusts** (*Puccinia alli* and *P. porri*) and suppression of White rot (*Sclerotium cepivorum*).	R3
Viruses (*Iris yellow spot virus, Mosaic virus*) **Priority: Low**							
Viruses were not ranked in the recently conducted survey, but other industry sources have indicated that it is an issue in Leeks. Viruses including Leek Yellow Stripe, Shallot Latent & Onion Dwarf have been found on leeks in Australia, but they are not considered widespread. Viruses are transmitted by several aphid species in a non-persistent manner. A key aspect of virus disease management is to accurately identify the virus causing the disease and then implement appropriate management strategies. Keeping weeds that act as hosts and insects that transmit the virus in check seem to be the best options available to control these viral diseases.							

4.2 Insect and mite pests of Leeks

4.2.1 Insect and mite pest priorities

Common name	Scientific name
High	
Onion thrips	*Thrips tabaci*
Moderate	
Onion maggot	*Delia platura*
Western flower thrips	*Frankliniella occidentalis*
Bean Blossom thrips	*Megalurothrips usitatis*
Melon thrips	*Thrips palmi*
Plague thrips	*Thrips imaginis*
Low	
Cabbage aphid	*Brevicoryne brassicae,*
Green peach aphid	*Myzus persicae,*
Turnip aphid	*Lipaphis pseudobrassicae*
Crickets	*Gryllidae*
Cutworms	*Agrotis spp.*
Jassids	Cicadellidae
Light brown apple moth	*Epiphyas postvittana*
Parasitic nematodes	*Paratrichodorus* sp. (stubby root) *Pratylenchus* sp. (root lesion) *Ditylenchus* sp. (stem and bulb)
Redlegged earth mite	*Halotydeus destructor*
Snails	Gastropoda
Spotted vegetable weevil	*Desiantha diversipes*
Two-spotted mite	*Tetranychus urticae*
Vegetable Leaf miner	*Liriomyza chenopodii*
Vegetable weevil	*Listroderes difficilis*
Wingless grasshopper	*Phaulacridium vittatum*
Wireworm	*Heteroderes sp.*

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

New Pest to Australia (unknown priority)	
Fall Armyworm	*Spodoptera frugiperda*

Constant use of insecticides from one chemical grouping - Mode of Action (MoA), will increase the risk of rapid build-up of resistance to that chemical group. Alternate use of chemical groups with different MoAs will slow down the process of selection for resistance[1].

Resistance is a serious concern in onion thrips because overseas studies, including those in New Zealand, detected pyrethroid and organophosphate resistance (2006) with levels high enough to cause major control problems[2].

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

[2] https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/97742/Pesticide-resistance-in-onion-thrips.pdf

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
Onion thrips (*Thrips tabaci*) **Priority: High**								
Onion thrips were ranked a major problem in all states. There is reported resistance to commonly used insecticides. Onion thrips are easier to control than Western Flower Thrips, in that they do not develop resistance to insecticides as quickly. A range of insecticides are currently available to growers with diversity in mode of action. IPM Recommendations include: The use of predatory thrips, mites & bug releases, control flowering weeds, mulch and use of certified seed								
Alpha-cypermethrin (Dominex) PER14457	3A	Contact	H:7 NG	A	ALL (excl. VIC)	PER14457 for leeks for control of **Onion thrips**. [Max 3 applications per crop; re-treatment interval 7 d].	VH H-Bees	-
Beauveria bassiana (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, **Onion thrips**, Greenhous Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d]	-	-
Cyantraniliprole (Benevia)	28	Foliar, systemic & stomach	7	A	ALL	Registered in leeks for suppression of **Onion thrips**. More effective on nymphs rather than adults. [Max no. of applications not specified; re-treatment interval 7 d].	M VH-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Flonicamid (Mainman) PER89185	9C	Systemic	7	A	ALL (excl. VIC)	PER89185 for suppression of **Onion thrips** & Western flower thrips in bulb vegetables including leeks (field only). [Max. 3 applications per crop; re-treatment interval 7 d].	M	-
Maldison (Fyfanon) PER13653	1B	Contact & systemic	H:7	A	ALL (excl. VIC)	PER13653 for leeks for control of **Onion thrips.** [Max 3 applications per crop; re-treatment interval 7 d].	H H-Bees	-
Petroleum oil PER12221	UN	Contact	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and **Thrips** in alliums. [Max no. of applications per crop and re-treatment interval not specified].	-	-
Potassium salts of fatty acids (Natrasoap)	-	Contact	Nil	A	ALL	Registered in vegetables for control of Aphids, **Thrips**, Mealybug, Two spotted mites, Spider mite, and White fly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d].	-	-
Pyrethrins + piperonyl butoxide (various)	3A	Contact	1	A	ALL	Registered in vegetables for control of ants, Aphids, **Thrips,** Caterpillars, Leaf hoppers, and Whitefly. [repeat spray weekly, if required]	VH H-Bees	-
Rotenone (Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of **Thrips**. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Spirotetramat (Movento 240 SC)	23	Contact & systemic		A		Registered in bulb vegetables for control of **Onion thrips**, Western flower thrips, Tomato thrips & Plague thrips. [Max 2 sprays per crop; re-treatment interval: 14 d].	M	-
Chlorantraniliprole + thiamethoxam (Durivo) Syngenta	4A+28	Contact & systemic		P		Registered in other vegetables as a seedling drench or soil drench for Aphids, Lepidoptera, Whitefly and **Thrips**.	M	R2
SYNFOI21 Syngenta		TBC		P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for **Thrips**, Bugs and Caterpillars.	-	
Spinosad (Entrust Organic) Corteva	5	Ingestion		P		Registered for control of **Thrips** in various crops. Suitable for organic growers.	L H- Bees	-
Spinetoram (Success Neo) Corteva	5	Ingestion		P		Registered in various crops for control of various **Thrips** species.	M VH-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
NUL3445 Nufarm	TBC			P		New active in development from Nufarm with activity on **Thrips**.		-
Onion maggot (fly) (*Delia platura*) **Priority: Moderate**								
Onion maggots were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS, although it was considered a moderate priority in 2014. However, other industry sources have confirmed that it is a significant pest. Maximise seed health by selecting seed free of damage and disease and delay sowing until the soil is warm to maximise vigour and reduce damage. The larvae live beneath the soil and burrow into germinating seeds or the stems of young seedlings. Direct feeding damage results in reduced plant vigour and the wounds can become entry points for diseases. If chemical controls are to be used, treating the seed is likely to be more effective than targeting the adult itself.								
Diazinon PER82551	1B	Contact & systemic	H:21	A	ALL (excl. VIC)	PER82551 for control of **Onion maggot** in Leeks. [Max 4 applications per crop; re-treatment interval 10-14 d].	H H-Bees	R3
Phorate (Thimet)	1B	Contact	70	A	ALL	Registered in onions for control of **Onion Maggot** and Thrips. Apply granules as a band at sowing or to established plants in 5cm band either side of the growing crop. Incorporate into soil where possible or apply when rain is expected, or overhead irrigation can be made. Avoid contact with seed. Treatments per season not limited.	H Bee H	R3
Thrips - Western Flower thrips (*Frankliniella occidentalis*), **Bean Blossom Thrips** *(Megalurothrips usitatis),* **Melon thrips** *(Thrips palmi),* **Plague thrips** *(Thrips imaginis)* **Priority: Moderate**								
Thrips ranked a moderate priority in all States consulted. Identification of the correct species would help in choosing the appropriate chemical. Resistance is an ongoing issue and virus transmission with thrip infestations are a concern for industry. IPM Recommendations include: The use of predatory thrips, mites & bug releases, control flowering weeds, mulch and use of certified seed.								
Beauveria bassiana (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including: **Western Flower Thrips**, Onion thrips, Greenhous Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d]	-	-
Cyantraniliprole (Benevia)	28	Foliar, systemic & stomach	7	A	ALL	Registered in leeks for suppression of **Thrips**. More effective on nymphs rather than adults. [Max no. of applications not specified; re-treatment interval 7 d].	M	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Diazinon (Barmac) PER82551	1B	Contact & systemic	H:21	A	ALL (excl. VIC)	PER82551 for control of **Thrips** in Leeks. [Max 4 applications per crop; re-treatment interval 10-14 d].	H VH-Bees	R3
Flonicamid (Mainman) PER89185	9C	Systemic	7	A	ALL (excl. VIC)	PER89185 for suppression of Onion thrips & **Western flower thrips** in bulb vegetables including leeks (field only). [Max. 3 applications per crop; re-treatment interval 7 d].	M	-
Petroleum oil PER12221	UN	Contact	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and **Thrips** in alliums. [Max no. of applications per crop and re-treatment interval not specified].	-	-
Potassium salts of fatty acids (Natrasoap)	3A	Contact	NR	A	ALL	Registered in vegetables for control of **Thrips**. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d].	-	-
Pyrethrins+piperonyl butoxide (various)	3A	Contact	1	A	ALL	Registered in vegetables for control of Ants, Aphids, **Thrips**, Caterpillars, Leaf hoppers, and Whitefly. [repeat spray weekly, if required]	VH H-Bees	-
Spinetoram (Success) PER13088	5	Contact & ingestion	H:3 NG	A	ALL (excl. VIC)	PER13088 for leeks for the control of **Western flower thrips** (specified resistance management strategy on label)	M	-
Spirotetramat (Movento 240 SC)	23	Contact & systemic	7	A	ALL	Registered in bulb vegetables for the control of Onion thrips, **Western flower thrips**, **Tomato thrips**, and **Plague thrips**. Uses subject to CropLife resistance management strategies. [Max 2 applications per crop; re-treatment interval 7 d].	M	-
Rotenone (Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Cabbage white butterfly, Cabbage moth, Cabbage-centre grub, Caterpillars, Potato moth (leaf miner) and **Thrips.** [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-
Chlorantraniliprole + thiamethoxam (Durivo) Syngenta	4A+28			P		Registered in other vegetables as a seedling drench or soil drench for Aphids, Lepidoptera, Whitefly and **Thrips**.	M	R2
SYNFOI21 Syngenta		TBC		P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for **Thrips**, Bugs and Caterpillars.		

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Ingestion		P		Registered for control of **Thrips** in various crops. Suitable for organic growers.	L H-Bees	-
Spinetoram (Success Neo) Corteva	5	Ingestion		P		Registered in various crops for control of various **Thrips** species.	M VH-Bees	-
NUL3445 Nufarm	TBC			P		New active in development from Nufarm with activity on **Thrips**.		-
Aphids: Cabbage aphid *(Brevicoryne brassicae),* **Green peach aphid** *(Myzus persicae)* **& Turnip aphid** *(Lipaphis pseudobrassicae)* **Priority: Low**								
Aphids in general were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
Beauveria bassiana (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion thrips, Greenhous Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, **Green Peach Aphid** & Two-spotted Spider Mites. [Max. 3 application per crop; re-treatment interval 3-14 d]	-	-
Petroleum oil PER12221	UN	Contact	1	A	ALL (excl. VIC)	PER12221 for control of **Aphids**, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips in alliums. [Max no. of applications per crop and re-treatment interval not specified].	-	-
Pirimicarb (Aphidex)	1A	Aphicide	2	A	ALL	Registered in leeks for control of **Aphids**. Spray when aphids are detected. [Max. no. of applications & re-treatment interval not specified].	VL	R3
Potassium salts of fatty acids (Natrasoap)	3A	Contact	NR	A	ALL	Registered in vegetables for control of **Aphids**. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d].	-	-
Pyrethrins + piperonyl butoxide (various)	3A	Contact & protectant	1	A	ALL	Registered in vegetables for control of ants, **Aphids**, Thrips, Caterpillars, Leaf hoppers, and Whitefly. [repeat spray weekly, if required]	VH H-Bees	-
Rotenone (Amgrow Derris Dust)	21B	Contact	1	A	ALL	Registered in vegetables for control of **Aphids**. [Max no. of applications not specified; Re-treatment interval: 10-14 d]	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Afidopyropen (Verseys) BASF	9D	Disrupts feeding		P		Label registration is underway for bulb vegetable group for control of **Aphids**. Hort Innovation ST17000 Contracted 30-Apr-18 Due for completion 30-Nov-2020.	L	-
Flonicamid (Mainman) ISK	9C	Systemic		P		Registered in Cucurbits for control of **Green peach Aphids**, **Melon aphids** and Silverleaf whitefly.	M VL-Bees	
Flupyradifurone (Sivanto) Bayer	4D	Systemic, ingestion & contact		P		Registered in macadamia for control of Macadamia lace bug, Banana spotting bug, Fruit spotting bug and suppression of Scirtothrips. US label (Sivanto) approves use on Brassica vegetables for control of Leafhoppers, **Aphids** and Whiteflies and for control of Blueberry thrips in Bushberries.	L VL-Bees	-
Crickets (Gryllidae) **Priority: Low**								
This pest did not get a ranking in the survey, but other industry sources have confirmed that it is a pest of occasional concern.								
1,3-dichloropropene (Tri-Form)	-	Soil fumigant	NR	A	ALL	Registered in vegetables for control of soil borne pests. Leave soil undisturbed for 14 d after treatment.	-	-
Chlorpyrifos (Sinon)	1B	Contact & systemic	5	A	QLD & WA only	Registered in young vegetable plants for the control of Field and Mole **crickets**. Apply as a soil drench or boom spray. [Max no. of applications and re-treatment interval not specified]	H H-Bees	R1
Cutworms (*Agrotis* spp.) **Priority: Low**								
This pest did not get a ranking in the survey, but other industry sources have confirmed that it is a pest of occasional concern. Recommendations include: Predatory wasps, crop rotation and early insecticide applications.								
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 H-Bees	-
Alpha-cypermethrin (Dominex)	3A	Contact		P		Registered in Field peas for control of **Cutworms**. Spray late afternoon or evening. [Max. no. of applications and re-treatment interval not specified]	VH H-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Bifenthrin (various)	3A	Contact & systemic		P		Registered in ornamentals for soil application for control of **Cutworms**. Spray evenly over the soil. After application apply approximately 5 mm of sprinkler irrigation.	VH H-Bees	R3
Clothianidin + Imidacloprid (Poncho Plus) BASF	4A	Protective		P		Registered in sweet corn, sunflower, canola and forage brassica for control of Wireworms, **Cutworms** and Aphids. Will provide early protection for 3-4 weeks after sowing.	M VH-Bees	R2
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		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 VH-Bees	-
Jassids (Cicadellidae) **Priority: Low**								
Jassids were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
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 H-Bees	-
Pyrethrins + Piperonyl butoxide (Crop Culture)	3A	Contact	1	A	ALL	Registered in vegetables for control of Aphids, Thrips, Caterpillars, Ants, Flies, Earwigs, Whitefly and **Leafhoppers.** [Max no. of applications not specified; Re-treatment interval: 7 d]	VH H-Bees	-
Petroleum Oil PER12221		Contact	1	A	ALL (excl. VIC)	Permitted in alliums for control of Aphids, Green Mirid, Green Vegetable Bug, Grey Cluster Bug, **Leafhoppers**, Mites, Rutherglen Bug and Thrips. Apply as a cover spray when pest numbers are low and repeat as necessary. Treatments per season not limited.	L	-
SYNFOI21 Syngenta		TBC		P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and Caterpillars.	-	

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Light Brown Apple Moth (*Epiphyas postvittana*) **Priority: Low**								
This pest did not get a ranking in the survey, but other industry sources have confirmed that it is a pest of some concern.								
Bacillus thuringiensis subsp. kurstaki (Biocrystal)	11A	Protective biopepticide	NR	A	ALL	Registered in vegetables for control of Lepidopteran caterpillars including Armyworm, Cabbage moth, Cabbage white butterfly, Green looper, **Light brown apple moth**, Pear looper, Soybean looper, Vine moth, Tobacco looper & *Helicoverpa* spp. Most effective on larvae < 8 mm. [Apply a minimum of 2 sprays, 3 d apart; re-treatment interval 3-5 d]	VL	-
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 H-Bees	-
Indoxacarb (Avatar) FMC	22A	Contact & stomach		P		Registered in apples, pears, stone fruits and grapes for control of **Light brown apple moth**.	L H-Bees	R3
Methoxyfenozide (Prodigy) Corteva	18	Insect growth regulator		P		Controls a range of **Lepidoptera** pests. Registrations and permits to control Lepidoptera pests in various vegetables including fruiting vegetables and lettuce. IPM compatible.	L	-
Spinetoram (Success Neo / Delegate) Corteva	5	Contact & ingestion		P		Registered in culinary herbs for control of **Light brown apple moth.** [Max. no. of applications not specified; re-treatment interval 7-14 d]	M	-
SYNFOI21 Syngenta		TBC		P		SYNFOI21 is not registered but the first global application is proposed for 2020/21 for Thrips, Bugs and **Caterpillars**.		
Parasitic nematodes *Paratrichodorus* sp. (stubby root), *Pratylenchus* sp. (root lesion) and *Ditylenchus* sp. (stem and bulb) **Priority: Low**								
Parasitic nematodes did not get a ranking in the survey, but other industry sources have confirmed that they are pests of some concern.								
1,3-dichloropropene (Tri-Form)	-	Soil fumigant	NR	A	ALL	Registered for control of plant parasitic **Nematodes**, Symphylans, Wireworms, and soil borne diseases in field crops.	-	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Chloropicrin + 1,3-dichloropropene (Tri-Form)	8B	Soil fumigant	NR	A	ALL (Restricted use TAS, VIC & SA)	Registered in vegetable crops 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 (Cerlong)	8F	Soil fumigant	NR	A	ALL	Registered in broadacre seed beds for control of soil fungi (including *Fusarium* spp.), **Nematodes** (cyst and non-cyst forming), soil and germinating seeds of weeds.	-	-
Ethanedinitrile (EDN Fumigas)	-	Soil fumigant	NR	A	ALL	Registered in cucurbits for control of soil borne pathogens (including *Fusarium oxysporum*), **Nematodes** (including *Meloidogyne* spp.) and weeds (including *Amaranthus retroflexus*, *Cyperus rotundus* and *Solanum nigrum*). [Use by licensed fumigators or approved persons only].	-	-
Metham sodium (Imtrade)	-	Soil fumigant	NR	A	ALL	Registered for control of **Nematodes**, various weeds and fungal diseases in field crops.	-	-
Abamectin (Tervigo) Syngenta	6	Contact		P		Registered in cucurbits, tomato, capsicum, chilli and egg plant for control of Root-knot **Nematodes**.		
Sulfonamide (Reklemel) Corteva	TBC			P		Pending registration as a nematicide by Corteva. Previously known product (Velloxine) is to be launched as Rekelemel in North America and Asia Pacific in 2021. Reklemel is a novel sulfonamide nematicide with a unique mode of action against plant-parasitic **Nematodes**.	L	
Fluensulfone (Nimitz) Adama	-	Contact & systemic		P		Registered in cucurbits for control of **Nematodes**. Apply a minimum of 7 d before transplanting.	-	-
Fluopyram (Velum) Bayer	7	Protective		P		Pending registration as a Nematicide. Registered in US for control of **Nematodes** in a range of vegetables.	-	-
NUL3145 Nufarm	TBC			P		New nematicide under development by Nufarm.		-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Redlegged earth mite (*Halotydeus destructor*) **Priority: Low**								
Redlegged earth mites were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS. IPM Recommendations include: Control broadleaf weed hosts (e.g. capeweed) in the season prior to planting.								
Dazomet (Cerlong)	8F	Soil fumigant	NR	A	ALL	Registered in various situations for control of soil fungi, nematodes, soil insects and weeds. Soil moisture is essential for release of gas and plastic cover brings optimum results. See label for details.	-	-
Propargite (Betamite)	12C	Contact	7	A	ALL	Registered in vegetables for control of Two spotted **mites** and Spider **mites** (QLD & WA). [Apply at first sight of infestation: max no. of applications not specified]	M	R3
Bifenthrin (Various)	3A	Contact & stomach		P		Registered in Faba beans for control of **Redlegged earth mite**. [Max. no. of applications and re-treatment interval not specified]	VH H-Bees	R3
Snails (Gastropoda) **Priority: Low**								
Snails were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS. They can become a problem in some regions.								
Iron EDTA Complex (Eradicate Snail)	-	Contact & ingestion	NR	A	ALL	Registered in all plants for the control of **Snails** and Slugs. Spread pellets evenly on ground. [Max no. of applications and re-treatment not specified]	-	-
Metaldehyde (Sabakem)	-	Contact & ingestion	7	A	ALL	Registered in vegetables for the control of **Snails** and Slugs. Spread pellets evenly on ground. [Max no. of applications and re-treatment not specified]	-	-
Spotted vegetable weevil (*Desiantha diversipes*) **Priority: Low**								
Spotted vegetable weevil was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
Pyrethrins (Yates)	3A	Contact	1	A	ALL	Registered in vegetables for control of various **insect pests**. Apply when pests first appear. [Max no. of applications not specified; re-treatment interval: 7 d]	VH H-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Indoxacarb (Avatar eVo) FMC	22A	Contact		P		Registered in celery for control of **Vegetable weevils**. [Max. 3 applications per crop; re-treatment interval 7 d]	L H-Bees	R3
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		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 VH-Bees	-
Two Spotted Mites (*Tetranychus urticae*) **Priority: Low**								
Mites were ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
Beauveria bassiana (Broadband OD / Velifer) BASF	UNF	Protective biopesticide	NR	A	ALL	Registered in protected vegetables and ornamentals for suppression of various pests including: Western Flower Thrips, Onion thrips, Greenhous Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & **Two-spotted Spider Mites**. [Max. 3 application per crop; re-treatment interval 3-14 d]	-	-
Petroleum oil PER12221	UN	Contact	1	A	ALL (excl. VIC)	PER12221 for control of Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, **Mites,** Rutherglen bug and Thrips in alliums. [Max no. of applications per crop and re-treatment interval not specified].	-	-
Potassium salts of fatty acids (Natrasoap)	-	Contact	Nil	A	ALL	Registered in vegetables for control of Aphids, Thrips, Mealybug, **Two spotted mites**, Spider mite, and White fly. Apply when temperatures are cooler. [Max no. of applications not specified; re-treatment interval 5-7 d].	-	-
Propargite (Betamite)	12C	Contact	7	A	Variable refer to label	Registered in vegetables for control of Spider mite (QLD & WA) and **Two spotted mites** (All States). Apply at first appearance and repeat as necessary. [Max no. of applications per crop and re-treatment interval not specified].	M	R3
Sulphur (Zulfa)	M2	Contact	NR		Variable refer to label	Registered in vegetables for control of Powdery mildew, Bean rust, Tomato russet mite (NSW), and **Two spotted mites** (VIC, SA, WA & TAS). Apply at first appearance and repeat as necessary. [Max no. of applications per crop and re-treatment interval not specified].	L	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Abamectin	6	Contact		P-A		Abamectin is registered in multiple crops for various **Mites**. PER81876 for control of Vegetable leafminer *(Liriomyza sativae)* in Bulb Vegetables, including Leeks. [Max. 2 sequential applications; re-treatment interval 7-14 d]		
Bifenazate (Acramite) Arysta	20D	Contact & oral		P		Registered in cucumber for control of **Two-spotted mites** and Byrobia mites. [Max. 1 application per season].	-	-
Etoxazole (Paramite) Sumitomo	10B	Contact & translaminar		P		Registered in pome and stone fruits and almons and grape for control of two-spotted mites. New permit is pending for the use of etoxazole for control of **Two-spotted mites** in sweet corn.	L	
Spiromesifen (Oberon) Bayer	23	Contact & systemic		P		Australian Registration pending for control of **Mites**. Hort Innovation is undertaking data generation projects across multiple commodities for a new label registration in Australia.		
Vegetable Leafminer (*Liriomyza* spp.) **Priority: Low**								
Vegetable Leafminer was ranked as a low priority in QLD & TAS. *Liriomyza* leafminers are serious horticultural pests, causing severe yield losses and quality downgrades. The Vegetable leafminer (*Liriomyza sativae*) is currently confined to the northern tip of Cape York Peninsula. Future outbreaks of Vegetable leafminer or other exotic *Liriomyza* species could potentially occur in any jurisdiction.								
Abamectin (Vertimec) PER81876	6	Contact	30 NG	A	ALL (excl. VIC)	PER81876 for control of **Vegetable leafminer *(Liriomyza sativae)*** in Bulb Vegetables, including Leeks. [Max. 2 sequential applications; re-treatment interval 7-14 d]	M H-Bees	-
Cyromazine (Diptex) PER81867 Agrocare	17	Contact		P		PER81867 for control of leafminer (*Liriomyza sativae*) in broccoli, fruiting vegetables, legume vegetables, root and tuber vegetables and stalk and stem vegetables (field & protected cropping). [Max. 6 applications per crop; re-treatment interval: 7 d]. Cyromazine is registered for control of Sciarid and Phorid fly larvae in mushroom compost.	-	-
Emamectin (Proclaim Opti) PER87563 Syngenta	6	Contact & systemic		P		PER87563 for control of **Vegetable leaf miner** (*Liriomyza* spp.) in Brassica vegetables. [Max. 4 applications per crop; re-treatment interval: 7 d]	M H-Bees	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Registered in root & tuber vegetables for control of Lightbrown apple moth, Loopers, Helicoverpa & Potato moth. Registered in US and Canada for control of a range of insect pests such as Ants, Caterpillars, Colorado Potato Beetle, Corn Earworms, Flea Beetle, **Leaf miners**, Loopers, Mites & Thrips.	L	-
Spinetoram (Success Neo) Corteva	5	Contact & ingestion		P		Registered in fruiting vegetables for control of Tomato leaf miner. Registered in US and Canada for control of a range of insect pests including **Leaf miners** in several fruit crops.	M	-
Vegetable weevil (*Listroderes difficilis*) **Priority: Low**								
Vegetable weevil was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
Indoxacarb (Avatar eVo) FMC	22A	Contact		P		Registered in celery for control of **Vegetable weevils**. [Max. 3 applications per crop; re-treatment interval 7 d]	L H-Bees	R3
Tetraniliprole (Vayego) Bayer	28	Disrupts feeding		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 VH-Bees	-
Wingless grasshopper (*Phaulacridium vittatum*) **Priority: Low**								
Wingless grasshopper was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
1,3-dichloropropene (Tri-Form)	-	Soil fumigant	NR	A	ALL	Registered in vegetables for control of soil borne pests. Leave soil undisturbed for 14 d after treatment.	-	-
Chlorpyrifos (Sinon)	1B	Contact & systemic	5	A	QLD & WA only	Registered in young vegetable plants for the control of Field and Mole **crickets**. Apply as a soil drench or boom spray. [Max no. of applications and re-treatment interval not specified]	H H-Bees	R1
Carbaryl	1A	Contact & ingestion		P		Registered in cucurbits (prior to flowering) for the control of Helicoverpa, Pumpkin beetle, 28 spotted lady bird, **Wingless grasshopper**, Green vegetable bug, Leaf eating ladybird, Cutworms, Earwig, Potato moth, Rutherglen bug and Army worm. [Max. no. of applications and re-treatment interval not specified].	H	-

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Wireworm (*Heteroderes* spp., *Arachnodima* spp., *Agrypnus* spp.) **Priority: Low**								
Wireworm was ranked consistently as a low priority in VIC, QLD, NSW, WA & TAS.								
1,3-dichloropropene + Chloropicrin (Tri-Form)	8B	Soil fumigant	NR	A	ALL	Registered in vegetables for control of **Wireworms**. Leave soil undisturbed at least 7 d after treatment. Aeration before planting should be for a minimum of 21 days.	-	-
Metham sodium (Imtrade)	-	Soil fumigant	NR	A	ALL	Registered for pre-planting soil treatment to control soil borne fungal diseases in food crops.	-	-
Bifenthrin	3A	Contact & ingestion		P		Registered in cotton and sugar cane for control of **Wireworm**.	VH H-Bees	R3
Fipronil	2B	Contact & systemic		P		Registered in potatoes for control of **Wireworms**. Apply as a broadcast spray to surface of soil and incorporate to a depth of 15 cm prior to planting.	M H-bees	R3
Imidacloprid (Various)	4A	Systemic		P		Registered in cotton, maize, sorghum, sunflower and sweet corn for control of **Wireworm**.	M VH-Bees	R2
Phorate	1B	Contact & systemic		P		Registered in carrots for the control of or control of Carrot fly, Aphids, Thrips and Jassids. Registered in potatoes for control of **Wireworms**.	H H-Bees	R3
Fall Armyworm (*Spodoptera frugiperda*) **Priority: Low**								
Fall armyworm was not ranked as a pest in Leeks. It is an exotic pest that is considered a potential threat that could affect most vegetable crops if allowed to spread. If incursions occur, valid permits are in place for its control.								
Methomyl (Lannate) PER89293	1A	Contact & systemic	7	A	ALL (excl. VIC)	PER89293 for control of **Fall Armyworm** in Spinach, Fennel, Brassica leafy vegetables, Bulb onions, Fennel bulb, Leeks & turf. [Max. 3 applications per crop; re-treatment interval not specified]	H H-Bees	R2
Spinetoram (Success Neo) PER89284	5	Contact & ingestion	3 NG	A	ALL (excl. VIC)	PER89293 for control of **Fall Armyworm** in Leeks, Spring onion, Shallot & Galangal. [Max. 3 applications per crop; re-treatment interval not specified]	M	-
Indoxacarb (Avatar eVo) FMC	22A	Contact		P		Registered in several vegetable groups for control of various **Lepidoptera** pests. [Max 4 applications per crop: re-treatment interval 7 d]	L H-Bees	R3

Pest / Active Ingredient (Trade Name)	Chemical group	Activity	WHP, days	Availability	States	Comments	Impact on beneficials	Regulatory risk
Spinosad (Entrust Organic) Corteva	5	Contact & ingestion		P		Registered in various crops for control of various **Lepidoptera**. [Max. no. of applications not specified; re-treatment interval 7-14 d].	L	-
Tetraniliprole (Vayego) Bayer	28	Ingestion		P		Registered for control of various weevils, beetles and **Lepidoptera** in almonds, macadamias, pome and stone fruit. Hort Innovation has several projects underway towards assisting registration in minor crops.	L-M VH-Bees	-
Chlorantraniliprole (various)	28	Systemic		P		Registered in several vegetable groups for control of various Lepidoptera pests. [Max. 3 applications per crop; 2 consecutive; re-treatment interval 7 d]	L	-

4.3 Weeds in Leeks

4.3.1 Weed priorities

Common name	Scientific name
Moderate	
Groundsel (VIC)	*Senecio vulgaris*
Marshmallow (VIC)	*Malva parviflora*
Nutgrass (VIC & WA)	*Cyperus rotundus*
Oxalis (VIC)	*Oxalis pes-caprae*
Potato weed (VIC)	*Galinsoga* spp.
Stinging nettles (VIC)	*Urtica* spp.
Winter grass (VIC)	*Poa annua*

All weeds mentioned were ranked moderate priority in one or two 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.

The main problems with weed management in Leek seem to arise from the long crop cycle of 21-30 weeks compared to some other vegetable crops and the general herbicide phytotoxicity exhibited by leeks.

Resistance management
Of the weeds listed in the table above there are confirmed cases of resistance in Australia for Awnless Barnyard grass (Group M at more than 200 sites), Feather top Rhodes grass (Group M at 4 sites) and Blackberry nightshade (Group L at 2 sites).

Specific resistance management strategies for high resistance risk (A and B) and moderate resistance risk (C, D, F, G, I, J, K, L, M, N, Q and Z) herbicide modes of action are available on the CropLife Australia webpage.
https://www.croplife.org.au/resources/programs/resistance-management/herbicide-resistance-management-strategies-2/

Managing these weeds would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, using mechanical devices and other cultural practises including crop rotation.

4.3.2 Available and potential products for weed control

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

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

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Groundsel (*Senecio vulgaris*) **Priority:** considered important only in VIC							
The Groundsel weed was considered important in VIC only. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3
Oxyfluorfen PER81271	G**	Leeks / Pre-emergent	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Groundsel**). Apply at 2.5 - 3 leaf stage after transplanting. [max. 2 application per crop].	NR	A	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Groundsel** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as contained on the relevant product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3
Bromoxynil (Maya) Unregistered Nufarm	C**	Bulb Onions/ pre- & post-emergent	Nufarm advised in 2018 that they are undertaking the required label registration for the EU formulation of Bromoxynil (Group C) in onions. The Australian formulation is not compatible with onions as it causes crop damage. This will be an alternative to Ioxynil (Group C) herbicide. Nufarm carried out Australian trials in 2019. Registration submission is expected October 2020.		P		-
Norflurazon (Zoliar) Agnova	F**	Asparagus, citrus, grapes, nuts, stone and pome fruits / pre-emergent	Registered in asparagus, citrus, grapes, nuts, stone & pome fruits for control of grass and **broadleaf weeds.** [Max. 2 applications per year; re-treatment interval not specified].		P		
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Pendimethalin + Dimethenamid (Podium) BASF	D+K**	Ornamental plants & recreational turf / pre-emergent	Registered in ornamentals & recreational turf for control of grass and **broadleaf weeds** [Max. no. of applications not specified; re-treatment interval 60 – 90 d]		P		
Marshmallow (*Malva parviflora*) **Priority:** considered important only in VIC							
The Marshmallow weed was considered an issue only in VIC. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Ioxynil PER81271	C**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Marshmallow**). Apply at 5-8 leaf stage after transplanting. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	-
Methabenzthiazuron (Tribunil) PER14742	C**	Leeks / Post-emergent	Grass and broadleaf weeds as per the product label (including **Marshmallow**). Can cause crop damage in hot weather. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	R3
Oxyfluorfen PER81271	G**	Leeks / Pre-emergent	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Marshmallow**). Apply at 2.5 - 3 leaf stage after transplanting. [max. 2 application per crop].	NR	A	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Marshmallow** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3
Bromoxynil (Maya) Unregistered Nufarm	C**	Bulb Onions/ pre- & post-emergent	Nufarm advised in 2018 that they are undertaking the required label registration for the EU formulation of Bromoxynil (Group C) in onions. The Australian formulation is not compatible with onions as it causes crop damage. This will be an alternative to Ioxynil (Group C) herbicide. Nufarm carried out Australian trials in 2019. Registration submission is expected October 2020.		P		-

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Norflurazon (Zoliar) Agnova Technologies	F**	Asparagus, citrus, grapes, nuts, stone and pome fruits / pre-emergent	Registered in asparagus, citrus, grapes, nuts, stone & pome fruits for control of grass and **broadleaf weeds.** [Max. 2 applications per year; re-treatment interval not specified].		P		
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Pendimethalin + Dimethenamid (Podium) BASF	D+K**	Ornamental plants & recreational turf / pre-emergent	Registered in ornamentals & recreational turf for control of grass and **broadleaf weeds** [Max. no. of applications not specified; re-treatment interval 60 – 90 d]		P		
Nutgrass (*Cyperus rotundus*) **Priority:** considered important only in VIC & WA							
The Nutgrass was considered important in VIC & WA only. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Nutgrass** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Oxalis (*Oxalis pes-caprae*) **Priority:** considered important only in VIC							
Oxalis was considered important only in VIC. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Oxalis** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3
Bromoxynil (Maya) Unregistered Nufarm	C**	Bulb Onions/ pre- & post-emergent	Nufarm advised in 2018 that they are undertaking the required label registration for the EU formulation of Bromoxynil (Group C) in onions. The Australian formulation is not compatible with onions as it causes crop damage. This will be an alternative to Ioxynil (Group C) herbicide. Nufarm carried out Australian trials in 2019. Registration submission is expected October 2020.		P		-
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Potato weed (*Galinsoga* spp.) **Priority:** considered important only in VIC							
The Potato weed was considered important only in VIC. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Ioxynil PER81271	C**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Potato weed**). Apply at 5-8 leaf stage after transplanting. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	-
Methabenzthiazuron (Tribunil) PER14742	C**	Leeks / Post-emergent	Grass and broadleaf weeds as per the product label (including **Potato weed**). Can cause crop damage in hot weather. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	R3
Oxyfluorfen PER81271	G**	Leeks / Pre-emergent	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Potato weed**). Apply at 2.5 - 3 leaf stage after transplanting. [max. 2 application per crop].	NR	A	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergence inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3
Propachlor PER81271	K**	Leeks / Pre- and post-emergent / check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Potato weed**). [max. 1 application per crop].	NR	A	ALL (excl. VIC)	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Potato weed** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Bromoxynil (Maya) Unregistered Nufarm	C**	Bulb Onions/ pre- & post-emergent	Nufarm advised in 2018 that they are undertaking the required label registration for the EU formulation of Bromoxynil (Group C) in onions. The Australian formulation is not compatible with onions as it causes crop damage. This will be an alternative to Ioxynil (Group C) herbicide. Nufarm carried out Australian trials in 2019. Registration submission is expected October 2020.		P		-
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Stinging nettles (*Urtica spp.*) **Priority:** considered important only in VIC							
The Stinging nettles were considered an issue in VIC only. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Chlorthal-dimethyl (Dacthal)	D**	Leeks / Pre-emergent weed control	Registered in leeks for control of various weeds including **Stinging nettle** and Winter grass. Spray at time if seeling or transplanting. Can be sprayed directly over transplants. Apply up to 14 weeks of planting or transplanting. [max no of applications and re-treatment interval not specified]	NR	A	ALL	-
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3
Methabenzthiazuron (Tribunil) PER14742	C**	Leeks / Post-emergent	Grass and broadleaf weeds as per the product label (including **Stinging nettle**). Can cause crop damage in hot weather. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	R3
Oxyfluorfen PER81271	G**	Leeks / Pre-emergent	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Stinging nettle**). Apply at 2.5 - 3 leaf stage after transplanting. [max. 2 application per crop].	NR	A	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Propachlor PER81271	K**	Leeks / Pre- and post-emergent / check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Stinging nettle**). [max. 1 application per crop].	NR	A	ALL (excl. VIC)	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Stinging nettle** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3
Bromoxynil (Maya) Unregistered Nufarm	C**	Bulb Onions/ pre- & post-emergent	Nufarm advised in 2018 that they are undertaking the required label registration for the EU formulation of Bromoxynil (Group C) in onions. The Australian formulation is not compatible with onions as it causes crop damage. This will be an alternative to Ioxynil (Group C) herbicide. Nufarm carried out Australian trials in 2019. Registration submission is expected October 2020.		P		-
NUL3438 Nufarm	TBC		New active in development, Nufarm claims activity on broadleaf weeds.		P		-
Winter grass (*Poa annua*) (VIC). **Priority:** considered important only in VIC							
The Winter grass was considered an issue only in VIC. Managing this would be possible using herbicides mentioned in Appendix 3 or by various management practices such as soil fumigation, pre-crop spraying, spot spraying, or using mechanical devices.							
Chlorthal-dimethyl (Dacthal)	D**	Leeks / Pre-emergent weed control	Registered in leeks for control of various weeds including Stinging nettle and **Winter grass**. Spray at time if seeling or transplanting. Can be sprayed directly over transplants. Apply up to 14 weeks of planting or transplanting. [max no of applications and re-treatment interval not specified]	NR	A	ALL	-

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Clethodim (Arysta) PER82459	A***	Leeks / Grass selective post-emergent	PER82459 for control of various grass weeds in leeks as per the product label. Considered very effective on most annual grass weeds, especially **Winter grass**. Also used to spot spray couch grass post-emergent. [max. 1 application per crop]	H:14	A	ALL	R3
Ethofumesate (various) PER81271	J**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Winter grass**). Apply at 2-5 leaf stage after transplanting. [max. 1 application per crop].	H:56	A	ALL (excl. VIC)	-
Glyphosate (various)	M**	General seed bed preparation	Various weeds as specified, a pre-crop spray. Only used in field grown crops.	NR	A	ALL	R3
Methabenzthiazuron (Tribunil) PER14742	C**	Leeks / Post-emergent	Grass and broadleaf weeds as per the product label (including Winter grass). Can cause crop damage in hot weather. [max. 1 application per crop].	H:49	A	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergent inter-row weed control.	General weeds as a pre-crop spray. Only used in field grown crops. Post-emergence inter-row weed control (shielded spray – do not touch the crop). Add diquat where broadleaf weeds dominate. [Max no of applications not specified]	NR	A	ALL	R3
Propachlor PER81271	K**	Leeks / Pre- and post-emergent / check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions (including **Winter grass**). [max. 1 application per crop].	NR	A	ALL (excl. VIC)	R3
Linuron (Farmoz) PER13367	C**	Leeks / post-emergent	PER13367 allows use in Leeks for control of Grass and broadleaf weeds as per the product label. Rainfall or irrigation is needed within 3-4 d of application. Apply 5-10 weeks of transplanting. [max. 3 application per crop]. **Winter grass** is not covered by label.		P-A		R3
Simazine (Accensi) PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	PER81271 allows use in Leeks for control of Grass and broadleaf weeds as per product label for onions. Apply within 2 d of transplanting. [max. 1 application per crop]. Onions are not covered by product label.		P-A		R3

Active ingredient (Trade Name)	Chemical Group	Situation / Crop	Comment / Use / Weed	WHP (days)	Availability	States	Regulatory risk
Metolachlor+ Prosulfocarb (Boxer Gold) Syngenta	J+K**	Potatoes / Pre-emergent	Registered in potatoes for control of Ryegrass. Apply after planting, but no later than 25% potato shoot emergence. Hort Innovation is progressing to undertake the required studies in carrots and onions for a label registration		P		-
Quizalofop-P-Ethyl (Targa) Sipcam	A***	Onions / Post-emergent	Registered in onions for control of various **grass weeds**, including Annual Ryegrass. Apply to young, actively growing weeds. Treatments per season not limited.		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.comlaw.gov.au/Series/F2012L02501
APVMA Permit search	https://productsearch.apvma.gov.au/permits
APVMA Product search	https://productsearch.apvma.gov.au/products
Codex MRL database	http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/pestres/en/
Cotton Pest Management Guide 2018-19	https://www.cottoninfo.com.au/publications/cotton-pest-management-guide
CropLife Australia	https://www.croplife.org.au/
Growcom – Infopest Database	www.infopest.com.au
Hort Innovation	www.horticulture.com.au
Ausveg	https://ausveg.com.au/

5.2 Abbreviations and Definitions:

APVMA	Australian Pesticides and Veterinary Medicines Authority
IPM	Integrated pest management
LOQ	Limit of quantification
MRL	Maximum residue limit (mg/kg or ppm)
Pesticides	Plant protection products (fungicide, insecticide, herbicide, nematicides, rodenticides, etc.).
Plant pests	Diseases, insects, nematodes, rodents, viruses, weeds, etc.
SARP	Strategic Agrichemical Review Process
TBC	To be continued
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 Leek
Appendix 2. Products available for control of insects and mites in Leek
Appendix 3. Products available for weed control in Leek
Appendix 4. Current permits for use in Leek
Appendix 5. Leek Maximum Residue Limits (MRLs)
Appendix 6. Leek regulatory risk assessment

Appendix 1. Products available for disease control in Leeks

Active Ingredient (Trade Name)	Chem. group	Crop/Situation	Pests / Comments	States	WHP	Regulatory risk
1,3-dichloropropene (Tri-Form)	-	Field crops	Soil borne diseases, plant parasitic nematodes. Restricted chemical.	ALL (Restricted use TAS, VIC & SA)	NR	-
Azoxystrobin (Amistar 250 SC Fungicide)	11	Leeks	Downy mildew and suppression of White rot	ALL	7	-
Chloropicrin (Tripicrin)	8	General pre-plant soil fumigation	Nematodes, insects, Pythium, Phytophthora, Fusarium, and Verticillium	ALL	NR	-
Chlorothalonil (Sabakem)	M5	Leeks	Purple blotch	ALL	1	R3
Cyprodinil + fludioxonil (Switch) PER80501	9+12	Alliums	Suppression of black mould and Botrytis grey mould	ALL	7	R3
Dazomet (Cerlong)	8F	Vegetables	Soil fungi, nematodes, soil insects and weeds	ALL	NR	-
Dimethomorph (Acrobat) + Mancozeb (Penncozeb) PER14473	40+M3	Leeks	Downy mildew, Purple blotch and Botrytis rots (Mancozeb only)	ALL (excl. VIC)	H:7 NG	R2
Fluopicolide + Propamocarb hydrochloride (Infinitio)	28+43	Bulb vegetables	Downy mildew	ALL	7	-
Hydrogen peroxide + peroxyacetic acid (Peratec Plus)	M	Leeks	Botrytis neck & bulb rot and Downy mildew	ALL	1	-
Mancozeb + Sulphur (various)	M3 + UN	Seedlings (general)	Damping off	ALL	7	R2
Metalaxyl + copper as hydroxide (Ridomil Gold Plus)	4 + M1	Leeks	Downy mildew and Purple blotch	ALL	7	-

Active Ingredient (Trade Name)	Chem. group	Crop/Situation	Pests / Comments	States	WHP	Regulatory risk
Metham sodium (Metham)	-	General pre-plant soil fumigation	Nematodes, fungi, and weed seeds.	ALL	NR	--
Oxathiapiprolin (Zorvec)	49	Leeks	Downy mildew	ALL	10	-
Phosphorous acid (various) PER13698	-	Leeks	Downy mildew (suppression only)	ALL (excl. VIC)	H:1	-
Sulphur (Solo)	UN	Vegetables	Powdery mildew, Rust, Tomato russet mite, Bean spider mite, and Two-spotted mite	Variable refer to label	NR	-
Thiabendazole (Sharda)	I	Bulbs and corms	Fusarium basal rot and Blue mould.	ALL	NR	-
Triadimenol (Allitron) PER14906	3	Leeks	White rot (*Sclerotium cepivorum*)	ALL (excl. VIC)	H:28	R3

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

Active Ingredient (Trade Name)	Chem. group	Crop/Situation	Pests / Comments	States	WHP	Regulatory risk
1,3-dichloropropene (Tri-Form)	-	Field crops	Soil borne diseases, plant parasitic nematodes.	ALL (Restricted use TAS, VIC & SA)	NR	-
1,3-dichloropropene + Chloropicrin (Tri-Form)	8B	Vegetables	Wireworms. Leave soil undisturbed at least 7 d after treatment.	ALL	NR	-
Abamectin PER81876	6	Leeks	Vegetable Leaf miner	ALL (excl. VIC)	30 NG	-
Alpha-cypermethrin PER14457	3A	Leeks	Onion thrips	ALL (excl. VIC)	H:7 NG	-
Bacillus thuringiensis subsp. *kurstaki* (Biocrystal)	11A	Vegetables	Armyworm, Cotton bollworm, Native budworm, Cabbage moth, Cabbage white butterfly, Green looper, Lightbrown apple moth, Pear looper, Soybean looper, Vine moth, and Tobacco looper.	ALL	NR	-
Beauveria bassiana (Broadband OD / Velifer) BASF	UNF	Protected vegetables and ornamentals	Suppression of various pests including: Western Flower Thrips, Onion thrips, Greenhous Whitefly, Silverleaf Whitefly, Sweet Potato Whitefly, Green Peach Aphid & Two-spotted Spider Mites.	ALL	NR	-
Chlorpyrifos (Sinon)	1B	Vegetables	Field and mole crickets. Apply as a soil drench or boom spray.	QLD & WA	5	R1
Cyantraniliprole (Benevia)	28	Leeks	Suppression of Onion thrips	ALL	7	-
Dazomet (Cerlong)	8F	Vegetables	Soil fungi, nematodes, soil insects and weeds	ALL	NR	-
Diazinon (Barmac) PER82551	1B	Leeks	Onion fly	ALL (excl. VIC)	H:21	R3
Dicofol (Miti-Fol)	UN	Vegetables	Two spotted mite, Tomato russet mite	ALL	7	R2

Active Ingredient (Trade Name)	Chem. group	Crop/Situation	Pests / Comments	States	WHP	Regulatory risk
Ethanedinitrile (EDN Fumigas)	-	Cucurbits/General soil fumigant	soil borne pathogens (including Fusarium oxysporum), nematodes (including Meloidogyne spp.) and weeds (including *Amaranthus retroflexus*, *Cyperus rotundus* and *Solanum nigrum*).	ALL	NR	-
Flonicamid (Mainman) PER89185	9C	Bulb vegetables including leeks (field only)	Onion thrips & Western flower thrips	ALL (excl. VIC)	7	-
Garlic + Chilli + Pyrethrins + Piperonyl Butoxide	3A	Vegetables	Ants, Aphids, Caterpillars, Earwigs, Whitefly, Thrips and Leafhoppers. Suitable for organic growers.	ALL	1	-
Iron EDTA Complex (Eradicate Snail)	-	Plants generally	Slugs and snails	ALL	NR	-
Maldison PER13653	1B	Leeks	Onion thrips	ALL (excl. VIC)	H:7	-
Metaldehyde (Sabakem)	-	Plants generally	Slugs and snails	ALL	7	-
Metham sodium (Imtrade)	-	General pre-plant soil fumigation	Nematodes, fungi, and weed seeds.	ALL	NR	-
Methomyl (Lannate) PER89293	1A	Leeks	Fall armyworm (*Spodoptera frugiperda*)	ALL (excl. VIC)	TBA	R2
Petroleum oil PER12221	UN	Alliums	Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips	ALL (excl. VIC)	1	-
Pirimicarb (Aphidex)	1A	Leeks	Aphids	ALL	2	R3
Potassium salts of fatty acids (Natrasoap)	3A	Vegetables	Aphids, Thrips, Mealybug, Two spotted mites, Spider mite, and White fly	ALL	Nil	-
Propargite (Betamite)	12C	Vegetables	Spider mite (QLD and WA only) and Two spotted mites	Variable refer to label	7	R3
Pyrethrins (Yates)	3A	Vegetables	Insect pests	ALL	1	-

Active Ingredient (Trade Name)	Chem. group	Crop/Situation	Pests / Comments	States	WHP	Regulatory risk
Pyrethrins + piperonyl butoxide (various)	3A	Vegetables	Ants, Aphids, Thrips, Caterpillars, Leaf hoppers, and Whitefly.	ALL	1	-
Rotenone (Derris Dust)	21B	Vegetables	Aphids, Cabbage white butterfly, Cabbage moth, Cabbage-centre grub, Caterpillars, Potato moth (leafminer), Thrips	ALL	1	-
Spinetoram (Success Neo) PER13088	5	Leeks	Western flower thrips (specified resistance management strategy on label)	ALL (excl. VIC)	3 NG	-
Spinetoram (Success Neo) PER89284	5	Leeks	Fall armyworm (*Spodoptera frugiperda*)	ALL (excl. VIC)	3 NG	-
Spirotetramat (Movento 240 SC)	23	Bulb vegetables	Onion thrips, Western flower thrips, Tomato thrips, and Plague thrips	ALL	7	-
Sulphur (Zulfa)	UN	Vegetables	Powdery mildew, Bean rust, Tomato russet mite, and Two spotted mites	Variable. Refer to label.	NR	-

Appendix 3. Products available for weed control in Leeks

Active ingredient (Trade Name)	Chem. Group	Situation / Crop	Comment / Use / Weed	WHP (days)	States	Regulatory risk
Chlorthal-dimethyl (Dacthal)	D**	Leeks / Pre-emergence weed control	Pre-emergence weed control	NR	ALL	-
Clethodim PER82459	A***	Leeks / Grass selective post-emergent	Various grass as per the product label	H:14	ALL	R3
Cyanazine PER81271	C**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions	NR	ALL (excl. VIC)	R3
Ethofumesate PER81271	J**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions	H:56	ALL (excl. VIC)	-
Fluazifop-P (Fusilade) PER82556	A***	Leeks / post- emergent	Various grass weeds	H:35	ALL (excl. VIC)	-
Glyphosate (various)	M**	General seed bed preparation	General weeds as a pre-crop spray	NR	ALL	R3
Ioxynil PER81271	C**	Leeks / pre- and post- emergent/ check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions	H:49	ALL (excl. VIC)	-
Linuron PER13367	C**	Leeks / post-emergence	Grass and broadleaf weeds as per the product label	H:70	ALL (excl. VIC)	R3
Methabenzthiazuron (Tribunil) PER14742	C**	Leeks / Post-emergent	Grass and broadleaf weeds as per the product label	H:49	ALL (excl. VIC)	R3
Oxyfluorfen PER81271	G**	Leeks / Pre-emergent	Grass and broadleaf weeds as contained on the relevant product label for onions	NR	ALL (excl. VIC)	-
Paraquat + diquat (various)	L**	General seed bed preparation / Post-emergence inter-row weed control.	General weeds as a pre-crop spray	NR	ALL	R3

Active ingredient (Trade Name)	Chem. Group	Situation / Crop	Comment / Use / Weed	WHP (days)	States	Regulatory risk
Pendimethalin PER81271	D*	Leeks / Pre- and post-emergent / check permit for details	Hogweed	NR	ALL (excl. VIC)	-
Propachlor PER81271	K**	Leeks / Pre- and post-emergent / check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions	NR	ALL (excl. VIC)	-
Simazine PER81271	C**	Leeks / Pre- and post-emergent / check permit for details	Grass and broadleaf weeds as contained on the relevant product label for onions	NR	ALL (excl. VIC)	R3

Appendix 4. Current permits for use in Leeks

Permit No.	Description	Issued Date	Expiry Date	Permit Holder
PER81876 Version 3	Abamectin / Bulb Vegetables except Bulb onions (including leeks, spring onions) / Vegetable leaf miner	24-June-16	30-Apr-24	Hort Innovation
PER14457 Version 3	Alpha-cypermethrin / Leek / Onion thrips	19-Mar-14	30-Jun-24	Hort Innovation
PER82459	Clethodim / Leeks / Various grass as per product label	19-Apr-17	30-Sep-21	Hort Innovation
PER80501 Version 3	Cyprodinil + fludioxonil (Switch) / Alliums / Suppression of Black mould and Botrytis grey mould	20-Jul-15	31-Jul-24	Hort Innovation
PER82551 Version 2	Diazinon / Leek / Onion fly	20-May-16	31-Mar-21	Hort Innovation
PER14473 Version 2	Dimethomorph and Mancozeb / Leeks / Downy mildew, Purple blotch & Botrytis rots	18-Dec-13	30-Jun-23	Hort Innovation
PER89185	Flonicamid (Mainman) / Leeks / Onion thrips & Western flower thrips	06-Aug-20	31-Aug-23	Hort Innovation
PER82556	Fluazifop-P (Fusilade) / Leek / Various grass weeds	16-Apr-14	31-Jan-23	Hort Innovation
PER13367 Version 3	Linuron / Leek / Grass and broadleaf weeds as per the product label	31-May-13	30-Apr-21	Hort Innovation
PER13653 Version 3	Maldison / Leeks / Onion thrips	01-Oct-12	28-Feb-23	Hort Innovation
PER14742 Version 3	Methabenzthiazuron (Tribunil) / Leek / Broadleaf and grass weeds as listed on the product label	01-Jul-14	30-Jun-21	Hort Innovation
PER89293	Methomyl (Lannate) / Leeks and various vegetables / Fall Armyworm	10-Apr-20	30-Apr-23	Hort Innovation
PER12221 Version 4	Petroleum oil / Alliums / Aphids, Green mirid, Green vegetable bug, Grey cluster bug, Leafhoppers, Mites, Rutherglen bug and Thrips	29-Jun-12	30-Nov-22	Hort Innovation
PER13698 Version 3	Phosphorous acid / Leek / Downy mildew (suppression only)	01-Oct-12	30-Nov-22	Hort Innovation
PER81271 Version 3	Simazine, Cyanazine, Propachlor, Ioxynil, Ethofumesate, Oxyfluorfen & Pendimethalin / Leek / Grass and broadleaf weeds	10-Nov-15	31-Oct-21	Hort Innovation
PER13088 Version 2	Spinetoram (Success Neo) / Leek / Western flower	29-Mar-12	31-Mar-22	Hort Innovation
PER89284	Spinetoram (Success Neo) / Various Tubers and Bulbs / Fall Armyworm	16-Mar-20	31-Mar-23	Hort Innovation
PER14906 Version 3	Triadimenol (Allitron) / Leek / White rot	22-Oct-14	31-Oct-24	Hort Innovation

Appendix 5. Leek Maximum Residue Limits (MRLs)

CODEX commodity groupings of bulb vegetables and subgroups:

VA0035 Bulb vegetables
VA0384 Leek

Note: Major export markets for leeks include Japan, New Caledonia, Singapore and Malaysia. Available information indicates that in the absence specific limits in legislation the most countries defers to Codex, followed by EU MRL standards or applies a 0.01ppm default value. Food exported to New Zealand from Australia may be legally sold if it complies with Australian requirements. MRLs and legislation are subject to change; the values presented should not be relied on.

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
Abamectin	VA0035	Bulb Vegetable	T0.05	-
Abamectin	VA0384	Leek	-	0.005
Aldrin and Dieldrin	VA0035	Bulb Vegetable	-	E0.05
Azoxystrobin	VA0036	Bulb Vegetable	5	-
Azoxystrobin	VA0035	Bulb Vegetable		10
Boscalid	VA0035	Bulb Vegetable	T5	5
Chlorothalonil	VA0384	Leek	T10	40
Chlorpyrifos	VA0384	Leek	T5	-
Cyanazine	VA0035	Bulb Vegetable	*0.02	-
Cyanazine	VA0384	Leek	0.05	-
Cyantraniliprole	VA0035	Bulb Vegetable	7	-
Cyhalothrin (includes lambda-cyhalothrin)	VA0035	Bulb Vegetable	-	0.2
Cypermethrin	VA0384	Leek	T0.5	0.05
Cyprodinil	VA0036	Bulb Vegetable	T3	-
Deltamethrin	VA0384	Leek	-	0.2
Difenoconazole	VA0384	Leek	-	0.3
Dimethomorph	VA0384	Leek	0.5	0.8
Dithiocarbamates (Mancozeb, metham, thiram, metiram, zineb, ziram)	VA0035	Bulb Vegetable	T10	-
Dithiocarbamates	VA0384	Leek	-	0.5
Ethofumesate	VA0035	Bulb Vegetable	*0.1	-
Fenamidone	VA0384	Leek	-	0.3
Fluazifop-p-butyl	VA0384	Leek	T1	-
Fludioxonil	VA0036	Bulb Vegetable	T3	-
Fluopicolide	VA0035	Bulb Vegetable	3	-
Fluopyram	VA0384	Leek	-	0.15
Glyphosate	VA0035	Bulb Vegetable	*0.1	-
Imidacloprid	VA0384	Leek	-	*0.05
Ioxynil	VA0384	Leek	T2	-
Linuron	VA0384	Leek	*0.02	-
Maldison	VA0384	Leek	2	-
Metalaxyl	VA0035	Bulb Vegetable	0.1	-
Methabenzthiazuron	VA0384	Leek	T*0.05	-
Methiocarb	VA0384	Leek	-	0.5
Myclobutanil	VA0035	Bulb Vegetable	-	0.06
Oxathiapiprolin	VA0035	Bulb Vegetable	1	-
Oxyfluorfen	VA0035	Bulb Vegetable	*0.05	-
Pendimethalin	VA0035	Bulb Vegetable	*0.05	-
Permethrin	VA0384	Leek	-	0.5

Chemical	Codex	Description	APVMA MRL mg/kg	Codex MRL mg/kg
Phosphorous acid	VA0035	Bulb Vegetable	T10	-
Propachlor	VA0384	Leek	*0.02	-
Propamocarb	VA0035	Bulb Vegetable	30	30
Pyraclostrobin	VA0384	Leek	-	0.7
Sethoxydim	VA0384	Leek	0.7	-
Simazine	VA0384	Leek	*0.01	-
Spinetoram	VA0384	Leek	T0.2	-
Spirotetramat	VA0035	Bulb Vegetable	0.5	-
Tebuconazole	VA0035	Bulb Vegetable	*0.01	0.7
Triadimenol	VA0384	Leek	T3	-
Trifloxystrobin	VA0384	Leek	-	0.7
Trifluralin	VA0035	Vegetable	0.05	-

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

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

Sources: APVMA MRLs: Agricultural and Veterinary Chemicals Code Instrument No. 4 (MRL Standard) 2019. Compilation 4. Prepared 15 January 2020. CODEX MRLs: In addition to the online CODEX database, meeting reports were used to update recent changes (to July 2019).

Appendix 6. Leek regulatory risk assessment

Leek
Agrichemical Regulatory Risk Assessment

June 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 require the generation of new data. A consequence of which can be that many of these chemicals 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 farm chemicals 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 prohibiting the use in the exporting country to ensure compliance, as breaches of MRLs would adversely affect market access.

The effects of the above are greater pressure placed on the availability and use of individual chemicals 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 Leeks as well as current initiatives aimed at addressing identified pest management deficiencies.

Leek 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
Aphids				
Aphids	Paraffinic oil/ petroleum oil	**UN**		ST17000 project underway for Afidopyropen (Versys) Bulb vegetable crop group Label registration with BASF
	Pirimicarb	**1A**	JMPR Periodic re-evaluation 2020	
Mites				
Mites	Petroleum oil	**UN**		
Plant bugs and leaf hoppers				
Green vegetable bug	Petroleum oil	**UN**		
Grey cluster bug	Petroleum oil	**UN**		
Jassids/Leafhoppers	Petroleum oil	**UN**		
Rutherglen bugs	Petroleum oil	**UN**		
Grasshoppers and crickets				
Field crickets Mole crickets	Chlorpyrifos	**1B**	APVMA: Currently under review,outcome uncertain. Potential issues w.r.t. environmental loading and dietary exposure. EU: Proposed cancellation of use Canada – proposed cancellation of most uses. USA – EPA decision to allow continued use	

Problem	Active Constituents	Chemical Group	Comment	Activities
Thrips				
Onion thrips	Alpha-cypermethrin (PER14457)	**3A**	EU: Proposed restricted authorisation & Candidate for substitution	ST17000 Data generated for a minor use permit for MainMan (Flonicamid) for various thrips in Bulb vegetables. PER89185 issued 6-Aug-20
	Cyantraniliprole	**28**		
	Flonicamid	**9C**		
	Maldison (PER13653)	**1B**	APVMA – Under review – chemistry Codex: Re-evaluation scheduled for 2022/23	
	Spirotetramat	**23**		
Plague thrips	Spirotetramat	**23**		
Thrips	Petroleum oil	**UN**		
Western flower thrips	Flonicamid	**9C**		
	Spinetoram (PER13088)	**5**		
	Spirotetramat	**23**		
Other insect pests				
Onion fly	Diazinon (PER82551)	**1B**	EU – Deregistered JMPR Periodic re-evaluation 2020	
Vegetable leafminer	Abamectin (PER81876)	**6**		

Problem	Active Constituents	Chemical Group	Comment	Activities
DISEASES				
Black mould	Cyprodinil (PER80501)	**9**	Canada – Under review	
	Fludioxonil (PER80501)	**12**	EU – Under review	
Botrytis rot	Dimethomorph (PER14473)	**40**		
	Mancozeb (PER14473)	**M3**	APVMA – Previously nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
Botrytis grey mould	Cyprodinil (PER80501)	**9**	Canada – Under review	
	Fludioxonil (PER80501)	**12**	EU – Under review	
Downy mildew	Azoxystrobin	**11**		
	Copper	**M1**	EU: Candidate for substitution	
	Dimethomorph (PER14473)	**40**		
	Mancozeb (PER14473)	**M3**	APVMA – Previously nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
	Metalaxyl/metalaxyl-M	**4**		
	Fluopicolide	**43**		
	Oxathiapiprolin	**49**		
	Peroxyacetic acid	**M**		
	Phosphorous acid (PER13698)	**33**		
	Propamocarb	**28**		
Neck and bulb rot	Peroxyacetic acid	**M**		
Purple blotch	Chlorothalonil	**M5**	APVMA – Previously nominated for review Canada – Review recently completed; continued use considered acceptable Europe - Authorisation not renewed.	

Problem	Active Constituents	Chemical Group	Comment	Activities
Purple blotch	Copper	**M1**	EU: Candidate for substitution	
	Dimethomorph (PER14473)	**40**		
	Mancozeb	**M3**	APVMA – Previously nominated for review Canada – Under review Codex - To be reviewed 2022/23 EU: Proposed non-renewal of authorisation	
	Metalaxyl-M	**4**		
White rot	Azoxystrobin	**11**		ST16000 Data generation for a label registration – Luna Experience
	Triadimenol (PER14906)	**3**	APVMA - Nominated for review	
WEEDS				
Broadleaf weeds and grasses	Clethodim (PER82459)	**A**	Codex: MRLs proposed for deletion	
	Cyanazine (PER81271)	**C**	APVMA – Nominated for review Europe - Deregistered	
	Ethofumesate (PER81271)	**J**		
	Fluazifop-P (PER82556)	**A**		
	Ioxynil (PER84370)	**C**		
	Linuron (PER13367)	**C**	Europe - Deregistered	
	Methabenzthiazuron (PER14742)	**C**	Europe - Deregistered	
	Oxyfluorfen (PER81271)	**G**		
	Pendimethalin (PER81271)	**C**	EU: Review outcome uncertain	
	Propachlor (PER81271)	**K**	Europe - Deregistered	
	Simazine (PER81271)	**C**	APVMA – Nominated for review Europe - Deregistered	

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