Peppers

Strategic Agrichemical Review Process 2011-2014

HAL Projects - MT10029 & VG12081

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This report was funded by Horticulture Australia and the Australian vegetable industry to investigate the pest problem, agrichemical usage and pest management alternatives for the peppers industry across Australia. The information in this report will assist the industry with its agrichemical selection and usage into the future.

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1. Media Summary

A Strategic Agrichemical Review Process (SARP) through the process of a desktop audit and industry liaison assesses the importance of the diseases, insects and weeds (plant pests) that can affect a horticultural industry; evaluates the availability and effectiveness of fungicides, insecticides and herbicides (pesticides) to control the plant pests; determines any 'gaps' in the pest control strategy and 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.

SARP workshops for peppers were conducted in Queensland, South Australia, Victoria and Western Australia as part of combined vegetable meetings in 2008, 2010 and 2011. The results of the process provide the peppers industry (capsicum and chilli) with pesticide options for the future that the industry can pursue for registration with the manufacturer, or minor-use permits with the Australian Pesticides and Veterinary Medicines Association (APVMA).

DISEASE

Diseases identified as high priorities:

Disease (common name)	Disease (scientific name)
Bacterial spot	*Xanthomonas campestris pv. Vesicatoria*
Powdery mildew	*Leveillula taurica*
Base rot	*Sclerotium* spp.

Although a number of new chemicals have become available, either by registration or permit in recent years, there are gaps in control options for a number of key diseases. Growers would welcome the consideration of extension of registrations on tomatoes and/ or fruiting vegetables-cucurbits to peppers. This is particularly the case as peppers are considered a major crop group by the APVMA, making access to permits difficult.

NEMATODES

Nematodes identified as high priorities:

Nematode (common name)	Nematode (scientific name)
Root-knot nematodes	*Melodoigyne* spp.

INSECTS

Insects identified as high priorities:

Insect (common name)	Insect (scientific name)
Cutworms	*Agrotis* spp.
Eggfruit caterpillar	*Sceliodes cordalis*
Fruit flies - Queensland fruit fly Mediterranean fruit fly	*Bactrocera tryoni* *Ceratitis capitata*
Helicoverpa	*Helicoverpa* spp.
Mites - Two-spotted mite Tomato russet mite European red mite Rust mite	 *Tetranychus urticae* *Aculops lycopersici* *Panonychus ulmi* *Eriophyidae*
Western flower thrips	*Frankliniella occidentalis*

For some high priority pests, growers have reasonable options for developing a treatment schedule with alternation of products from different chemical groups. However for others there are limited options. Management of insect pests would be facilitated if insecticides approved for Helicoverpa could be extended to Lepidoptera more generally, and if insecticides approved for use in capsicums could be extended to peppers more broadly.

WEEDS

Weeds identified as high priorities:

Insect (common name)	Insect (scientific name)
Blackberry nightshade	*Solanum nigrum*
Pigweeds	*Portulaca* spp.
Marshmallow	*Malva parviflora*

Growers generally use a pre-plant weed control (general knockdown herbicides) to prepare the paddock for field-grown crops. Growers then either alternate the herbicides used or use them in combination for effective weed control. Other than trifluralin (permit) all the herbicides registered are either pre-emergent knockdown herbicides or grass selective post-emergent herbicides.

Most weeds can be controlled with currently available herbicides.

2. The Australian peppers industry (capsicum and chilli)

The Australian peppers industry (capsicum and chilli), is a growing, innovative, resourceful and dynamic horticultural industry. Consumption of peppers has risen in recent years. It was Australia's 8th largest vegetable crop in 2011. (Ausveg 2011)

Peppers are grown across Australia with the main growing regions being:

- Bowen / Burdekin (Qld)
- Bundaberg (Qld)
- Lockyer Valley (QLD)
- North Adelaide Plains (SA)
- Adelaide Hills (SA)
- Sunraysia (Vic & NSW)
- Goulburn Valley (Vic)
- Perth Metro outer areas (WA)
- Sydney Basin (NSW)

In 2011/12 Qld produced 69% of the national peppers crop and SA, WA, Vic and NSW each produced between 6 and 9%. Tasmania produced less than 2% of the national crop but achieved a yield of 171 kt/ha as opposed to the national yield of 19 kt/ha. (ABS 2013)

In 2011/12, the total capsicum production in Australia was estimated to be 36.6 kt grown by 451 growers. (ABS 2013) Chill production contributes around 10 % of the approximate 2,200 ha grown. (Ausveg 2011).

In 2007/08, 92.7% of capsicums were field grown; 7.3% of capsicums were protected cropping grown; 90+% of chilli were protected cropping grown. It is expected that a swing to protected cropping will be seen when more recent statistics are released. (Ausveg 2011)

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

In 2010/11 783 t was exported. New Zealand was the major destination (80%) with other destinations in the Pacific. Exports have fluctuated over the last four years, with an overall downward trend. (HAL, 2012)

Australian imports of capsicum are higher than imports. In 10/2011 we imported around 2 kt, with 99% coming from New Zealand. (HAL, 2012)

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 is not of sufficient size for agchem manufacturers 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 agchem companies unwilling to bear the initial high cost of registering suitable pesticides. As an added complication some horticultural crops may be grown in protected cropping or hydroponic situations. These can have a significant impact on pesticide performance and residue outcomes, further increasing product development requirements and registration costs.

Growers may at times be in a situation where they face severe losses from diseases, pests and weeds if they do nothing to protect their crops, or face penalties if they use a product that is not registered or available via a permit. The peppers industry is very aware of the possible consequences of the use of unregistered or non-permitted pesticides. These can include: produce with unauthorised pesticide residues; rejection at both local and export market levels; placing Australian export trading arrangements in jeopardy, and; fines and penalties.

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.

Pesticides have always been an important tool in the production of peppers. 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 utilized in seedling production, pre-plant, during plant establishment, through crop development and into crop maturity to maximise crop yield, quality and customer appeal.

From a pesticide access perspective, the APVMA classifies peppers, as a group, as a major crop. The crop fits within the APVMA crop group 012 Fruiting vegetables other than cucurbits.

As a consequence of the issues facing the peppers industry regarding pesticide access, Horticulture Australia Ltd and the vegetable industry undertook a review of the pesticide requirements in peppers via a Strategic Agrichemical Review Process (SARP). See Appendix 1 – the Strategic Agrichemical Review Process. The aim was to determine solutions (primarily pesticide) to current and future pest threats.

This SARP process identified diseases, insect pests and weeds of major concern to the industry. Against these threats available registered or permitted pesticides, along with non-pesticide solutions, were evaluated for overall suitability in terms of IPM, resistance, residues, withholding period, efficacy, trade, human safety and environmental issues. Where tools were unavailable or unsuitable the process aimed to identify potential future solutions.

This report is not a comprehensive assessment of all pests and control methods impacting on peppers production in Australia but attempts to prioritise the major problems.

3.2 Minor-use permits and registration

Peppers as a group are classified as major by the APVMA. Capsicums are considered as a major crop and chilli as a minor crop. Therefore access to minor-use permits can be relatively difficult for capsicum and relatively straight forward for chilli 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 available
- Current pesticides no longer work – resistance
- Current pesticides limiting trade
- IPM, environmental or operator issues
- Loss of pesticides due to removal from market
- New, effective pesticide registered in another crop
- Alternate pesticide has overseas registration or minor use permit

With each of these options, sound, scientific argument is required to justify any new registrations or permit applications.

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

3.3 Methods

The SARP was conducted in Queensland, South Australia and Victoria as part of combined vegetable meetings in 2008, 2010 and 2011. The meeting included leading growers, consultants, government agencies, agchem companies and agricultural reseller staff.

- Participants were given a comprehensive list of most major pests of peppers and asked to prioritise them into high, moderate and low categories.
- Participants were then asked to list the main pesticides and or other control agents used for each pest.
- Mostly pesticide trade names were used and the list provided was certainly not comprehensive but a starting point for further assessment.
- Pesticides that are under review by the Australian Pesticides and Veterinary Medicines Authority (AVPMA) were listed.
- Information was collated onto Excel spreadsheets for diseases, insects and weeds.
- The information was circulated to participants for any further comments to ensure the accuracy of the information.
- Each alternative pesticide was assessed for:
    - IPM compatibility
    - Improved scope for resistance management
    - Sound biological profile
    - Residue and trade acceptance domestically and for export

Final selections of proposed new pesticides for the industry to pursue were listed.

3.4 Results and Discussions

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

4. Pests and diseases of peppers

4.1 Diseases of Peppers

Common name	Scientific name
HIGH PRIORITY	
Bacterial spot	*Xanthomonas campestris pv. vesicatoria*
Powdery mildew	*Leveillula taurica*
Base rot	*Sclerotium* spp.
MODERATE PRIORITY	
Anthracnose	*Microdochium panattonianum*
LOW PRIORITY	
Bacterial leaf spot and canker	*Pseudomonas syringae pv. syringae, Clavibacter michiganensis* ssp. *michiganensis*
Damping off	*Pythium* spp., *Phytophthora* spp.
Downy Mildew	*Peronospora* spp.
Fusarium	*Fusarium* spp.
Grey mould	*Botrytis cinerea*
Irish (Late) blight	*Phytophthora infestans*
Sclerotinia	*Sclerotinia* spp.
Septoria	*Septoria* spp.
Target spot (Early blight)	*Alternaria solani*
Soft Rot	*Erwinia Carotovora*
Biosecurity risk	
Stem blight (NZ)	*Didymella* spp.
Potato spindle tuber viroid	*Potato spindle tuber viroid (Pospiviroidae)*
Tomato-potato psyllid infected with *Candidatus Liberibacter psyllaurous*	

4.1.1 High priority diseases

Bacterial spot (*Xanthomonas campestris* pv. *vesicatoria*)

Bacterial spot is a very common and destructive disease of peppers. This disease is present wherever tomato and peppers are grown.
On leaves, the spots are generally brown, circular, and water soaked. When conditions favour disease development, spots can form long, dark streaks. A general yellowing may also appear on foliage.
Bacterial spot affects all aboveground plant parts and fruit may become heavily infected. Fruit occasionally develop dark coloured scabs, often on the shoulders of the fruit.

- Bacterial spot is considered a major problem in Qld in wet weather, a moderate problem in SA and Vic and a minor problem in WA.
  - Most important and destructive foliar disease of capsicum and chilli.
  - Copper tank mixed with mancozeb has been shown to improve control of bacterial spot compared with copper alone. Alternatives to copper, including curative fungicides, are required by industry.

- Fungicides **registered / permitted** for the control of Bacterial spot in peppers:
  - Copper (various formulations, label and PER14038) – Group M1 protectant fungicide.
    - Commonly used.
    - Only provides protective fungicidal control.
    - Considered effective, but requires regular application.
    - SA & Qld - need curative options & alternative pesticides.
    - Minimal impact on most beneficial insects.

- **Potential** fungicides for the control of Bacterial spot in peppers:
  - Copper tolerance has been confirmed in Qld. It has been suggested that copper could be tank mixed with mancozeb for best results.

  - A copper formulation available in the US has a low concentration of Iron Chloride which acts as a synergist (similar to mancozeb) but without the negative on beneficials.

- **Alternate solutions for the control of Bacterial spot in peppers:**
  - Erosion control is important in the control of bacterial diseases as to prevent sandblasting of seedlings.
  - Bacteriaphages and antibiotics not implicated in animal resistance could improve bacterial disease management.
  - Plant defence activator chemicals (e.g. Bion)

Powdery mildew (*Leveillula taurica*)

Detecting Powdery mildew on peppers can be difficult. The white powdery growth characteristic of powdery mildew occurs only on the underside of leaves (see picture) and it will turn brown rather than remaining white. Diffuse yellow spotting often develops on the upper surface. Affected leaves tend to drop off the plant, as occurs with bacterial leaf spot.
Symptoms appear on older leaves first.
Powdery mildew can develop over a wide range of temperatures in low or high humidity conditions.

- Powdery mildew is considered a major problem in most states. However, since the time of the SARP meetings several fungicides from alternate chemical groups have become available. Therefore it is no longer a high priority disease for action.
  - Most serious foliar fungal disease in the dry tropics of Qld but incidence is increasing in Bundaberg. Dry climatic conditions are favourable for this disease. Powdery mildew has been a major constraint to producing quality capsicums in the Bowen/Burdekin and Bundaberg production districts. (Qld PMS 2008)
  - It has been found that sulphur based fungicides were ineffective in the control of this disease. Available products are alternated to minimise resistance risk.
  - Resistant varieties are being investigated.

- Fungicides **registered** for the control of Powdery mildew in peppers:
  - Hydrogen peroxide + peroxyacetic acid (PERATEC PLUS^) - Group M fungicide
    Maximum 5 sprays per crop
    1 day witholding period

  - Penthiopyrad (FONTELIS^) - Group 7 – residual, preventative and post-infection activity.
    - Broad spectrum
    - Growing use.
    - Resistance management tool
    -
  - Sulphur (various) – insecticide
    - High selectivity.
    - Only short term impact on beneficials.

- Tea tree oil (various) biological fungicide:
  - No reports of use from growers.

- Triadimenol (various) Group 3 systemic, protective and curative fungicide
  - Occasionally used.
  - Used as a protectant / curative fungicide.
  - It is reported as effective, especially in Queensland.
  - Growers expressed concern that with regular use and limited options that resistance may develop.
  - Minimal impact on most beneficial insects.

- Fungicides listed for control of Powdery mildew control in peppers via **permit**:

  - Bupirimate (NIMROD^) (PER10979, expires Sep 2014) Group 8 systemic, protective and curative fungicide
    - Occasionally used.
    - Used as a protectant / curative fungicide.
    - It is very effective, especially in Queensland.
    - Growers expressed concern that with regular use and limited options that resistance may develop.
    - Moderate impact on all beneficial insects.

  - Potassium bicarbonate (various) (PER13695, expires Aug 2017) Group M2 fungicide
    - For use in greenhouse crops only.
    - Occasionally used.
    - It is effective, but does not provide complete control in high pressure situations.
    - Minimal impact on most beneficial insects.

  - Trifloxystrobin (FLINT^) (PER14050, expires Jun 2023) Group 11 systemic, protective and curative fungicide
    - Permitted for use in protected cropping situations only
    - Occasionally used, used as a protectant fungicide.
    - It is very effective, especially in Queensland.
    - Growers expressed concern that with regular use and limited options that resistance may develop.
    - Minimal impact on most beneficial insects.

- **Potential** fungicides for the control of Powdery mildew in peppers are:
  - It has been suggested by growers that azoxystrobin would be a better fit in the program than trifloxystrobin. There are MRLs for tomato and fruiting vegetables – cucurbits, but not for peppers

Base rot (*Sclerotium* spp.)

Base rot is often misdiagnosed by growers as Sclerotinia.

Base rot is a soil-borne fungus that attacks at ground level. It appears as white threadlike growth that darkens over time. The plant may wilt and die rapidly. Sclerotia appear spherical and about 2 mm in diameter.
They are capable of infecting plants months or years later. High organic matter in the soil, temperatures 25-30°C, wetting and drying of the soil surface are all favourable for the development of this disease (McMaugh 1989).

- Base rot is considered a major-moderate problem in Qld.
- There are no fungicides **registered** or **permitted** for the control of Base rot in peppers.
- No fungicides were suggested by growers for permits or registration.
- Biological control and cultural techniques in combination with soil fumigation are the only current options for growers.

4.1.2 Biosecurity risk diseases

Stem blight (NZ) (*Didymella* spp.)

Stem blight is considered a high priority disease in New Zealand and therefore a potential biosecurity risk for Australia.

Potato spindle tuber viroid (Potato spindle tuber viroid (*Pospiviroidae*))

Industries affected: Wild gooseberry, tomatoes, capsicum, white potoato vine.
First detection was in September 2009 in Carnarvon WA. Since then it has also been found in SA and Qld. Response activities involved destroying all infected plants and implementing strict quarantine and hygiene measures. (Plant Health Australia 2012)

Tomato-potato psyllid infected with *Candidatus Liberibacter psyllaurous*

There is the risk of importation of infected tomato-potato psyllids from New Zealand. Risk reduction includes: a systems approach with pre- and post-harvest measures to ensure that fruit are not infested with tomato-potato psyllids; or application to fruit of a treatment known to be effective against all life stages of the psyllid (including but not limited to methyl bromide fumigation). (Biosecurity Australia, 2009).

4.1.3 Summary

High Priority Diseases and control options

Although a number of new chemicals have become available, either by registration or permit in recent years, there are gaps in control options for a number of key diseases. Growers would welcome the consideration of extension of registrations on tomatoes and/ or fruiting vegetables-cucurbits to peppers. This is particularly the case as peppers are considered a major crop group by the APVMA, making access to permits difficult.

Disease	Control option
Bacterial spot (*Xanthomonas campestris pv. vesicatoria*)	**Currently registered or permitted fungicides** Copper (various formulations, label and PER14038) – Group M1 protectant fungicide. **Fungicide gaps:** Curative fungicides, alternate fungicides **Potential fungicide solutions** Mancozeb mixed with copper Copper + Iron Chloride formulation (available in the USA) **Non-chemical options** - Farm hygiene and crop management measures - Investigation of bacteriophages - Plant defence activator chemicals
Powdery mildew (*Leveillula taurica*)	**Registered fungicides** - Hydrogen peroxide + peroxyacetic acid (PERATEC PLUS^) - Group M fungicide - Penthiopyrad (FONTELIS^) - Group 7 – residual, preventative and post-infection activity. - Sulphur (various) – insecticide - Tea tree oil (various) biological fungicide: - Triadimenol (various) Group 3 systemic, protective and curative fungicide. **Permitted fungicides** - Bupirimate (NIMROD^) (PER10979, expires Sep 2014) Group 8 systemic, protective and curative fungicide. - Potassium bicarbonate (various) (PER13695, expires Aug 2017) Group M2 fungicide. - Trifloxystrobin (FLINT^) (PER14050, expires Jun 2023) Group 11 systemic, protective and curative fungicide. **Fungicide Gaps:** Sufficient chemicals available now **Non-chemical options:** None identified

Disease	Control option
Base rot (*Sclerotium* spp.)	**Registered fungicides** Soil fumigants only **Permitted fungicides** None **Fungicide Gaps** Sufficient chemicals available now **Non-chemical options** Cultural control including crop rotation, biological controls

Currently available fungicides

Pest	Active	Crop	WHP, days	Chemical group
Alternaria Leaf Spots	Mancozeb		7	M3
Anthracnose	Chlorothalonil		1	M5
	Mancozeb		7	M3
Bacterial Canker	Copper		1	M1
Bacterial Spot	Copper (PER14038, expires Sep 2023)	Paprika, Chilli	1	1
Bactericide	Iodine		NR	-
Bean rust	Sulphur	Vegetables	NR	M2
Botryris – Grey mould	Captan (PER14326, expires Nov 2016)	Capsicums, Chilli Peppers - All Protected	7	M4
	Cyprodinil+Fludioxonil (SWITCH^) PER11564, expires Nov 2014)	Capsicum	7	9+12
	Chlorothalonil		1	M5
	Fenhexamid (PER12447, expires May 2016)	Peppers	1	17
	Penthiopyrad (FONTELIS^)	Fruiting vegetables	NR	7
	Pyrimethanil (PER12565, expires Sept 2017)	Capsicums (Protected)	3	9
Damping Off	Metalaxyl		7	4
Downy Mildew	Mancozeb		7	M3
	Metalaxyl-M + mancozeb (RIDOMIL GOLD MZ^) (PER12399, expires Sep 2016)	Field Grown Capsicums, Chillies & Paprika	14	4+M3
Fungi	Iodine		NR	Fungicide, Sanitiser
Late blight	Zineb		7	M3
Nematodes - Root-knot	oxamyl		NR	1A
Powdery Mildew	Bupirimate (NIMROD^) (PER10979, expires Sep 2014)	Peppers	1	8
	Hydrogen Peroxide+ Peroxyacetic Acid (PERATEC^ PLUS)	Peppers	1	M
	Penthiopyrad (FONTELIS^)	Fruiting vegetables	NR	7
	Potassium Bicarbonate (PER13695, expires Aug 2017)	Peppers	NR	_
	Sulphur	Vegetables	NR	M2
	Tea Tree Oil		NR	
	Triadimenol		1	3
	Trifloxystrobin (FLINT) (PER14050, expires Jun 2023)	Capsicums (Peppers)	3	11

Pest	Active		Crop	WHP, days	Chemical group
Sclerotinia rot	Cyprodinil+Fludioxonil (SWITCH^)	(PER11564, expires Nov 2014)	Capsicum	7	9+12
	Iprodione	(PER13656, expires Sep 2014)	Chillies, Paprika	7	2
	Procymidone	(PER11440, expires Jan 2015)	Peppers	9	2
Soil borne diseases incl *Fusarium, Verticillium* wilts, *Rhizoctonia, Pythium*	1,3-dichloropropene + chloropicrin			NR	_
Soil Fungus- Phytophthora	Metalaxyl			7	4
	Phosphorous acid	(PER11778, expires Nov 2015)	Capsicum	1	_
Target Spot (Early Blight)	Boscalid			14	7
	Mancozeb			14	M3
	Mancozeb + Copper			14	M1/M3
	Metiram			14	M3
	Metiram + Pyraclostrobin (AERO^)			28	11/M3
	Penthiopyrad (FONTELIS^)		Fruiting vegetables	NR	7
	Zineb			7	M3

(H)=Harvest
(G)= Grazing
NR= not required
*= do not graze or cut for stockfood
**Note that for some broad registrations the pests may not occur in leek

4.2 Nematodes of Peppers

Common name	Scientific name
PRIORITY	
Root-knot nematode	Melodoigyne spp.

4.2.1 Priority nematodes

Nematodes - including Root-knot (*Melodoigyne* spp.)

Plant-parasitic nematodes feed on plant roots by means of a stylet, a needle like mouthpart which is inserted into cells to remove cell contents. Root-knot nematodes (*Meloidogyne* sp.) are the most serious nematode parasites of peppers. Symptoms of root-knot nematode are characteristic of root damage: stunting, wilting, chlorosis, and reduced fruit yield and size. Symptoms can resemble drought or nutrient deficiencies. Plants fail to respond to fertilizer applications.

- Nematodes are considered a low priority in SA and a moderate priority in WA and Qld.
  - Common problem on sandy soils of central Qld.
  - Alternative products are required.
  - Nematodes more of an issue in crops grown on lighter, sandy soils e.g. Bundaberg region (Qld PMS 2008).

- Insecticides/nematicides registered for the control of nematodes in peppers are:
  - Oxamyl (various) Group 1A systemic insecticide;
    - Commonly used in some pockets of Qld.
    - Very effective.
    - Harmful to many beneficial insects.

If growers are planting in the same ground, they normally fumigating to manage a range of soil-borne diseases:

- 1,3-dichloropropene + chloropicrin (various products) fumigant
  - Restricted chemical
  - Broad vegetable claim for control of soil borne diseases as pre-plant treatment
  - Schedule 7 dangerous poison

- Metham sodium (METHAM^) Group 1A broad spectrum insecticide/biocide fumigant

- No insecticides are listed for nematode control in capsicums via permits.

4.3 Insects of Peppers

Common name	Scientific name
HIGH PRIORITY	
Cutworms	*Agrotis* spp.
Eggfruit caterpillar	*Sceliodes cordalis*
Fruit flies - Queensland fruit fly and Mediterranean fruit fly	*Bactrocera tryoni, Ceratitis capitata*
Helicoverpa	*Helicoverpa* spp.
Mites - including Two-spotted, Tomato russet, European red, Rust and Broad mite	*Tetranychus urticae, Aculops lycopersici, Panonychus ulmi, Eriophyidae, Polyphagotarsonemus latus (Banks)*
Western flower thrips	*Frankliniella occidentalis*
MODERATE PRIORITY	
Cluster caterpillar	*Spodoptera litura*
Green vegetable bug	*Nezara viridula*
Leafhoppers - including Jassids	*Cicadellidae*
Thrips - other than WFT	*Thysanoptera*
Whiteflies - including Silverleaf	*Aleyrodidae*
Green mirids	*Creontiades dilutus*
LOW PRIORITY	
Beetles	*Coleoptera*
Black field cricket	*Teleogryllus commodus*
Crickets - included Field and Mole	*Teleogryllus commodus, Gryllotalpa* spp.
Cucumber fly	*Bactrocera cucumis*
Grasshoppers	*Orthoptera*
Lace bugs	*Tingidae*
Leafminer (Potato moth)	*Phthorimaea operculella*
Looper caterpillars	*Chrysodeixis spp.*
Mealybugs	*Pseudococcidae*
Rutherglen bug	*Nysius vinitor*
Vegetable weevil	*Listroderes difficilis*
Biosecurity risk	
Sciarid Fly	*Bradysia* spp.
Potato psyllid	*Psyllidae* spp.

Opinions vary on the priority of the various insect pests. For example, some Qld growers consider **aphids** - including green peach aphid, to be an extremely high priority, capable of wiping out the entire crop in a region. A range of products are available, from different chemical groups, for management of aphids. These are listed in the table in the summary section.

Mealybug was nominated as a priority by some growers, causing deforming of flowers and fruit in. SA, VIC and WA. Buprofezin was suggested as a potentially efficacious chemical for control of the pest.

4.3.1 High priority insects

Cutworms (*Agrotis* spp.)

These caterpillars feed at night and stay in the soil during the day. Larvae are most likely to be found around the base of the plant (Qld DPI 1996). They may grow to 30-40 mm in length and 5 mm thick. Colour may vary (McMaugh 1989).

Damage can be seen by the chewing off of seedlings at ground level so that they collapse. With older plants, fruit near the ground may be holed but otherwise damage is confined to holes in the leaves.

- Cutworms are considered a high-moderate problem for the peppers industry in some regions.
  - Cutworms are mainly a problem to seedlings.
  - All insecticides used are old chemistry. Growers require new soft chemistry.

- Insecticides **registered** for the control of cutworm in peppers are:
  - Chlorpyrifos (various) Group 1B contact and systemic insecticide
    - Occasionally used.
    - Controlled other insect pests.
    - Moderately disruptive to disruptive to many beneficial insects.

  - Diazinon (various) Group 1B contact and systemic insecticide
    - Occasionally used.
    - Controlled other insect pests.
    - Moderately disruptive to disruptive to many beneficial insects.

  - Both these insecticides are under review by APVMA.

- No insecticides are listed for control of cutworm in peppers via **permit**.

Biological control agents, including fly and wasp parasites, disease organisms and predatory beetles, continually reduce cutworm numbers but do not give adequate control on their own..

Eggfruit caterpillar (*Sceliodes cordalis*)

Eggfruit caterpillar moths have yellowish-brown patterned wings with a 25 mm wingspan. Eggs are laid mainly on the calyx, hatch in 4-5 days at 25°C. Larvae tunnel into the fruit and remain there until emerging to pupate.

Eggfruit caterpillar is active all year in warm areas but has a winter diapause in cold climates. Larvae damage peppers by feeding in the fruit, making extensive tunnels that are usually filled with their excreta. Mature larvae leave a hole (3-4 mm diameter) as they exit the fruit to pupate. Damaged fruit will eventually break down and rot.

Cultural controls involve the removal of susceptible weeds such as thornapple and other *solonum* species and ploughing in of crop residues soon after harvest (Qld DPI 1996).

- Eggfruit caterpillars are a sporadic problem and are considered a low priority in SA, moderate in WA and a high-moderate priority in Qld.
  - Growers commented that insecticides generally not sprayed specifically for this pest. They are controlled with Helicoverpa sprays.

- No insecticides are **registered** for Eggfruit caterpillar control in peppers.

- No insecticides are listed for Eggfruit caterpillars control in peppers via **permit.**

Fruit fly

- including- Mediterranean fruit fly *(Ceratitis capitata)* and Queensland fruit fly *(Bactrocera tryoni*

The Mediterranean fruit fly (Medfly) originates from tropical Africa and is a major problem in South Australia and Western Australia. The Medfly grows to 3-5 mm long, slightly smaller than a housefly. The body is light brown and the wings are mottled with distinct brown bands.

The Medfly has a lifespan of 2-3 months and will generally stay in the same area for its lifetime as long as there is a readily available food source.

They can be active in all areas of Australia as long as the temperature does not fall below 12°C, if this occurs they can burrow into the soil and wait until temperatures increase. However they are most active in spring and summer when the weather is warmer and there is an abundance of food available.

The Queensland fruit fly (QFF) is the major fruit fly pest of Australia and is a little larger at about 8mm long. It is a native of Australia and a pest of the eastern states of Australia. QFF do not normally affect 'green' fruit, but has a wide host range. Eggs are laid under the skin, leading to gum exudates.
As with all fruit fly the most damage to fruit is caused by the larvae as they burrow through the fruit. Affected fruit are readily recognised since rots develop rapidly and the skin around the sting marks (the site the eggs are laid) becomes discoloured.

Fruit flies are considered a major and frequent pest of capsicums in Qld, a moderate problem in WA and a low problem in SA. It is a increasing pest of Vic and NSW.

- Replacements will be needed for dimethoate uses are under review - in crop use only allowed.
- HAL projects are generating data for dimethoate and other insecticides. Systems approach in the management of Queensland fruit fly is being practiced in Bowen-Gumlu.
- Active management required for Queensland fruit fly in regions - Bundaberg, Lockyer Valley, Stanthorpe but further north this pest is less of a concern and are only treated to meet export requirements. Fruit fly is a major export issue (Qld PMS 2008).
- The Gumlu-Bowen region barely has a fruit fly issue during the dry winter production window (Qld PMS 2008). Conditions are more favourable in the wetter area of south-east Qld where capsicums are produced in the warmer months (Qld DPI 1996).

- Insecticides **registered** for the control of fruit fly in peppers in-crop are:

  - Dimethoate (various) Group 1B contact and systemic insecticide
    - Has activity on Medfly and QFF.
    - Dimethoate is considered very effective when used pre-harvest as a foliar spray.
    - Dimethoate is regularly used in NSW and Qld. Less in other states.
    - Used in Vic for QFF outbreak only.
    - Harmful to many beneficial insects.
    - Used earlier in the season under low pressure.

  - Spinosad (various) Group 5- nerve poison insecticide
    - Controls all fruit fly.
    - Use in an 'attract and kill' system.
    - Occasionally used. Very effective.
    - Minimal impact on most beneficial insects.
    - Home garden registrations only

- Trichlorfon (various) Group 1B contact and residual insecticide
  - Registered for capsicum and chilli. Not for use in protected cropping.
  - Occasionally used.
  - Very effective.
  - Used as an in-crop foliar spray from first sting.
  - Has a 2 day WHP.
  - Used in outbreak in Vic.
  - Moderately disruptive to disruptive to many beneficial insects.

- Insecticides available for the control of fruit fly in peppers via **permit**:
  - Bifenthrin (various) (PER13567, expires May 2014, Qld only) Group 3A contact and systemic insecticide
    - Permit in capsicum as an in-crop cover spray, 1 day WHP.
    - For use in growing districts of Bowen and Gumlu Qld only.
    - Harmful to many beneficial insects.

  - Dimethoate (various) (PER13158, PER13254, expires Oct 2014) Group 1B contact and systemic insecticide
    - Permit in chilli as an in-crop cover spray, 7 day WHP.
    - Dimethoate is considered very effective when used pre-harvest as a foliar spray.
    - Dimethoate is regularly used in NSW and Qld. Less in other states.
    - Used in Vic for QFF outbreak only.
    - Harmful to many beneficial insects.

  - Fenthion (LEBAYCID^) (PER13860, expires Oct 2014) Group 1B contact and residual insecticide
    - Permit in capsicum (in-crop) and chilli (post harvest).
    - Moderately disruptive to disruptive to many beneficial insects.

  - Maldison (various) (PER13031, expires May 2014) Group 1B contact and systemic insecticide
    - Permit in capsicum as an in-crop cover spray, 3 day WHP.
    - Maldison is considered very effective when used pre-harvest as a foliar spray.
    - Maldison is regularly used in NSW and Qld. Less in other states.
    - Used in Vic for QFF outbreak only.
    - Moderately disruptive to disruptive to many beneficial insects.
    - Fits well IPM system only at low rate (25% of the normal rate) been low-moderate toxic to most of the beneficial insects. Good control for Mirids.

  - Methomyl (various) (PER13566, expires May 2014, Qld only) Group 1A contact and systemic insecticide
    - Permit in capsicum as an in-crop cover spray, 1 day WHP.
    - For use in growing districts of Bowen and Gumlu Qld only.
    - Harmful to many beneficial insects.

  - It is recommended that the existing products registered for 'capsicums' be pursued for registration in 'peppers' as to also include chillies and paprika.

Helicoverpa (*Helicoverpa armigera* and *Helicoverpa punctigera*)

This caterpillar varies greatly in appearance. They can reach lengths of 50 mm. It is generally initially pale green, sometimes with black dots, and a pattern of thin dark lines running along the body, the lines being darker around the second and third segments. Later the dark lines become less conspicuous, and the black spots develop red areas around them. All species of Helicoverpa have hairs protruding from each black (or white) dots.

Most obvious damage is caused by larvae that burrow directly into developing fruit causing holes in fruit to be unsaleable. Smaller larvae may cause pinprick holes which can act as entry points for disease. First stage larvae can damage flowers which decreases potential yield.

In terms of damage Helicoverpa are considered a high priority problem in Qld and WA and a moderate problem in SA. However as there are now a considerable number of options available they are not a high priority for action on new chemistry if IPM is utilised to keep resistance at bay.

- Many soft options are available
- Insecticide resistance especially in *Helicoverpa armigera,* has made this species a particularly difficult pest when insecticides are totally relied upon for control.

- Insecticides **registered** for Helicoverpa control in peppers:
  - Amorphous silica (ABRADE^) physical contact insecticide
    - Registered for Helicoverpa and cluster caterpillar on capsicums.
    - Control may be limited in high pressure situations.

  - *Bacillus Thuringiensis* subsp. *Kurstaki* (Btk) (various) Group 11C contact insecticide
    - Btk is commonly used.
    - Very effective on small grubs, but needs regular reapplication.
    - Minimal impact on all beneficial insects.

  - Chlorantraniliprole (CORAGEN^) Group 28 contact and systemic insecticide
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects.

  - Chlorantraniliprole + Thiamethoxam (DURIVO^) Group 4A + 28 contact and systemic insecticide
    - Commonly used as a seedling drench or soil drench for aphid control - also controls lepidoptera, whitefly and thrips.
    - Adds significantly to the cost of seedlings from nurseries.
    - Growers expressed concern that resistance may develop.
    - Moderately disruptive to some beneficial insects.- application timing important.
    - Compatible with IPM strategies.
    - Very effective treatment method.

  - Emamectin (various) Group 6 contact and systemic insecticide
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Growers want registration for all lepidoptera.
    - Moderately harmful to some beneficial insects.

  - Flubendiamide (BELT^) Group 28 contact and systemic insecticide
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects.

  - Helicoverpa NPV (various) biological insecticide
    - Commonly used.
    - Very effective on small grubs.
    - Minimal impact on all beneficial insects.

  - Indoxacarb (various) Group 22A contact and systemic insecticide
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Growers want registration for all lepidoptera.
    - Moderately disruptive to some beneficial insects.

  - Methomyl (various) Group 1A contact and systemic insecticide
    - Occasionally used in some regions.
    - Very effective on a range of pests, including thrips.
    - Moderately harmful to harmful to many beneficial insects.

  - Methoxyfenozide (PRODIGY^) Group 18 insect growth regulator
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects.

- Spinetoram (SUCCESS^ NEO) Group 5A contact and systemic insecticide
  - Commonly used in some regions.
  - Very effective on a range of pests, including thrips.
  - Moderately harmful to some beneficial insects.
  - Growers expressed concern that with a heavy reliance that resistance may develop.

- No insecticides are available for the control of Helicoverpa in peppers via **permit**.

Resistance to some insecticides is an important issue. Growers are trying to manage resistance with the selective use of insecticides and beneficial insects. Growers would like insecticides that are currently registered for use on Helicoverpa registered for all lepidoptera species.

It is recommended that the existing products registered for 'capsicums' be pursued for registration in 'peppers' as to also include chillies and paprika.

Mites

Including Two-spotted mite (*Tetranychus urticae*), Tomato russet mite (*Aculops lycopersici*), European red mite (*Panonychus ulmi*), Rust mite (*Eriophyidae*), Broad mite *Polyphagotarsonemus latus (Banks)*

Mites generally overwinter as adult females in protected places on the tree or in the litter, trash, and weeds on the orchard floor. The mites become active in early spring soon after trees leaf out and begin feeding on weeds or in the lower part of the trees. Mites generally favoured hot, dry conditions, and as the weather becomes warmer, they increase in numbers and move through the plant until the entire plant is infested.

Their feeding stimulates the production of distorted plant growth where they shelter and feed. Mites are frequent pest of foliage, flowers and fruit. Mites attack new leaves causing a felt-like growth to be produced on the under-surface. This forms as small blisters but may eventually cover the entire leaf, causing it to curl. In severe cases, whole shoots may be deformed. There can also be a problem if the mite moves from leaves onto the developing flowers and fruit. Fruit set can be disrupted or the fruit deformed. Such fruit are unmarketable.

- Two-spotted mites are considered a major and sporadic pest of Qld, Vic, NSW and SA. Other mites are less of a problem, although broad mite has increased in importance in recent years in the warmer parts of Australia.

- Insecticides **registered** for the control of mites in peppers are:

  - Abamectin (various) Group 6 contact and systemic insecticide
    - Registered in capsicum.
    - Commonly used in Vic, SA, NSW and Qld.
    - Opinion varies on efficacy
    - Resistance reported throughout Australia in controlling WFT.
    - Moderately harmful to some beneficial insects.

  - Botanical oil (various) – oil contact insecticide
    - Registered in capsicum only.
    - Oils are regularly used.
    - Qld & WA - effective on low populations.
    - Also controls other pests.
    - Risk of burning and stunting plant in hot and humid weather.
    - Moderately disruptive to some beneficial insects.

  - Dimethoate (various) Group 1B contact residual and systemic insecticide.
    - Registered in capsicum only.
    - Occasionally used in some areas in-crop.
    - Controls a range of pests.
    - Harmful to many beneficial insects.

- Etoxazole (various) Group 10B contact and systemic insecticide
    - Registered in capsicum only.
    - Commonly used in Vic and Qld.
    - Effective and inexpensive.
    - Disruptive to some beneficial insects with up to 36 days residual.

- Potassium salts of fatty acids (various) contact biological insecticide
    - Registered in vegetables.
    - Occasionally used.
    - Very effective. Also controls some other pests.
    - Minimal impact on most beneficial insects.

- Milbemectin (various) Group 6 contact/systemic insecticide
    - Registered in capsicum only.
    - Similar to abamectin. Poor efficacy.
    - Not reported to be used.
    - Moderately disruptive to some beneficial insects.

- Paraffinic oil / petroleum oil (various) contact insecticide
    - Registered in peppers.
    - Occasionally used.
    - SA, Qld & WA - effective on low populations.
    - Issues in hot/humid weather - phytotoxicity.
    - Also controls other pests.
    - Moderately disruptive to some beneficial insects.

- Propargite (various) Group 12C contact/systemic insecticide
    - Registered in vegetables.
    - Occasionally used.
    - Very effective.
    - Moderately disruptive to some beneficial insects.
    - 21 day re-entry period

- Insecticides available for the control of mites in peppers via **permit**:

    - Bifenazate (various) (PER12906, expires Mar 2018) Group 2D contact and systemic insecticide
        - Permit in capsicum only for Two-spotted mites.
        - Commonly used.
        - Effective but expensive.
        - Minimal impact on most beneficial insects.
        - This should get a registration for caps. Most important miticide for IPM.

    - Bifenthrin (various) (PER12906, expires Mar 2018) Group 3A contact and systemic insecticide
        - Permit in peppers for Two-spotted mites.
        - Occasionally used in some regions.
        - Mixed reports on efficacy.
        - Moderately disruptive to disruptive to many beneficial insects.

    - Phorate (various) (PER8930, expires Jul 2017) Group 1B contact and systemic insecticide
        - Permit in peppers for mites. Controls many pests.
        - Rarely used.
        - Very effective.
        - Disruptive to many beneficial insects.

NOTE: In most regions miticides are applied 1-2 times per season. Growers alternate between insecticides to minimise the risk of resistance developing and rely on predatory mites and beneficial insects.

Although there are other possible miticide options for use to control mites in peppers, some of these products have been used for many years and there are reports of resistance. Therefore the future of these products in the medium to long term is questionable.

It is recommended that the existing products registered for 'capsicums' be pursued for registration in 'peppers' as to also include chillies and paprika.

- Potential insecticides for the control of mites in peppers:

Western flower thrips (*Frankliniella occidentalis*)

The adults are tiny insects, generally measuring only 1 to 2 mm in length. They have thin bodies and vary in colour from near black to straw coloured.

While thrips can cause direct damage to foliage and fruit, their role as vectors of tomato spotted wilt is of primary concern, especially in tomato and pepper.
They are weak fliers but are capable of infesting large areas of crop as they are easily blown by wind.

They cause most damage by discolouring, scaring and deforming leaves and fruit as they feed. WFT can cause damage to fruit at all stages of maturity. They are fast breeders when the weather is warm but not too hot and are capable of producing 12-15 generations per year with optimal conditions. Females live for up to 90 days and are capable of reproducing after approx 15-20 days.

- Western flower thrips are considered a major-moderate problem Vic, NSW and WA and a moderate problem in Queensland.
  - All insecticides used in alternation due to rapid resistance development to many commonly used insecticides.
  - Potential for increase in incidence due to limited insecticides.
  - Growers find it difficult to distinguish difference between thrips species with the naked eye due to their very small size.
  - WFT develop resistance more easily than other thrips species.
  - Growers need several new 'soft' options and biological control.
  - Growers want registrations to cover 'peppers'.

- Insecticides **registered** for the control of Western flower thrips in peppers:

  - Chlorantraniliprole + Thiamethoxam (DURIVO^) Group 4A + 28 contact and systemic insecticide.
    - Commonly used as a seedling drench or soil drench for aphid control - also controls lepidoptera, whitefly and thrips.
    - Adds significantly to the cost of seedlings from nurseries.
    - Growers expressed concern that with regular use that resistance may develop.
    - Moderately disruptive to some beneficial insects.- application timing important.
    - Compatible with IPM strategies.
    - Very effective treatment method.
    -
  - Spinetoram (SUCCESS^ NEO) Group 5A contact and systemic insecticide
    - Commonly used in some regions.
    - Good efficacy although resistance reported in most parts of Australia.
    - Used for a range of pests, including helicoverpa.
    - Moderately disruptive to some beneficial insects.
    - Reports of resistance in most growing regions.
    - Used for Lepidoptera and WFT.

  - Spirotetramat (MOVENTO^) – Group 23 contact and systemic insecticide
    - Broad spectrum insecticide
    - IPM compatible.

- Insecticides are **registered** for the control of thrips in peppers:

  - Dimethoate (dimethoate) – Group 1B contact/systemic insecticide.
    - Will be ineffective against Western flower thrips due to resistance.

- Paraffinic oil, petroleum oil (various) – contact insecticide
  - Occasionally used, considered very effective.
  - Issues in hot/humid weather - phytotoxicity.
  - Also controls other pests.
  - Moderately harmful to some beneficial insects.

- Potassium salts (various) – contact biological insecticide
  - Occasionally used.
  - Very effective. Also controls some other pests.
  - Minimal impact on all beneficial insects.

- Pyrethrins+piperonyl butoxide (various) – Group 3A contact insecticide
  - Good knockdown.
  - Harmful to beneficials.

- Insecticides listed for control of Western flower thrips in peppers via **permit**:

  - Acephate (various products) (PER12378, expires Oct 2015) Group 1B contact/systemic insecticide
    - Rarely used.
    - Can be very effective but there are reports of resistance.
    - Disruptive to many beneficial insects.

  - Phorate (various) (PER8930, expires Jul 2017) - Group 1B contact/systemic insecticide
    - Permit in peppers for thrips. Controls many pests.
    - Rarely used.
    - Very effective.
    - Disruptive to many beneficial insects.

- **Potential** insecticides for control of Western flower thrips in peppers:
  - Sulfoxaflor (TRANSFORM^) – Group 4C insecticide
    - Thrips registrations in a range of vegetables
    - May have adverse effects on parasitic wasps in IPM situations.

4.3.2 Biosecurity risk insects

The following insects are currently found in peppers in New Zealand and pose a potential threat to the Australian pepper industry:

Sciarid Fly (*Bradysia* spp.) – Medium priority in NZ

Potato psyllid (*Psyllidae* spp.) – Low priority in NZ

4.3.3 Summary

High Priority Insects and control options

For some high priority pests growers have reasonable options for developing a treatment schedule with alternation of products from different chemical groups. However for others there are limited options. Management of insect pests would be facilitated if insecticides approved for Helicoverpa could be extended to Lepidoptera more generally, and if insecticides approved for use in capsicums could be extended to peppers more broadly.

Insect	Control option
Cutworms (*Agrotis* spp.)	**Currently registered insecticides** - Chlorpyrifos (various) Group 1B contact and systemic insecticide - Diazinon (various) Group 1B contact and systemic insecticide **Currently permitted insecticides:** None **Insecticide Gaps:** Alternates with good IPM fit. **Potential insecticide solutions:** None suggested **Non-chemical options:** Biological control agents, including fly and wasp parasites, disease organisms and predatory beetles
Eggfruit caterpillar (*Sceliodes cordalis*)	**Currently registered or permitted insecticides:** None **Potential insecticide solutions:** Products used to control Helicoverpa **Non-chemical options:** Cultural controls, including removal of weed hosts
Fruit fly	**Currently registered insecticides** - Dimethoate (various) Group 1B contact and systemic insecticide - Spinosad (various) Group 5- nerve poison insecticide - Trichlorfon (various) Group 1B contact and residual insecticide **Currently permitted insecticides** - Bifenthrin (various) (PER13567, expires May 2014, Qld only) Group 3A contact and systemic insecticide - Dimethoate (various) (PER13158, PER13254, expires Oct 2014) Group 1B contact and systemic insecticide - Fenthion (LEBAYCID^) (PER13860, expires Oct 2014) Group 1B contact and residual insecticide - Maldison (various) (PER13031, expires May 2014) Group 1B contact and systemic insecticide - Methomyl (various) (PER13566, expires May 2014, Qld only) Group 1A contact and systemic insecticide **Insecticide Gaps:** Approvals in the minor crops **Potential insecticide solutions** Conversion of permits to registrations Extension of registered or permitted options in sections of the peppers group to the entire crop group **Non-chemical options** IPM strategies including monitoring to allow targeted pesticide treatments
Helicoverpa (*Helicoverpa armigera* and *Helicoverpa punctigera*)	**Currently registered insecticides** - Amorphous silica (ABRADE^) physical contact insecticide - *Bacillus Thuringiensis* subsp. *Kurstaki* (various) Group 11C contact insecticide - Chlorantraniliprole (CORAGEN^) Group 28 contact and systemic insecticide - Chlorantraniliprole + Thiamethoxam (DURIVO^) Group 4A + 28 contact and systemic insecticide - Emamectin (various) Group 6 contact and systemic insecticide - Flubendiamide (BELT^) Group 28 contact and systemic insecticide - Helicoverpa NPV (various) biological insecticide - Indoxacarb (various) Group 22A contact and systemic insecticide - Methomyl (various) Group 1A contact and systemic insecticide - Methoxyfenozide (PRODIGY^) Group 18 insect growth regulator - Spinetoram (SUCCESS^ NEO) Group 5A contact and systemic insecticide **Currently permitted insecticides:** None **Insecticide Gaps:** None at this stage. Currently available options need to be managed to avoid resistance. **Non-chemical options:** Biological control agents, IPM techniques

Insect	Control option
Mites	**Currently registered insecticides** - Abamectin (various) Group 6 contact and systemic insecticide - Botanical oil (various) – oil contact insecticide - Dimethoate (various) Group 1B contact residual and systemic insecticide. - Etoxazole (various) Group 10B contact and systemic insecticide - Potassium salts of fatty acids (various) contact biological insecticide - Milbemectin (various) Group 6 contact/systemic insecticide - Paraffinic oil / petroleum oil (various) contact insecticide - Propargite (various) Group 12C contact/systemic insecticide **Currently permitted insecticides** - Bifenazate (various) (PER12906, expires Mar 2018) Group 2D contact and systemic insecticide - Bifenthrin (various) (PER12906, expires Mar 2018) Group 3A contact and systemic insecticide - Phorate (various) (PER8930, expires Jul 2017) Group 1B contact and systemic insecticide **Insecticide Gaps** Alternates with good IPM fit. **Potential insecticide solutions** None suggested by growers **Non-chemical options** Biological control agents, including fly and wasp parasites, disease organisms and predatory beetles
Western flower thrips (*Frankliniella occidentalis*)	**Currently registered insecticides - WFT** - Chlorantraniliprole + Thiamethoxam (DURIVO^) Group 4A + 28 contact and systemic insecticide. - Spinetoram (SUCCESS^ NEO) Group 5A contact and systemic insecticide **Currently registered insecticides – General thrips registration** - Dimethoate (dimethoate) – Group 1B contact/systemic insecticide. - Paraffinic oil, petroleum oil (various) – contact insecticide - Potassium salts (various) – contact biological insecticide - Pyrethrins+piperonyl butoxide (various) – Group 3A contact insecticide **Currently permitted insecticides** - Acephate (various products) (PER12378, expires Oct 2015) Group 1B contact/systemic insecticide. - Phorate (various) (PER8930, expires Jul 2017) - Group 1B contact/systemic insecticide. **Insecticide Gaps** - Alternates with good IPM fit. There are resistance concerns with much of the current chemistry. - Extension of approvals in sections of the peppers group to the group more broadly. **Potential insecticide solutions** Sulfoxaflor (TRANSFORM^) – Group 4C insecticide **Non-chemical options** Biological control agents IPM strategies

Currently available insecticides

Pest	Active	Crop	WHP, days	Chemical group
Ants	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Aphid - Green Peach	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Imidacloprid		7	4A
	Methamidophos	No longer available	14	1B
	Spirotetramat (MOVENTO^)	Peppers	1	23
	Sulfoxaflor (TRANSFORM^)	Fruiting vegetables	1	4C
Aphids	Botanical Oil		NR	Insecticide
	Dimethoate	Capsicums, Chilli, Peppers	7	1B
	Paraffinic Oil, petroleum oil	Peppers, capsicums	1	Oil
	Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	70	1B
	Pirimicarb (PER14144, expires Mar 2016)	Peppers, Chilli	2	1A
	Potassium Salts Of Fatty Acids		Nr	
	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Armyworm	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11
Bugs	Dimethoate	Capsicums, Chilli, Peppers	7	1B
Cabbage Moth	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11
	Trichlorfon	Vegetables	2	1B
Cabbage White Butterfly	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11
	Trichlorfon	Vegetables	2	1B
Caterpillar - Cluster	Amorphous Silica		NR	
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Methomyl (PER13395, expires Sep 2014)	Chilli Peppers	3d	1A
	Methoxyfenozide	Peppers (capsicum, chilli) Field label, protected PER12391)	NR	18
Caterpillars	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Cricket - Black Field	Chlorpyrifos		NR	1B
Cricket - Mole	Chlorpyrifos		NR	1B
Crickets - Field	Chlorpyrifos		NR	1B
Cucumber Fly	Dimethoate	Capsicum (NSW, WA only)	3	1B
	Maldison	(PER13031, expires May 2014)	3	1B
Cucumber Moth	Methomyl (PER13395, expires Sep 2014)	Chilli Peppers NOT Protected Cropping	3d	1A
Cutworms	Chlorpyrifos		0	1B
	Diazinon		14	1B
Fruit Fly	Bifenthrin (PER13567, expires May 2014, Qld only)	Capsicums	1	3A
	Dimethoate	Capsicum (NSW, WA only)	3	1B
	Dimethoate (PER13158, expires Oct 2014)	Hot Chilli Peppers	NR	1B
	Dimethoate (PER13254, expires Oct 2014)	Chilli Peppers	7	1B
	Fenthion (PER13860, expires Oct 2014)	Chilli Peppers	7	1B
	Maldison (PER13031, expires May 2014)	Capsicums (Protected And Field)	3(H), 3(G)	1B
	Methomyl (PER13566, expires May 2014, Qld only)	Capsicums	1	1A
	Methyl bromide (PER10145, PER11092, expires Oct 2014, Tas only, not persons generally)	Fruit, Fruiting Vegetables (Not Persons Generally)	3	8A
	Trichlorfon	Capsicum, chilli		

Pest	Active	Crop	WHP, days	Chemical group
Fungas Gnats	*Bacillus thuringiensis* subs. *Israelensis* Serotype H14 (VECTOBAC WG) (PER11472, expires May 2014)	Protected - Capsicums	NR	11
Grasshopper - Wingless	Chlorpyrifos		NR	1B
	Dimethoate	Capsicums, Chilli, Peppers	7	1B
Green Vegetable Bug	Dimethoate	Capsicums, Chilli, Peppers	3	1B
	Trichlorfon	Vegetables	2	1B
Helicoverpa	Flubendiamide (BELT^)		1	28
	Indoxacarb		3	22A
	Methomyl (PER13395, expires Sep 2014)	Chillie Peppers	3d	1A
	Spinetoram (SUCCESS NEO^)	Fruiting vegetables	1	5
Helicoverpa armigera (Corn Earworm / Cotton Bollworm)	Helicoverpa NPV		NR	
	Bacillus thuringiensis subsp. *kurstaki*	Vegetables	NR	11
	Chlorantraniliprole (CORAGEN^)	Vegetables	3	28
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
Helicoverpa punctigera (Native Budworm)	Amorphous Silica		NR	
	Bacillus thuringiensis subsp. *kurstaki*	Vegetables	NR	11
	Chlorantraniliprole (CORAGEN^)	Vegetables	3	28
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Emamectin		3	6
	Helicoverpa NPV		NR	
	Methamidophos – no longer available		14	1B
	Methomyl		1	1A
	Methoxyfenozide	Peppers (capsicum, chilli) Field label, protected PER12391)	NR	18
Jassids	Dimethoate	Capsicums, Chilli, Peppers	3	1B
	Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	70	1B
Leaf hoppers	Dimethoate	Capsicums, Chilli, Peppers	NR	1B
	Paraffinic Oil, petroleum oil	Peppers, capsicums	1	Insecticide
	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Leafminer (Potato Moth)	Flubendiamide (BELT^)		1	28
	Indoxacarb		3	22A
	Methamidophos	No longer available	14	1B
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Spinetoram (SUCCESS NEO^)	Fruiting vegetables	1	5
	Chlorantraniliprole (CORAGEN^)	Vegetables	3	28
Lightbrown Apple Moth	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11
Locust - Australian Plague	Carbaryl			1A/1B
	Chlorpyrifos			1A/1B
	Diazinon			1A/1B
	Maldison			1A/1B
Loopers	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11

Pest	Active	Crop	WHP, days	Chemical group
Mealybugs	Potassium Salts Of Fatty Acids		NR	
Mites	Dimethoate	Capsicums, Chilli, Peppers	7	1B
	Paraffinic Oil, petroleum oil	Peppers, capsicums	1	Oil
	Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	70	1B
Mite-Blue Oat	Bifenthrin (PER12947, expires Apr 2015)	Chilli Peppers, Paprika	NR(H) 28(G)	3A
Mite - Two-Spotted (Red Spider)	Abamectin		3	6A
	Bifenazate (PER12906, expires Mar 2018)	Peppers	1(H), *(G)	UN
	Bifenthrin (PER12947, expires Apr 2015)	Peppers (Sweet & Chilli)	NR(H) , 28(G)	3A
	Botanical Oil		NR	Oil
	Etoxazole		7	10b
	Milbemectin		1	6
	Potassium Salts Of Fatty Acids		NR	
	Propargite	Vegetables (21 day re-entry)	7	12C
Onion Maggot	Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	70	1B
Plant parasitic nematodes	1,3-Dichloropropene + Chloropicrin	Vegetables	NR	8B
Rutherglen Bug	Methidathion		7	1B
	Methidathion (PER14047, expires Jun 2018	Peppers (Capsicums, Chillies, Paprika)	7	1B
	Trichlorfon	Vegetables	2	1B
Symphylans (garden centipedes)	1,3-Dichloropropene + Chloropicrin	Vegetables	NR	8B
Thrips	Dimethoate	Capsicums, Chilli, Peppers	3	1B
	Methyl bromide (PER10145, PER11092, expires Oct 2014, Tas only, not persons generally)	Food Producing Plants (Not Persons Generally)	3	8A
	Paraffinic Oil, petroleum oil	Peppers, capsicums	1	Oil
	Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	70	1B
	Potassium Salts Of Fatty Acids		Nr	
	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Thrips - Tomato	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
Thrips - Western Flower	Acephate (PER12378, expires Oct 2015)	Peppers	3d	1B
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Ethyl Formate		NR	8a
	Methidathion		7	1B
	Spinetoram (SUCCESS NEO^)	Fruiting vegetables	1	5
	Spirotetramat (MOVENTO^)	Peppers	1	23
Tomato Grub	Emamectin As Benzoate		3	6
	Methoxyfenozide	Peppers (capsicum, chilli) Field label, protected PER12391)	NR	18
Vine Moth	*Bacillus thuringiensis* subsp. *kurstaki*	Vegetables	NR	11
Weevil - Vegetable	Chlorpyrifos		NR	1B
	Potassium Salts Of Fatty Acids		Nr	

Pest	Active	Crop	WHP, days	Chemical group
Whiteflies	Pyrethrins+Piperonyl Butoxide	Vegetables	1	3A
Whitefly - Cotton (Sweet Potato)	Imidacloprid		NR	4A
Whitefly-Greenhouse	Bifenthrin (PER12947, expires Apr 2015)	Peppers (Sweet & Chilli)	NR(H) 28(G)	3A
	Botanical Oil		NR	Oil
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Potassium (PER13920, expires Mar 2018)	Capsicums (Protected)	NR	_
	Petroleum (PER12221, expires Nov 2017)	Peppers Including Capsicum, Chilli And Paprika	1	_
	Pyriproxyfen		1	7C
	Sulfoxaflor (TRANSFORM^)	Fruiting vegetables	1	4C
Whitefly-Silverleaf	Bifenthrin (PER12947, expires Apr 2015)	Peppers (Sweet And Chilli)	1	3A
	Botanical Oil		NR	Oil
	Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting vegetables	NR	4A28
	Emulsifiable botanical oils (PER14077, expires Sep 2023)	Capsicums (Greenhouse And Hydroponic)	NR	_
	Imidacloprid		NR	4A
	Paraffinic Oil	Capsicums	1	Oil
	Potassium (PER13920, expires Mar 2018)	Capsicums (Protected)	NR	_
	Pyriproxyfen		1	7C
	Spirotetramat (MOVENTO^)	Peppers	1	23
Whitefly-*Bemisia Tabaci* Species (Sweet Potato Whitefly, Silverleaf Whitefly B Biotype And Whitefly Q Biotype)	Petroleum (PER12221, expires Nov 2017)	Peppers Including Capsicum, Chilli And Paprika	1	_
Wireworms	1,3-Dichloropropene + Chloropicrin	Vegetables	NR	8B

(H)=Harvest
(G)= Grazing
NR= not required
*= do not graze or cut for stockfood
**Note that for some broad registrations the pests may not occur in leek

4.4 Weeds of peppers

- **Registered** herbicides that are used in peppers are:
  - Fluazifop-P as butyl (various) – Group A grass selective post-emergent herbicide Commonly used.
    - Considered efficacious although there are some issues with resistant ryegrass not being control in some areas.
    - It is used to spot spray grass weeds such as couch grass post-emergent.
    - Controls most grass weeds.
  - Glyphosate (various) – Group M pre-plant general knockdown herbicide
    - Commonly used.
    - Works well as a pre-crop spray.
  - Paraquat + diquat (various) - Group L pre-plant general knockdown herbicide
    - Occasionally used.
    - Works well as a pre-crop spray
- Herbicides listed for control of weeds in peppers via **permit**:
  - Clethodim (various) (PER13397, expires Dec 2016) Group A grass selective post-emergent herbicide
    - For use in chilli and paprika.
    - Commonly used.
    - Considered very effective.
    - It is used to spot spray grass weeds such as couch grass post-emergent. Some issues with resistant ryegrass not being control in some areas.
    - Controls most grass weeds. Does not control Winter grass (Poa annum).
  - Glyphosate (various) (PER13901, expires Jun 2019) Group M pre-plant general knockdown herbicide
    - For use in capsicum.
    - Occasionally used as an inter-row spray with shielded nozzles.
    - Works well.
  - trifluralin (various) (PER12823, expires Jun 2021) Group D residual pre-emergent herbicide
    - For use in peppers.
    - Occasionally used as a pre-planting (also under plastic mulch) to control annual broadleaf weeds. Some varieties are sensitive - yellowing.
    - Considered very effective.
    - Controls many weeds.

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. Other than trifluralin (permit) all the herbicides registered are either pre-emergent knockdown herbicides or grass selective post-emergent herbicides.

Most weeds can be controlled with currently available herbicides.

Weeds identified as high priorities:

Insect (common name)	Insect (scientific name)
Blackberry nightshade	*Solanum nigrum*
Pigweeds	*Portulaca* spp.
Marshmallow	*Malva parviflora*

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Images: Google images

APVMA ……..	Australian Pesticides and Veterinary Medicines Authority
DPI …….	Department of Primary Industries
HAL ……	Horticulture Australia Ltd
IPM ……	Integrated pest management
IR-4 ……	Interregional Research Program 4 (USA)
MRL ……	Maximum residue limit (mg/kg or ppm)
Plant pests …..	Diseases, insects, nematodes, viruses, weeds, etc
Pesticides …...	Plant protection products (fungicide, insecticide, herbicide, nematicides, etc).
SARP …….	Strategic Agrichemical Review Process
WHP ……	Withholding period

Australian states and territories: NSW (New South Wales), NT (Northern Territory), Qld (Queensland), SA (South Australia), Tas (Tasmania), Vic (Victoria), WA (Western Australia)

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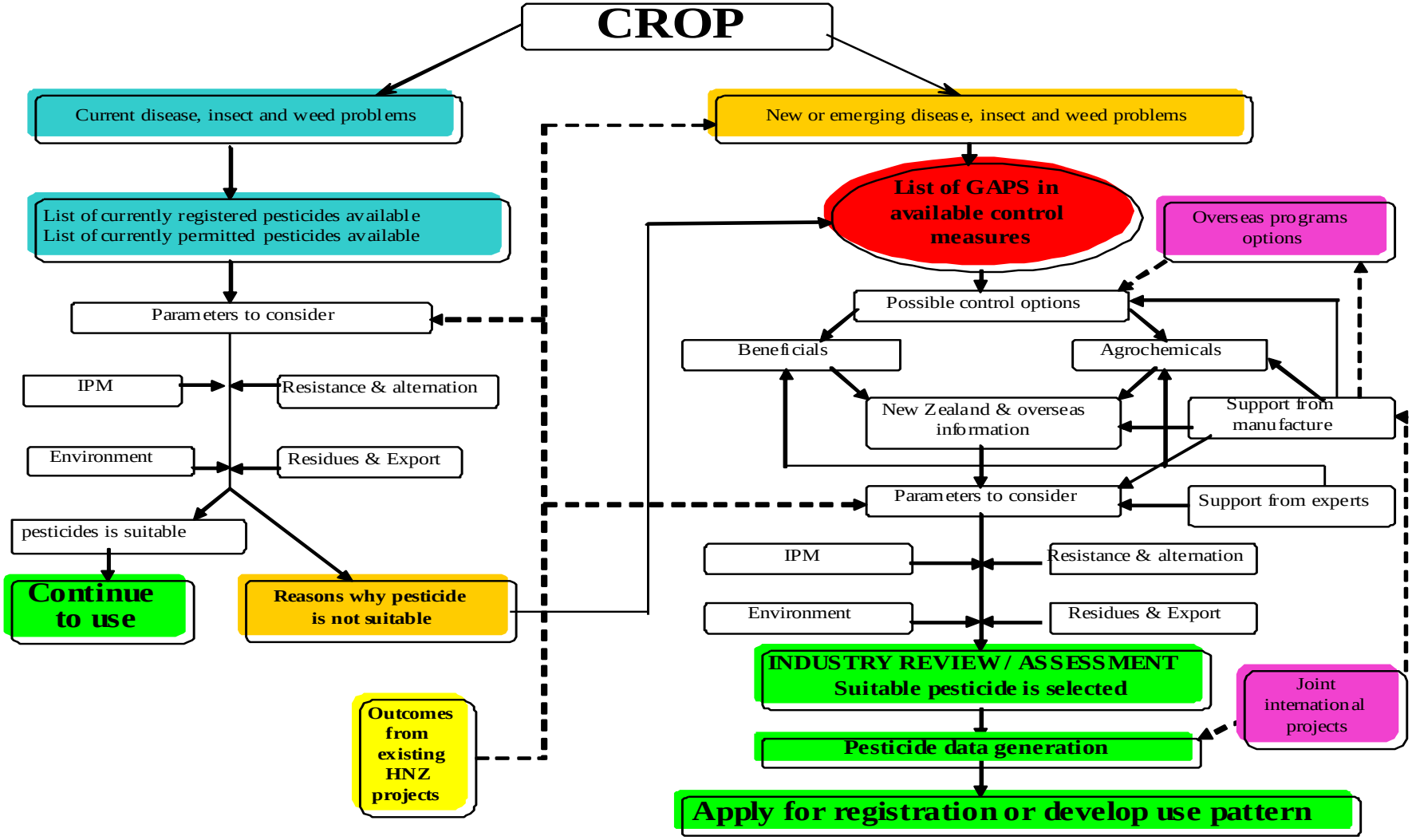
^Trademark

6. Appendices

DIAGRAM 1: The Strategic Agrichemical Review Process



Appendix 2 – currently available fungicides in peppers.

Active	Crop	Pest	WHP, days	Chemical group
1,3-dichloropropene + chloropicrin		Soil borne diseases incl Fusarium, Verticillium wilts, Rhizoctonia, Pythium	NR	_
Boscalid		Target Spot (Early Blight)	14	7
Bupirimate (NIMROD^) (PER10979, exp Sep 2014)	Peppers (Capsicum, Chillies, Paprika)	Powdery Mildew	1	8
Captan (PER14326, expires Nov 2016)	Capsicums, Chilli Peppers - All Protected	Botrytis - Grey Mould	7	M4
Chlorothalonil		Anthracnose	1	M5
		Botrytis - Grey Mould	1	M5
Copper		Bacterial Canker	1	M1
(PER14038, expires Sep 2023)	Paprika, Chilli	Bacterial Spot	1	1
Cyprodinil+Fludioxonil (SWITCH^) PER11564, exp Nov 2014)	Capsicum	Botrytis rots	7	9+12
		Sclerotinia rot	7	9+12
Fenhexamid (PER12447, exp May 2016)	Peppers	Botrytis- Grey Mould	3	17
Hydrogen Peroxide+ Peroxyacetic Acid (PERATEC^ PLUS)	Peppers	Powdery mildew	1	M
Iodine		Bactericide	NR	
		Fungi	NR	
Iprodione (PER13656, expires Sep 2014)	Chillies, Paprika	Sclerotinia	7	2
	Capsicum		7	2
Mancozeb		Alternaria Leaf Spots	7	M3
		Anthracnose	7	M3
		Downy Mildew	7	M3
		Target Spot (Early Blight)	14	M3
Mancozeb + Copper		Target Spot (Early Blight)	14	M1/M3
Metalaxyl		Damping Off	7	4
		Phytophthora Soil Fungus	7	4
Metalaxyl-M + mancozeb (RIDOMIL GOLD MZ^) (PER12399, expires Sep 2016)	Field Grown Capsicums, Chillies & Paprika	Downy Mildew	14	4+M3
Metiram		Target Spot (Early Blight)	14	M3
Metiram + Pyraclostrobin (AERO^)		Target Spot (Early Blight)	28	11/M3
Oxamyl		Root-knot nematodes	NR	1A
Penthiopyrad (FONTELIS^)	Fruiting vegetables	Botryris – Grey mould	NR	7
		Powdery mildew	NR	7
		Target Spot (Early Blight)	NR	7
Phosphorous acid (PER11778, expires Nov 2015)	Capsicum	Phytophthora Soil Fungus	1	33
Potassium (PER13695, expires Aug 2017)	Peppers	Powdery Mildew	NR	_
Procymidone (PER11440, expires Jan 2015)	Peppers	Sclerotinia	9	2
Pyrimethanil (PER12565, expires Sept 2017)	Capsicums (Protected)	Botrytis - Grey Mould	3	9
Sulphur	Vegetables	Bean rust	NR	M2
		Powdery mildew	NR	M2
Tea Tree Oil		Powdery Mildew	NR	
Triadimenol		Powdery Mildew	1	3
Trifloxystrobin (FLINT) (PER14050, exp Jun 2023)	Capsicums (Peppers)	Powdery Mildew	3	11
Zineb		Late blight	7	M3
		Target Spot (Early Blight)	7	M3

(H)=Harvest
(G)= Grazing
NR= not required
*= do not graze or cut for stockfood
**Note that for some broad registrations the pests may not occur in leek

Appendix 4 – currently available insecticides in peppers.

Active	Crop	Pest	WHP, days	Chemical group
1,3-Dichloropropene + Chloropicrin	Vegetables	Plant parasitic nematodes	NR	8B
		Symphylans (garden centipedes)	NR	8B
		Wireworms	NR	8B
Abamectin		Mite - Two-Spotted (Red Spider)	3	6A
Acephate (PER12378, expires Oct 2015)	Peppers	Thrip-Western Flower	3d	1B
Amorphous Silica		Caterpillar - Cluster	NR	
		Helicoverpa Punctigera (Native Budworms)	NR	
Bacillus thuringiensis subs. *Israelensis* Serotype H14 (VECTOBAC WG) (PER11472, expires May 2014)	Protected - Capsicums	Fungas Gnats	NR	11
Bacillus thuringiensis subsp. *kurstaki*	Vegetables	Armyworm	NR	11
		Cabbage Moth	NR	11
		Cabbage White Butterfly	NR	11
		Helicoverpa armigera (Corn Earworm / Cotton Bollworm)	NR	11
		Helicoverpa punctigera (Native Budworm)	NR	11
		Lightbrown Apple Moth	NR	11
		Loopers	NR	11
		Vine Moth	NR	11
Bifenazate (PER12906, expires Mar 2018)	Peppers	Mites-Two Spotted	1(H), *(G)	UN
Bifenthrin (PER13567, exp May 2014, Qld)	Capsicums	Fruit Fly	1	3A
(PER12947, expires Apr 2015)	Peppers	Mite-Blue Oat	NR(H), 28(G)	3A
		Mites-Two Spotted	NR(H), 28(G)	3A
		Whitefly-Greenhouse	NR(H), 28(G)	3A
		Whitefly-Silverleaf	1	3A
Botanical Oil		Aphids	NR	Insecticide
		Mite - Two-Spotted (Red Spider)	NR	Oil
		Whitefly - Greenhouse	NR	Oil
		Whitefly - Silverleaf	NR	Oil
Carbaryl		Locust - Australian Plague		1A/1B
Chlorantraniliprole (CORAGEN^)	Vegetables	*Helicoverpa armigera* (Corn Earworm / Cotton Bollworm)	3	28
		Helicoverpa punctigera (Native Budworms)	3	28
		Leafminer (Potato Moth)	3	28
Chlorantraniliprole + thiamethoxam (DURIVO)	Fruiting veg.	Aphid - Green Peach	NR	23+4A
		Caterpillar - Cluster	NR	
		Helicoverpa armigera (Corn Earworm)	NR	
		Helicoverpa punctigera (Native Budworms)	NR	
		Leafminer (Potato Moth)	NR	
		Thrips - Tomato	NR	
		Thrips - Western Flower	NR	
		Whitefly - Greenhouse	NR	
		Whitefly - Silverleaf	NR	
Chlorpyrifos		Cricket - Field, mole	NR	1B
		Cutworms	NR	1B
		Grasshopper - Wingless	NR	1B
		Locust - Australian Plague		1B
		Spotted Vegetable Weevil	0	1B
		Weevil - Vegetable	NR	1B

Active		Crop	Pest	WHP, days	Chemical group
Diazinon			Cutworms	14	1B
			Locust - Australian Plague		1A/1B
Dimethoate		Capsicums, Chilli, Peppers	Aphids	7	1B
			Bugs	7	1B
			Grasshopper - wingless	7	1B
			Green Vegetable Bug	3	1B
			Jassids	3	1B
			Leaf hoppers	NR	1B
			Mites	7	1B
			Thrips	3	1B
		Capsicum (NSW, WA only)	Cucumber Fly, Fruit Fly	3	1B
		Capsicums, Chilli, Peppers (Qld)	Fruit Fly	NR	1B
	(PER13158, expires Oct 2014)	Hot Chilli Peppers	Fruit Fly – Qld, Lesser Qld, NT, Mediterranean	NR	1B
	(PER13254, expires Oct 2014)	Chilli Peppers	QFF, MFF	7	1B
Emamectin			*Helicoverpa Punctigera* (Native Budworms)	3	6
			Tomato Grub	3	6
Emulsifiable botanical oils	(PER14077, expires Sep 2023	Capsicums (Greenhouse, hydroponic)	Whitefly-Silverleaf	NR	_
Ethyl Formate			Thrips - Western Flower	Nr	8a
Etoxazole			Mite - Two-Spotted (Red Spider)	7	10b
Fenthion			Fruit Flies	NR	1B
	(PER13860, expires Oct 2014)	Chilli Peppers	Fruit Fly	7	1B
Flubendiamide (BELT^)			Helicoverpa	1	28
			Leafminer (Potato Moth)	1	28
Helicoverpa NPV			*Helicoverpa armigera* (Corn Earworm / Cotton Bollworm)	NR	
			Helicoverpa punctigera (Native Budworms)	NR	
Imidacloprid			Aphid - Green Peach	7	4A
			Whitefly - Cotton (Sweet Potato)	NR	4A
			Whitefly - Silverleaf	NR	4A
Indoxacarb			Helicoverpa	3	22A
			Leafminer (Potato Moth)	3	22A
Maldison			Cucumber Fly	3	1B
			Fruit Fly - Mediterranean	3	1B
			Fruit Fly - Queensland	3	1B
			Locust - Australian Plague		1B
	(PER13031, expires May 2014)	Capsicums	Fruit fly - QFF, MFF, Cucumber Fly	3(H),3(G)	1B
Methamidophos	No longer available			14	1B
Methidathion	(PER14047, expires Jun 2018	Peppers	Rutherglen Bug	7	1B
			Thrips - Western Flower	7	1B
Methomyl	(PER13395, expires Sep 2014)	Chilli, field	Cluster Caterpillar	3d	1A
			Helicoverpa	3d	1A
			Cucumber Moth	3d	1A
Methomyl	(PER13566, exp May 2014, Qld	Capsicums	Fruit Fly	1	1A
Methomyl			*Helicoverpa Punctigera*	1	1A
Methoxyfenozide		Peppers (capsicum, chilli) Field label, protected PER12391)	Cluster Caterpillar	NR	18
			Helicoverpa Punctigera (Native Budworms)	NR	18
			Tomato Grub	NR	18

Active	Crop	Pest	WHP, days	Chemical group
Methyl bromide (PER10145, 11092, exp Oct 2014, not persons generally)	Fruiting Veg.	Fruit Fly	3	8A
		Thrips	3	8A
Milbemectin		Mite - Two-Spotted (Red Spider)	1	6
Paraffinic Oil	Capsicums	Whitefly - silverleaf	1	
Paraffinic Oil, petroleum oil	Peppers, capsicums	Aphids	1	
		Leafhoppers	1	
		Mites	1	
		Thrips	1	
Petroleum (PER12221, expires Nov 2017)	Peppers Including Capsicum, Chilli And Paprika	Whitefly-*Bemisia Tabaci* Species (Sweet Potato Whitefly, Silverleaf Whitefly B Biotype And Whitefly Q Biotype)	1	_
		Whitefly-Greenhouse	1	_
Phorate (PER8930, expires Jul 2017)	Peppers (Incl Chillies, Capsicums, Paprika)	Aphids	70	1B
		Jassids	70	1B
		Mites	70	1B
		Onion Maggot	70	1B
		Thrips	70	1B
Pirimicarb (PER14144, expires Mar 2016)	Peppers, Chilli	Aphids	2	1A
Potassium (PER13920, expires Mar 2018)	Capsicums (Protected)	Whitefly-Greenhouse, silverleaf	NR	_
Potassium Salts of Fatty Acids		Aphids	NR	
		Mealybugs	NR	
		Mite - Two-Spotted (Red Spider)	NR	
		Thrips	NR	
		Whitefly	NR	
Propargite	Vegetables (21 day re-entry)	Mite - Two-Spotted (Red Spider)	7	12C
Pyrethrins+Piper onyl Butoxide	Vegetables	Ants	1	3A
		Aphids	1	3A
		Caterpillars	1	3A
		Leafhoppers	1	3A
		Thrips	1	3A
		Whiteflies	1	3A
Pyriproxyfen		Whitefly – Greenhouse, Silverleaf	1	7C
Spinetoram (SUCCESS NEO^)	Fruiting veg.	Helicoverpa	1	5
		Leafminer (Potato Moth)	1	5
		Thrips - Western Flower	1	5
Spirotetramat (MOVENTO^)	Peppers	Aphid - Green Peach	1	23
		Thrip – Western Flower	1	23
		Whitefly - Silverleaf	1	23
Sulfoxaflor (TRANSFORM^)	Fruiting veg.	Aphid – Green peach	1	4C
		Whitefly - Greenhouse	1	4C
Trichlorfon	Vegetables	Cabbage moth	2	1B
		Cabbage white butterfly	2	1B
		Green vegetable bug	2	1B
		Rutherglen bug	2	1B
		Fruit fly	2	1B

(H)=Harvest
(G)= Grazing
NR= not required
*= do not graze or cut for stockfood
**Note that for some broad registrations the pests may not occur in leek

Appendix 5 – currently available herbicides in peppers.

Active	Crop	Pest	Chemical group
Clethodim (PER13397, expires Dec 2016)	Chilli Peppers, Paprika	Annual Ryegrass (Lolium Rigidum) And Winter Grass (Poa Annua) That Are Resistant To Quizalafop Herbicides.	A
Fluazifop-P		Grass weeds	A
Glyphosate (PER13901, expires Jun 2019)	Capsicums	Grass And Broadleaf	M
Paraquat+ diquat		Grass And Broadleaf	L
Trifluralin (PER12823, expires Jun 2021)	Peppers	Grass And Broadleaf-Label	D