



PEPPERS

Strategic Agrichemical Review Process
2007

Horticulture New Zealand

AgAware Consulting

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Purpose of the report:

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

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Disclaimer:

Any recommendations contained in this publication do not necessarily represent current Horticulture New Zealand policy. No person should act on the basis of the contents of this publication without first obtaining independent professional advice on their specific situation.

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Recommendations

In Auckland November 2006, a Strategic Agrichemical Review Process was conducted in peppers with the assistance of leading growers, consultants, retailers, government agencies and selected Horticulture New Zealand staff.

The purpose of the meeting was to record a ‘snap-shot’ of the plant pest issues and the pest management options used in peppers. Information was collected on the importance of plant pest, the frequency, selection and efficacy of the agrichemical use and any other issues related to pest management control in peppers.

Diseases and fungicides

The high priority diseases are:

Botrytis rot	<i>Botrytis cinerea</i>
Powdery mildew	<i>Leveillula taurica</i>
Stem blight	<i>Didymella spp</i>

The new fungicides that can be pursued for these uses are:

Product (active)	Target disease	Action
Scomlid Limb Aerosol (azaconazole + imazalil)	Botrytis rot	New use
Bravo (chlorothalonil)	Botrytis rot, Powdery Mildew, Stem blight	New uses
Switch (cyprodinil + fludioxonil)	Botrytis rot	New use
Rovral (iprodione)	Botrytis rot	New use
Sumisclax (procymidone)	Botrytis rot	New use
Filan (boscalid)	Botrytis rot	New use
Captan (captan)	Botrytis rot	New use
Shirlan (fluazinam)	Botrytis rot	New use
Amistar (azoxystrobin)	Powdery Mildew, Stem blight	New uses
Rubigan (fenarimol)	Powdery Mildew	New use
Cereous (triadimenol)	Powdery Mildew	New use
Stroby (kresoxim-methyl)	Powdery Mildew	New use
Ecocarb (potassium bicarbonate)	Powdery Mildew	New use
Euparen Multi (tolylfluanid)	Powdery Mildew, Stem blight	New use
Nimrod (bupirimate)	Powdery Mildew	New use
Quintec (quinoxifen)	Powdery Mildew	New use
Impulse (spiroxamine)	Powdery Mildew	New use
Copper oxychloride	Stem blight	New use
Manzate (mancozeb)	Stem blight	New use

Steps forward

1. For each of the major diseases identified, efficacy and crop safety trials (especially in greenhouse peppers) are required in the major peppers growing areas to determine the most efficacious fungicides for the control of Botrytis using chlorothalonil, cyprodinil + fludioxonil, iprodione, procymidone, boscalid, captan and fluazinam; for the control of Powdery Mildew using chlorothalonil, azoxystrobin, fenarimol, triadimenol, kresoxim-methyl, potassium bicarbonate, tolylfluanid, bupirimate, quinoxifen and spiroxamine; and for the control of Stem blight using chlorothalonil, azoxystrobin,

- tolylfluanid, Copper oxychloride and mancozeb; all in combination with currently registered products.
2. Once efficacy and the use pattern (and the withholding period) are determined, residue trials may be required in the major pepper growing area for these fungicides so that they comply with the default MRL (0.1 mg/kg). Residue data for some fungicides may be available from Australia or elsewhere.
 3. Provide the peppers industry with sound technical information for the control of Botrytis rot, Powdery Mildew and Stem blight listing fungicides, use patterns and withholding periods.
 4. Registration can be discussed with the manufacturer; otherwise a use pattern should be developed to comply with the NZ pesticide regulations.

Two of the major diseases in NZ peppers crops – Botrytis rot and Powdery Mildew, are fungi that have the potential to develop resistance to fungicides if overused. To maintain a high level of disease control, growers must alternate the fungicides used between the different resistance groups, not between products from the same resistance group. Product selection should also take into account ‘soft’ fungicides that are IPM compatible. Disease management strategies using fungicides and biological products should be developed for the NZ peppers industry.

Insects and insecticides

The high priority insects are:

Aphids (especially Green Peach Aphid)	<i>Myzus persicae</i>
Caterpillars (especially Heliothis, Tomato stem borer and Looper)	<i>Helicoverpa spp, Symmetrischema plaesiosoma, Lepidoptera spp.</i>
Mites (especially Two-Spotted Mite)	<i>Tetranychus urticae</i>
Thrips (especially Onion, Western Flower and Intonsa Flower thrips)	<i>Thrips tabaci, Frankliniella occidentalis, Frankliniella intonsa</i>

The new insecticides that can be pursued for these uses are:

Product (active)	Target insect	Action
Confidor (imidacloprid)	Aphids, Thrips	New uses
Lannate (methomyl)	Aphids, Lepidoptera, Thrips	New uses & Adding to existing registrations
Pirimor (pirimicarb)	Aphids	New use
Chess (pymetrozine)	Aphids	New use
Talstar (bifenthrin)	Aphids, Lepidoptera	New uses
Gaucho (imidacloprid)	Aphids	New use
Proclaim (emamectin)	Lepidoptera	New use
Ascend (fipronil)	Lepidoptera, Thrips	New uses
Steward (indoxacarb)	Lepidoptera	New use
Entrust (spinosad)	Lepidoptera, Thrips	New uses
Apollo (clofentezine)	Mites	New use
Torque (fenbutatin oxide)	Mites	New use
Avid (abamectin)	Mites, Thrips	New uses
Omite (propargite)	Mites	New use
Karate (lambda-cyhalothrin)	Thrips	New use
Monitor (methamidophos)	Thrips	New use

Steps forward

1. For each of the major insect pests identified, efficacy and crop safety trials (especially in greenhouse peppers) are required in the major peppers growing areas to determine the most efficacious insecticides for the control of aphids using imidacloprid, methomyl, pirimicarb, pymetrozine and bifenthrin; Lepidoptera (caterpillars) using methomyl, bifenthrin, emamectin, fipronil, indoxacarb and spinosad; mites using clofentezine, fenbutatin oxide, abamectin and propargite; and Thrips using imidacloprid, methomyl, fipronil, spinosad and abamectin; all in combination with currently registered products.
2. Once efficacy and the use pattern (and the withholding period) are determined, residue trials may be required in the major peppers growing areas for these insecticides so that they comply with the default MRL (0.1 mg/kg). Residue data for some insecticides may be available from Australia or elsewhere.
3. Provide the peppers industry with sound technical information for the control of aphids and Lepidoptera caterpillars listing insecticides, use patterns and withholding periods.
4. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ pesticide regulations.

All of the major insect pests in NZ peppers– aphids, Lepidoptera, mites and thrips are also insects that have a history of developing resistance to insecticides if overused. To maintain a high level of insect control, growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group. Product selection should also take into account ‘soft’ insecticides that are IPM compatible. Insect management strategies using insecticides and biological products should be developed for the NZ peppers industry.

Weeds and herbicides

No weed gaps were identified by peppers growers.

The New Zealand peppers industry

Introduction

The New Zealand vegetable industry comprises a large proportion of small owner-operated businesses. Most of the vegetables produced are consumed domestically. Brassicas, carrots, kumara, onions, potatoes, pumpkins, squash and sweet corn are the major vegetables produced. Asparagus, capsicums, carrots, onions, potatoes, squash and tomatoes are the major fresh vegetables exported. The main processed vegetables exported are dried and frozen peas, frozen potatoes, sweet corn, mixed vegetables, dried vegetables and vegetable preparations.

The main peppers growing areas are in (HortResearch¹):

- Auckland
- Canterbury

There are (HortResearch¹):

- 134 peppers growers
- 55 hectares planted
- 11,500 tonnes produced
- \$ 29.3 million from domestic sales
- \$ 28.9 million from fresh export sales (2006)

Growers of all horticultural crops frequently suffer from a lack of legal access to crop protection products (agrichemicals). The problem is that whilst their crops are valuable, they are too small individually for agchem manufacturers to bear the high cost of registering agrichemicals for their use. This is particularly true for small crops, such as peppers, where a problem may only be localised or spasmodic.

The Agricultural Compounds and Veterinary Medicines (ACVM) Group is responsible for the regulatory control of agricultural compounds (plant compounds / veterinary medicines), and their importation, manufacture, sale and use, on behalf of the New Zealand Food Safety Authority under the Agricultural Compounds and Veterinary Medicines Act 1997.

But growers are increasingly trapped in a situation where they face severe losses from diseases, pests and weeds (plant pests) if they do nothing to protect their crops, or face penalties if they use a product that is not registered and residue violations occur.

Fortunately, the ACVM Group has legislation available to growers where a default maximum residue limit (dMRL) of 0.1 mg/kg (or ppm) is permitted to allow the off-label use of registered agrichemicals (on another crop) without jeopardising the crop or the produce. But even with this allowance, issues still arise.

The peppers industry is very aware of the possible consequences that can occur from the use of unregistered agrichemicals even with the dMRL in place. These can include;

- Produce with unauthorised agrichemical residues, due to an incorrectly determined application rate or withholding period.
- Crop damage from unregistered agrichemical use.
- Rejection of produce from local markets due to residue non-compliance.
- Temporary exclusion from market access.
- Rejection of produce from export markets due to residue non-compliance.
- Jeopardising of export trading arrangements due to unacceptable agrichemical use or residue non-compliance.
- Fines and penalties

¹ HortResearch FreshFacts 2006
AgAware Consulting P/L

Agrichemicals have always been an important tool in the production of peppers. Fungicides and insecticides are used as a necessary tool to control plant pests, which can proliferate in ideal growing conditions. Herbicides are also used as pre-emergents and post-emergents to minimize weed competition.

The peppers industry has access to a limited range of agrichemicals to control the plant pests that affect the crop, during the establishment phase, during crop development, during fruit maturity and pre and post harvest.

Strategic Agrichemical Review Process

As a consequence of the issues facing the peppers industry regarding limited agrichemical access, AgAware Consulting Pty Ltd in association with Horticulture New Zealand Ltd undertook a review of the agrichemical requirements in peppers via a Strategic Agrichemical Review Process (SARP). See Diagram 1 – the Strategic Agrichemical Review Process.

The aims of the process are:

- to determine the current and future agrichemical requirements for peppers
- to protect the crops from plant pests by providing access to agrichemicals that they currently do not have legally available; and
- to provide information to use the agrichemicals under the dMRL legislation.

The project will undertake the assessment of agrichemical suitability, resistance, IPM, residues and exports in its evaluations and recommendations.

SARP was conducted with the New Zealand vegetable industry in Auckland November 2006. This assessment provided a list of key plant pests that are of major concern to the peppers industry. Against these threats the agrichemicals, agrichemical resistance group, withholding period, registered uses and overall suitability (IPM, residues, efficacy, trade and environment) for these pests were identified. Any potential new risks to the industry were also identified.

This report will provide the peppers industry with a clear picture of any gaps in the existing pest control options, and note the potential to address gaps with effective IPM compatible agrichemicals.

Solutions to the identified gaps (where acceptable agrichemicals are not legally available), were determined with new agrichemical control options using:

- Critical selection criteria for potential alternatives and/or new agrichemical
- Domestic and overseas information and resources that provide options and assist decision making

The list of agrichemical solutions for each identified gap will have the benefit of:

- IPM compatibility, wherever possible
- Improved scope for resistance management
- Sound biological profile
- Residue and trade acceptance domestically and for export

The results of the process will provide the peppers industry with sound agrichemical options that can be pursued for registration with the manufacturer.

This report is not a comprehensive assessment of ALL pests and control methods of peppers but attempts to prioritise the major problems.

Methods

SARP was conducted in Auckland in November 2006, as part of a specially convened vegetable specialists meeting. The meeting included members of key vegetable industry bodies, consultants, government agencies and Horticulture New Zealand.

- Participants were given a comprehensive list of the major pests of peppers and asked to prioritise them into high, moderate and low categories.
- Each of the pests were listed by common and scientific name.
- Participants were then asked to list the main agrichemicals and or other control agents used for each pest.
- Each agrichemical active ingredient as well as bio-control agent (biological agent, bio-fungicide or bio-insecticide) were listed along with a common trade name.
- The lists provided were certainly not comprehensive but a starting point for further assessment.
- The registration status in New Zealand was determined for each agrichemical and bio-control agent, as well as harvest withholding periods and comments collected for each pest and product.
- A further assessment and evaluation (of the agrichemical registered for each particular crop) was then conducted for each control method. This was done using information from the ACVM Group (ACVM 2007). The New Zealand Agrichemicals Manual (Agrimedia 2007) and Novachem Manual (Novachem Services Ltd, 2006/2007) were also used.
- Agrichemicals that are under review by the ACVM Group were listed as were agrichemicals under review by the Australian Agrichemicals and Veterinary Medicines Authority (APVMA).
- Information was collated onto Excel spreadsheets for plant pests.
- Agrichemical resistance groupings were assigned to each agrichemical (Australian information) to make it easier to identify each product and its mode of action. For example:
 - The fungicide, mancozeb belongs to the dithiocarbamate resistance grouping and has multi-site activity; it belongs to the Group Y fungicides.
 - The insecticide, diazinon belongs to the organophosphate resistance grouping and has contact/stomach activity; it belongs to the Group 1B insecticides.
 - The herbicide, linuron belongs to the photosynthesis inhibitor resistance grouping; it belongs to the Group C herbicides.
- The information was circulated to participants for any further comments and to ensure the accuracy of the information.
- An assessment or evaluation was conducted for each of the plant pests of peppers that required new or additional control options.
- Each alternative agrichemical 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 agrichemicals for the pepper industry to pursue are listed.

Results

For the peppers crops discussed in this SARP report, the two main types are reviewed:

Capsicum (peppers, sweet)	<i>Capsicum annuum</i> var. <i>grossum</i> or <i>longum</i>
Chilli	<i>Capsicum annuum</i>

For ease of management and because the plant pests for each crop are the same, both crops will be discussed as a whole (as peppers) and not individually. Although it is clearly understood that the vast majority of peppers grown in New Zealand are capsicums.

Specific differences will be discussed.

Special mention will be made of greenhouse grown peppers, as this offers some specific plant pest issues, that many not be relevant to field-grown crops.

The complete list of SARP worksheets is presented.

- Table 1 – results of the peppers Strategic Agrichemical Review Process – Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.
- Table 2 – results of the peppers Strategic Agrichemical Review Process – Fungicides registered and used for the control of the MINOR recorded diseases in peppers.
- Table 3 – results of the peppers Strategic Agrichemical Review Process – Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.
- Table 4 – results of the peppers Strategic Agrichemical Review Process – Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.
- Table 5: Herbicides registered and used for the control of the weeds in peppers.

Discussions

Diseases of peppers

The major diseases of peppers recorded are:

Common name **Scientific name**

HIGH PRIORITY

Botrytis rot *Botrytis cinerea*
 Powdery mildew *Leveillula taurica*
 Stem blight *Didymella spp*

MODERATE PRIORITY

Fusarium dry rot *Fusarium oxysporum*
 Late blight *Phytophthora capsici*

LOW PRIORITY

Phytophthora rot *Phytophthora spp.*
 Pythium root rot *Pythium spp.*

See **Table 1:** Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.

High priority disease

Botrytis rot (*Botrytis cinerea*)

Botrytis is considered a major problem in peppers (greenhouse and field grown).

Fungicides registered for Botrytis (*Botrytis cinerea*) control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registration		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
<i>Bacillus subtilis</i>	Serenade	Controls botrytis in vegetables		Biological	0	Starting to be used by growers.

* Resistance groups combine agrichemicals with the same mode of action.

	Registered
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Only *Bacillus subtilis* is registered for the control of Botrytis in vegetables (peppers). From the reports received, *Bacillus subtilis* is starting to be used by growers.

It was identified that alternatives are required.

Fungicides that are used off-label in peppers for the control of Botrytis are:

Active ingredient	Common Trade Name	Resistance group	Comments
AZACONAZOLE + IMAZALIL	Scomlid Limb Aerosol	C+C	Reg. in GH tomatoes. Commonly used and effective used as wound treatments in GH capsicums.

Active ingredient	Common Trade Name	Resistance group*	Comments
CHLOROTHALONIL	Bravo	Y	Registered in field tomatoes. AU label - registered in peppers. Commonly used and effective.
CYPRODINIL + FLUDIOXONIL	Switch	I	No reg. in any fruiting vegetables. Controls botrytis in grapes. AU permit – reg. in peas. Commonly used and effective.
IMAZALIL	Fungaflor	C	Commonly used and effective used as wound treatments in GH capsicums.
IPRODIONE	Rovral	B	Registered for botrytis control in glasshouse tomato. Commonly used and effective.
PROCYMIDONE	Sumisclex	B	Registered for botrytis in beans, cucurbits, tomato (field), grapes & strawberries. Commonly used and effective.
PYRIMETHANIL	Scala	I	No registration in any fruiting vegetables. Controls botrytis in grapes. AU permit - registered in capsicum. Commonly used and effective.
Scaniavital silica	Scaniavital silica	Bio-fungicide	Clay paste wound treatment is occasionally used in GH capsicums.
TOLYLFLUANID	Euparen Multi		Registered for botrytis control in grapes. Used and effective however knocks out predator for whiteflies.
<i>Trichoderma atroviride</i>	Sentinel	Biological	Registered in tomato for 'botrytis stem rot'. Occasionally used but still expensive.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Used off-label

These products are all commonly/occasionally used and considered effective.

- Scromrid, Fungaflor and Scaniavital are used as wound treatments in GH capsicums.
- Bravo and Euparen are all protectant fungicides used in GH and field capsicums.
- Switch, Rovral, Sumisclex and Scala are protectant/curative systemic fungicides with good activity on Botrytis in other crops. Used in GH and field capsicums.
- Sentinel is a biological used in GH capsicums.

Feedback indicated Botrytis appears to be a major disease in greenhouse peppers where many different products are used. There appears to be less of a concern in field-grown peppers.

Fungicides that are not registered in peppers but control Botrytis in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
AZOXYSTROBIN	Amistar	K	AU label - registered in grapes
BOSCALID	Filan	G	AU label - registered in grapes, permits in vegetables.
CAPTAN	Captan	Y	Registered in berries & grapes. AU label - registered in grapes & strawberries
CARBENDAZIM	Carbendazim	A	Reg. for botrytis in onion, beans and tomatoes (GH & field).
FENHEXAMID	Teldor	J	Controls botrytis in grapes & berries.
FLUAZINAM	Shirlan	Y	Registrations in field tomatoes for botrytis control
THIOPHANATE-METHYL	Topsin	A	Registered in tomato (field & GH) for botrytis.
THIRAM	Thiram	Y	Registered in tomato for botrytis.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Scomlid Limb Aerosol (azaconazole + imazalil)
 - MRL (azaconazole) in: Belgium, Netherlands (vegetables)
 - MRL (imazalil) in: EU, Japan, Korea, Malaysia, Switzerland (vegetables)
- Bravo (chlorothalonil)
 - MRL in: Aust, China, Codex, EU, Indonesia, Japan, Korea, NZ, Singapore, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)
- Switch (cyprodinil + fludioxnil)
 - MRL (cyprodinil) in: Austria, Codex, EU, Germany, Italy, Japan, Netherlands, (peppers, fruiting vegetables, vegetables)
 - MRL (fludioxnil) in: Austria, EU, Germany, Israel, Italy, Japan, USA (peppers, fruiting vegetables, vegetables)
- Rovral (iprodione)
 - MRL in: EU, Indonesia, Japan, Korea, Switzerland (peppers, fruiting vegetables, vegetables)
- Sumisclex (procymidone)
 - MRL in: Aust, China, Codex, EU, Japan, Korea, Switzerland, Taiwan (peppers, vegetables)
- Scala (pyrimethanil)
 - MRL in: Austria, EU, Germany, Italy, Netherlands, Switzerland (cucumber, pumpkin, vegetables)
- Euparen Multi (tolylfluanid)
 - MRL in: Austria, Belgium, Codex, EU, Finland, Germany, Japan, Netherlands, Sweden (peppers, fruiting vegetables, vegetables)
- Amistar (azoxystrobin)
 - MRL in: EU, Israel, Japan, Korea, Switzerland, USA (peppers, fruiting vegetables, vegetables)
- Filan (boscalid)
 - MRL in: Japan, Korea, USA (peppers, fruiting vegetables)
- Captan (captan)
 - MRL in: Austria, Denmark, EU, Indonesia, Japan, Korea, NZ, Singapore, Switzerland, Thailand, USA (peppers, fruiting vegetables, vegetables)
- Teldor (fenhexamid)
 - MRL in: EU, Israel, Japan, USA (peppers, fruiting vegetables, vegetables)
- Shirlan (fluazinam)
 - MRL in: EU, Germany, Japan, Korea, Netherlands (peppers, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

FUNGICIDE ALTERNATIVES IN LETTUCE FOR BOTRYTIS

In reviewing the possible alternatives:

- Scomlid Limb Aerosol (azaconazole + imazalil) – is an effective curative/protectant wound treatment product for Botrytis. As it is specific in its use, residue should be minimised. **The product should be pursued** for GH peppers only.

- Bravo (chlorothalonil) - is an effective protectant fungicide with a wide disease spectrum. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed. A use pattern needs to be developed to fit the residue requirements. This will provide a necessary new protectant fungicide.
- Switch (cyprodinil + fludioxnil) – is a protectant/curative systemic fungicide with excellent activity on Botrytis. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there limited overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed. This will provide a necessary new protectant/curative fungicide.
- Rovral (iprodione) – is a protectant/curative systemic fungicide with good activity on Botrytis. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there limited overseas MRL, **the product should be pursued**.
- Sumisclex (procymidone) – is a protectant/curative systemic fungicide with excellent activity on Botrytis. This product is under review in Aust, and registration is expected. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**.
- Amistar (azoxystrobin) – is a protectant/curative systemic fungicide with good activity on Botrytis. Resistance management is an issue, especially in greenhouse use. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are many overseas MRL, the product should not be pursued, due to a lack of registration for Botrytis and the resistance potential.
- Filan (boscalid) – is a curative systemic fungicide with excellent activity on Botrytis. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued**.
- Captan - an old protectant fungicide with a wide disease control spectrum. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**, provided efficacy is confirmed.
- Teldor (fenhexamid) – is a protectant/curative systemic fungicide with good activity on Botrytis. Resistance management is an issue, especially in greenhouse use. As there are few overseas MRL and many other fungicides are available, the product should not be pursued at this stage.
- Shirlan (fluazinam) - an old protectant fungicide with a wide disease control spectrum. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued**.

Powdery mildew (*Leveillula taurica*)

Powdery mildew is considered a major problem in peppers (greenhouse and field grown).

Fungicides registered for Powdery mildew control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registration		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
SULPHUR	Various	Registered for PM control in 'vegetables'. AU label - registered in tomato.		Y	0	Commonly used and effective.

* Resistance groups combine agrichemicals with the same mode of action.

	Registered
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Only sulphur is registered for the control of Powdery mildew in peppers. There are no reports of it being used.

It was identified that alternatives are required, particularly new systemic/curative fungicides.

Fungicides that are used off-label in lettuce for the control of Powdery mildew are:

Active ingredient	Common Trade Name	Resistance group*	Comments
AZOXYSTROBIN	Amistar	K	Reg. for Powdery in Peas. AU label - registered in tomatoes. Commonly used and effective, but problem with visible residues.
CHLOROTHALONIL	Bravo	Y	Registered for powdery mildew control in cucurbits. Commonly used and effective, but problem with visible residues.
CYPROCONAZOLE	Alto	C	Reg. for PM control in grapes and peas. Occasionally used and effective.
DIFENOCONAZOLE	Score	C	Reg. for PM control in apples. Occasionally used and effective.
FENARIMOL	Rubigan	C	Reg. for PM control in apples, grapes and peas. Occasionally used and effective.
FLUSILAZOLE	Nustar	C	Registered for Powdery Mildew in pipfruit. Occasionally used and effective.
KRESOXIM-METHYL	Stroby	K	Registered for Powdery Mildew in apples. Commonly used and effective. Stroby only one adequate, other products create visible residue.
MYCOBUTANIL	Sythane	C	Registered for Powdery Mildew in pipfruit. Occasionally used and effective.
POTASSIUM BICARBONATE	Ecocarb	X	Registered for Powdery Mildew in tomatoes. AU permit - registered in peppers. Commonly used and effective.
TEBUCONAZOLE	Orius	C	Reg. for PM control in peas and wheat. Occasionally used and effective.
TOLYLFLUANID	Euparean Multi	X	Registered for PM in apples and grapes. Commonly used and effective however knocks out predator for whiteflies.
TRIADIMEFON	Miltek	C	Reg. for PM control in grapes and peas and cucumbers. Occasionally used and effective.
TRIFORINE	Saprol	X	Powdery mildew control only listed for cucurbit. Commonly used and effective.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Used off-label

From the reports received, the current off-label fungicides used for Powdery mildew (*Leveillula taurica*) control in peppers are working adequately.

Although many different products are used ‘off-label’, they are only from 4 different resistance groups. Concerns have been raised by growers that Stroby (kresoxim-methyl) is less effective than it use to be.

Great care is required in the continued use of the Group K fungicides (strobilurins – azoxystrobin, kresoxim-methyl) and Group C fungicides (DMI – cyproconazole, difenoconazole, fenarimol, flusilazole, mycobutanil, tebuconazole and triadimefon) as they are highly prone to resistance developing with over use. These products should be used sparingly in combination with fungicides from many different resistance groups.

Fungicides that are not registered in peppers but control Powdery mildew in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group	Comments
BUPIRIMATE	Nimrod	H	Reg. for Powdery Mildew control in apples. AU label - reg. for PM in melons & apples.
CARBENDAZIM	Carbendazim	A	Reg. for Powdery Mildew control in cucurbits.
EPOXYCONAZOLE	Opus	C	Reg. for Powdery Mildew in barley and wheat.
QUINOXYFEN	Quintec	M	Registered for Powdery Mildew in grapes.
SPIROXAMINE	Impulse	K	Reg. for powdery mildew in grapes, wheat and barley
TRIADEMENOL	Cereous	C	AU permit - Powdery mildew control in peppers.
TRIFLOXTSTROBIN	Flint	K	Registered for PM in cucurbits. AU permit - registered for PM in capsicums.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Amistar (azoxystrobin)
 - MRL in: EU, Israel, Japan, Korea, Switzerland, USA (peppers, fruiting vegetables, vegetables)
- Bravo (chlorothalonil)
 - MRL in: Aust, China, Codex, EU, Indonesia, Japan, Korea, NZ, Singapore, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)
- Rubigan (fenarimol)
 - MRL in: Codex, EU, Israel, Japan, Switzerland (peppers, fruiting vegetables, vegetables)
- Stroby (kresoxim-methyl)
 - MRL in: EU, Japan, Korea, Switzerland, USA (peppers, vegetables)
- Ecocarb (potassium bicarbonate)
 - Residues exempt
- Euparen Multi (tolylfluanid)
 - MRL in: Austria, Belgium, Codex, EU, Finland, Germany, Japan, Netherlands, Sweden (peppers, fruiting vegetables, vegetables)
- Saparol (triflorine)
 - MRL in: EU, Israel, Japan, Korea, NZ, Switzerland (peppers, fruiting vegetables, vegetables)
- Nimrod (bupirimate)
 - MRL in: Aust, EU, Germany, Netherlands (peppers, fruiting vegetables, vegetables)

- Quintec (quinoxifen)
 - MRL in: EU, Israel (peppers, vegetables)
- Impulse (spiroxamine)
 - MRL in: EU (vegetables)
- Cereous (triadimenol)
 - MRL in: Aust, Codex, EU, Israel, Japan (peppers, vegetables)
- Flint (trifloxystrobin)
 - MRL in: EU, Japan, USA (peppers, fruiting vegetables, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

FUNGICIDE ALTERNATIVES IN PEPPERS FOR LEVEILLULA

In reviewing the possible alternatives:

- Amistar (azoxystrobin) – is a protectant/curative systemic fungicide with good activity on Powdery mildew. Resistance management is an issue, especially in greenhouse use. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued**. This will provide a necessary new protectant/curative fungicide.
- Bravo (chlorothalonil) - is an effective protectant fungicide with a wide disease spectrum. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**. This will provide a necessary new protectant fungicide.
- Rubigan (fenarimol) and Cereous (triadimenol) – are effective triazole fungicides (DMI), but with a high resistance risk. Rubigan and Cereous were selected over the other triazoles due to the greater number of overseas MRL. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. **The product should be pursued**. This will provide necessary new curative fungicides.
- Strobry (kresoxim-methyl) – is a protectant/curative systemic fungicide with good activity on Powdery mildew. Resistance management is an issue, especially in greenhouse use. This may already have been identified and should be tested. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued**
- Ecocarb (potassium bicarbonate) - an organic protectant fungicide. Registered in tomato. As the product is MRL exempt, **it should be pursued**. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. This will provide a necessary new protectant fungicide.
- Euparen Multi (tolylfluanid) - is an effective protectant fungicide with a wide disease spectrum. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**. This will provide a necessary new protectant fungicide.

- Nimrod (bupirimate) - is an effective protectant/curative fungicide. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued.** This will provide a necessary new protectant fungicide.
- Quintec (quinoxifen) - is an effective protectant fungicide for Powdery mildew. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are few overseas MRL, **the product should be pursued.** This will provide a necessary new protectant fungicide.
- Impulse (spiroxamine) - is an effective protectant/curative systemic fungicide for Powdery mildew. Resistance management is an issue; therefore it should always be used in alternation with other fungicides. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are few overseas MRL, **the product should be pursued.** This will provide a necessary new systemic fungicide.
- Flint (trifloxystrobin) - is an effective protectant/curative systemic fungicide with a wide disease spectrum. Crop safety needs to be tested in greenhouse and field grown cucumber crops. As there are limited overseas MRL compared to Amistar and Stroby, the product should not be pursued.

Several products have been recommended from the same resistance group, ie. Amistar and Stroby. Rather than selecting one product over another, efficacy trials should be conducted to determine the best product to pursue.

Stem blight (*Didymella spp.*)

Stem blight (*Didymella spp.*) is considered a major disease of peppers in New Zealand.

There are no fungicides registered for Stem blight (*Didymella spp.*) control in peppers or vegetables.

Fungicides that are used off-label in peppers for the control of Stem blight are:

Active ingredient	Common Trade Name	Resistance group*	Comments
AZOXYSTROBIN	Amistar	K	AU label - registered for Gummy stem blight in cucurbits. Commonly used and effective.
CHLOROTHALONIL	Bravo	Y	Registered for Gummy stem blight in cucurbits. Commonly used and effective.
TOLYLFLUANID	Euparen Multi	X	AU label - No registration for capsicums. Used and effective however knocks out predator for whiteflies.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Used off-label

From the reports received, the current off-label fungicides used for Stem blight (*Didymella spp.*) control in peppers are working adequately.

Fungicides that are not registered in peppers but control *Didymella spp.* in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
COPPER OXYCHLORIDE	Various	Y	Registered for Gummy stem blight in cucurbits.
COPPER HYDROXIDE + MANCOZEB	Mancocide	Y	AU label - registered for Gummy stem blight in cucurbits.
MANCOZEB	Manzate	Y	AU label - registered for Gummy stem blight in cucurbits.
METIRAM	Polyram	Y	AU label - registered for Gummy stem blight in cucurbits.
PROPINEB	Antracol	Y	AU label - registered for Gummy stem blight in cucurbits.

* Resistance groups combine agrichemicals with the same mode of action.

Of these products the only ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Amistar (azoxystrobin)
 - MRL in: EU, Israel, Japan, Korea, Switzerland, USA (peppers, fruiting vegetables, vegetables)
- Bravo (chlorothalonil)
 - MRL in: Aust, China, Codex, EU, Indonesia, Japan, Korea, NZ, Singapore, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)
- Euparen Multi (tolylfluanid)
 - MRL in: Austria, Belgium, Codex, EU, Finland, Germany, Japan, Netherlands, Sweden (peppers, fruiting vegetables, vegetables)
- Copper oxychloride
 - MRL in: Aust (exempt), Canada, EU, Finland, Japan (exempt), Malaysia (exempt), NZ (exempt), Singapore, South Africa, Switzerland, Taiwan (exempt), USA (exempt) (peppers, vegetables)
- Manzate (mancozeb)
 - MRL in: Aust, Canada, China, Codex, EU, Japan, NZ, South Africa, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)
- Polyram (metiram)
 - MRL in: Aust, Canada, Codex, EU, Japan, NZ, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

FUNGICIDE ALTERNATIVES IN PEPPERS FOR DIDYMELLA

In reviewing the possible alternatives:

- Amistar (azoxystrobin) – is a protectant/curative systemic fungicide with good activity on Gummy stem blight in cucurbits (Aust). Resistance management is an issue, especially in greenhouse use. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, **the product should be pursued**. This will provide a necessary new protectant/curative fungicide.
- Bravo (chlorothalonil) - is an effective protectant fungicide with a wide disease spectrum and good activity on Gummy stem blight in cucurbits. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**. This will provide a necessary new protectant fungicide.
- Euparen Multi (tolylfluanid) - is a protectant fungicide with a wide disease spectrum. As other protectant fungicides available, this should not be pursued.

- Copper oxychloride - is an effective protectant fungicide with a wide disease spectrum and good activity on Gummy stem blight in cucurbits. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL and many countries have exemptions for copper, **the product should be pursued**. This will provide a necessary new protectant fungicide.
- Manzate (mancozeb) - an old protectant fungicide with a wide disease control spectrum and good activity on Gummy stem blight in cucurbits (Aust). Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. It is not expected to offer any significant advantages over chlorothalonil. But as there are MRL in NZ and many overseas countries, **the product should be pursued**.
- Polyram (metiram) - is an protectant fungicide with a wide disease spectrum. As there are other protectant fungicides available, this should not be pursued.

Other diseases

See **Table 2:** Fungicides registered and used for the control of the MINOR recorded diseases in peppers.

Fusarium Dry Rot (*Fusarium spp.*)

Late Blight (*Phytophthora capsici*)

Phytophthora Rot (*Phytophthora spp.*)

Pythium Root Rot (*Pythium spp.*)

New fungicide that can be pursued

Product (active)	Target disease	Action
Scomlid Limb Aerosol (azaconazole + imazalil)	Botrytis rot	New use
Bravo (chlorothalonil)	Botrytis rot, Powdery Mildew, Stem blight	New uses
Switch (cyprodinil + fludioxonil)	Botrytis rot	New use
Rovral (iprodione)	Botrytis rot	New use
Sumislex (procymidone)	Botrytis rot	New use
Filan (boscalid)	Botrytis rot	New use
Captan (captan)	Botrytis rot	New use
Shirlan (fluazinam)	Botrytis rot	New use
Amistar (azoxystrobin)	Powdery Mildew, Stem blight	New uses
Rubigan (fenarimol)	Powdery Mildew	New use
Cereous (triadimenol)	Powdery Mildew	New use
Stroby (kresoxim-methyl)	Powdery Mildew	New use
Ecocarb (potassium bicarbonate)	Powdery Mildew	New use
Euparen Multi (tolylfluanid)	Powdery Mildew	New use
Nimrod (bupirimate)	Powdery Mildew	New use
Quintec (quinoxifen)	Powdery Mildew	New use
Impulse (spiroxamine)	Powdery Mildew	New use
Copper oxychloride	Stem blight	New use
Manzate (mancozeb)	Stem blight	New use

Insects of peppers

The insects of peppers recorded are:

Common name

Scientific name

HIGH PRIORITY

Aphids (especially Green Peach Aphid) ...	<i>Myzus persicae</i>
Caterpillars (especially Heliothis, Tomato stem borer and Looper)	<i>Helicoverpa spp, Symmetrischema plaesiosoma, Lepidoptera spp.</i>
Mites (especially Two-Spotted Mite)	<i>Tetranychus urticae</i>
Thrips (especially Onion, Western Flower and Intonsa Flower thrips)	<i>Thrips tabaci, Frankliniella occidentalis, Frankliniella intonsa</i>

MEDIUM PRIORITY

Whitefly	<i>various</i>
Sciarid Fly	<i>Bradysia spp.</i>
Mealy Bug	<i>Pseudococcus spp.</i>
Green Vegetable Bug	<i>Pseudococcus spp.</i>

LOW PRIORITY

Potato psyllid	<i>Psyllidae spp.</i>
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See **Table 3:** Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.

High priority insects

Aphids - Green Peach Aphid (*Myzus persicae*)

Although there are several aphid species that affect pepper crops in New Zealand, Green Peach Aphid (*Myzus persicae*) is the major species and is responsible for the transfer of various viruses including Potato virus Y (PVY). Rather than discussing each aphid individually, they will be discussed as a group.

No distinction was made between field and greenhouse peppers in relation to aphid severity.

Insecticides registered for aphid control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registrations		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
APHID PARASITE	<i>Aphidius colemani</i>			Biological		
APHIDOLETED	<i>Aphidoletes aphidimyza</i>			Biological		
CANOLA OIL	Eco-oil	GPA. AU label - aphid control in peppers.		Vegetable Oil	3	
DIAZINON	Diazinon	No GH listing.	Aphids	1B	14	
DICHLORVOS	Divap	Aphids		1B	3	
FATTY ACIDS (K SALTS)	Nature's Way	No GH listing.		Unlisted	1	

Active ingredient	Common Trade Name	Registrations		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
MALDISON	Malathion	No GH listing.	Aphids	1B	3	
PARATHION METHYL	Folidol	Vegetables - aphids.		1B	14	
PERMETHRIN + PIPERONYL BUTOXIDE	Permigas			3A	3	
PERMETHRINS + PIPERONYL BUTOXIDE	Greenseals Pyrethrum	No GH listing.	Aphids	3A	0	
PYRETHRINS	Garlic & Pyrethrum Concentrate	No GH listing.	Aphids	3A	1	
ROTENONE	Derris Dust	No GH listing.		21A	1	Label says "helpful in the control of aphids"

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered

None of the registered products are recorded as being used for aphid control in peppers. Interestingly, most of the registered products are OP and SP.

Many products have no label claim for greenhouse crops. Comments from growers are that insecticide resistance is an issue.

Insecticides that are used off-label in peppers for the control of aphids are:

Active ingredient	Common Trade Name	Resistance group*	Comments
IMIDACLOPRID	Confidor	4A	AU label - registration for aphids in peppers. Commonly used and effective. Confidor affects Bombus. Green peach aphid listed on AU label.
METHOMYL	Lannate	1A	Reg. for GPA in tomato, cauliflower, cabbage and lettuce. Occasionally used and effective. Not IPM compatible.
PIRIMICARB	Pirimor	1A	Reg. on tomato, cucurbits, brassicas and lettuce. AU label - registration for aphids in peppers. Commonly used and effective. IPM compatible.
PYMETROZINE	Chess	9A	Reg. in tomato, vegetable brassica, lettuce and potato. Commonly used and effective. IPM compatible. Chess is the only product compatible with <i>Aphidius</i> .

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in Aust
	Used off-label

All the products indicated are commonly/occasionally used as foliar insecticides in peppers. Some of the insecticides used and available are quite old, suggesting that resistance may be an issue (methomyl and pirimicarb). There is some risk of resistance developing in the future with Green peach aphid with the continued use of these insecticides. Resistance has been recorded in GPA to pirimicarb in Australia.

Feedback indicated the current insecticides used for aphid control in peppers are working adequately. To maintain a high level of aphid control, growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group.

The use of specialist aphicides such as Pirimor and Chess allows the use of beneficial insects in IPM systems.

Insecticides that are not registered in peppers but control aphids in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
ACEPHATE	Orthene	1B	Reg. for 'aphids' in lettuce and potato. AU label - aphid control in tomato.
ACETAMIPRID	Mospilan	4A	AU label - aphid control in potato.
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	'Aphids' listed for tomatoes. AU label - aphid control in various crops.
AZADIRACTIN	NeemAzal-T/S	Botanical insecticide	Not registered on any vegetable and only on non-fruit bearing trees and vines (aphids).
<u>Beauvaria bassiana</u>	Botanigard ES	Biological	
BIFENTHRIN	Talstar	3A	Reg. on field tomatoes, pumpkins, squash for 'aphids'. AU label - aphid control in various crops.
CHLORPYRIFOS	Lorsban	1B	Reg for 'aphids' in winter squash and vegetable brassicas. AU label - aphid control in tomato.
DELTAMETHRIN	Decis	3A	Reg. for 'aphids' in squash
DIMETHOATE	Perfekthion	1B	Reg. for CA in potato, carrots and brassicas. AU label - registration for aphids in peppers.
ENDOSULFAN	Thiodan	2A	Reg. on tomato, vegetable brassica and potato. AU label - aphid control in peppers.
IMIDACLOPRID	Gaucho	4A	Reg. on potato and squash for 'aphids'.
Lecanicillium lecanii blastospores		Biological	
METHAMIDOPHOS	Monitor Tamaron	1B	Reg. for 'aphids' in potato. AU label - registration for aphids in peppers.
PERMETHRIN + PIRIMIPHOS-METHYL	Attack	3A+1B	Reg. for 'aphids' in GH tomato, cucurbits group and vegetable brassica
PHORATE	Phorate	1B	Reg for 'aphids' in cucurbits, brassicas, potato and carrot. AU label - aphid control in tomato.
PIRIMIPHOS-METHYL	Actellic	1B	
TAU-FLUVALINATE	Mavrik	3A	Reg. on field tomato for GPA. AU label - aphid control in tomato.
TERBUFOS	Counter	1B	Aphids listed for forage brassicas as a seed/fertiliser treatment
THIACLOPRID	Calapso	4A	Requested by growers.
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFUVALINATE	Guardall	3A	

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Confidor (imidacloprid)
 - MRL in: Aust, Austria, Canada, Codex, EU, Germany, Israel, Italy, Japan, Korea, Malaysia, Netherlands, Sweden, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Lannate (methomyl)
 - MRL in: Aust, Codex, EU, Germany, indonesia, Israel, Japan, Korea, NZ, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)

- Pirimor (pirimicarb)
 - MRL in: Aust, Austria, Belgium, Codex, EU, France, Germany, Indonesia, Italy, Japan, Korea, Netherlands, NZ, Sweden, Switzerland, Taiwan (peppers, fruiting vegetables, vegetables)
- Chess (pymetrozine)
 - MRL in: Aust, EU, Germany, Japan, Korea, UK, USA (peppers, fruiting vegetables, vegetables)
- Talstar (bifenthrin)
 - MRL in: Aust, EU, Japan, Korea, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Mospilan (acetamiprid)
 - No MRL established as yet.
- Gaucho (imidacloprid)
 - MRL in: Aust, Austria, Canada, Codex, EU, Germany, Israel, Italy, Japan, Korea, Malaysia, Netherlands, Sweden, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Calypso (thiacloprid)
 - MRL in: Austria, EU, Germany, Italy, Japan, Korea, Netherlands, UK (peppers, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

INSECTICIDES ALTERNATIVES IN PEPPERS FOR APHIDS

In reviewing the possible alternatives:

- Confidor (imidacloprid) – is a systemic foliar insecticide with activity on various pests. Some impact on beneficial insects. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Resistance management is an issue, especially in greenhouse use. As there are many overseas MRL, **the product should be pursued.**
- Lannate (methomyl) – is an old systemic insecticide with activity on various pests. Some impact on beneficial insects. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued.**
- Pirimor (pirimicarb) – is an old contact insecticide with specific activity on aphids. Good IPM compatibility. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued.**
- Chess (pymetrozine) – is a selective systemic insecticide with activity on aphids and whiteflies only. Excellent IPM compatibility. Although there are few overseas MRL, **the product should be pursued** and a use pattern developed to comply with the MRL.
- Talstar (bifenthrin) – is a synthetic pyrethroid with a wide spectrum of activity. Although the SP can be highly prone to developing resistance, **one of the SP used should be pursued.** Bifenthrin is one of the better SP. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops.
- Gaucho (imidacloprid) – is a systemic seed treatment with activity on various pests. Resistance management will be an issue, if Confidor is used as a foliar

insecticide. As there are many overseas MRL, **the product should be pursued**. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. This will provide a necessary new insecticide to protect the crop during its early development.

- o Calypso (thiacloprid) – is a systemic insecticide with excellent activity on a range of pests, but not labelled for aphids. As it is in the same resistance group as Confidor and Gaucho, it should not be pursued.

Caterpillars – Heliothis/Tomato Fruitworm/Corn Earworm (*Helicoverpa armigera*); Tomato stem borer (*Symmetrischema plaesiosoma*); Loopers (*Chrysodeixis spp.*)

Heliothis or Tomato Fruitworm or Corn Earworm (*Helicoverpa armigera*); Tomato stem borer (*Symmetrischema plaesiosoma*) and Loopers (*Chrysodeixis spp.*) are major pests of peppers. No distinction was made between field grown and greenhouse peppers in relation to caterpillar severity.

Although there are several Lepidoptera (caterpillar) species that affect peppers crops in New Zealand, rather than discussing each pest individually, they will be discussed as a group. This approach will consider:

- Individual differences between caterpillar species and peppers varieties affected
- Resistance issues between species
- Insecticides that control all Lepidoptera species

Insecticides registered for Lepidoptera (caterpillar) control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registrations		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
<i>Bacillus thuringiensis t sub. Kurstaki</i>	Bacillus thuringiensis	Caterpillars		11C	0	Commonly used and effective. IPM compatible.
CARBARYL	Sevin	No GH use mentioned.	Looper, Potato tuber moth, Tomato fruitworm + other caterpillars 'Vegetable'	1A	1	
DIAZINON	Diazinon	No GH use mentioned.	Caterpillars	1B	14	
DICHLORVOS	Divap	Caterpillars		1B	3	
MALDISON	Malathion	No GH use mentioned.	Diamondback moth, Tomato fruitworm, White butterfly	1B	3	
PARATHION METHYL	Folidol	Vegetables - caterpillars.		1B	14	
PYRETHRUM	Garlic & Pyre Concentrate	No GH use mentioned.	Cabbage Moth and caterpillars	3A	1	

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered

Of all the products registered for Lepidoptera control in peppers, only Bt is commonly used and effective. Noticeably, most of the insecticides registered in peppers for Lepidoptera are very old carbamates (1A), organophosphates (1B) and synthetic pyrethroids (3A). Unfortunately most of these are quite disruptive of IPM programs.

Insecticides used off-label in peppers for the control of Lepidoptera (caterpillars) are:

Active ingredient	Common Trade Name	Resistance group*	Comments
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	Reg. in tomato and brassica. Commonly used and effective. Not IPM compatible.
BIFENTHRIN	Talstar	3A	Reg. in brassicas and field tomato. Commonly used and effective. Not IPM compatible.
CYPERMETHRIN	Ripcord	3A	Reg. in cauliflower, cabbage and tomato. Commonly used and effective. Not IPM compatible.
DELTAMETHRIN	Decis	3A	Reg. in field tomato, potato and brassicas. Commonly used and effective. Not IPM compatible.
ENDOSULFAN	Thionex	2A	Reg. for various caterpillars in brassicas and potato. AU label - reg. in capsicums for Heliothis. Occasionally used and effective. Not IPM compatible.
LAMBDA-CYHALOTHRIN	Karate	3A	Reg. in field tomato, brassica and potato. Commonly used and effective. Not IPM compatible.
METHOMYL	Lannate L	1A	Reg. cauliflower, cabbage, lettuce and tomato. Commonly used and effective. Not IPM compatible.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Used off-label

Feedback indicated the current off-label insecticides used for Lepidoptera (caterpillar) control in peppers are working adequately. All of these products are currently registered in other crops for lepidoptera control. It is unknown if growers are using these insecticides both in field grown and greenhouse pepper crops.

Again, most of the insecticides used off-label in peppers for Lepidoptera are very old carbamates (1A) or synthetic pyrethroids (3A). These are quite disruptive of IPM programs even though they are effective. There is also a significant resistance risk with the continued use of SP.

To maintain a high level of Lepidoptera (caterpillar) control, growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group.

Insecticides that are not registered in peppers but control Lepidoptera (caterpillars) in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group	Comments
ACEPHATE	Orthene	1B	Reg. in tomato, brassicas, lettuce and potato
<u>Beauveria bassiana</u>	Botanigard	Biological	
CHLORPYRIFOS	Lorsban	1B	Corn Earworm is listed for maize/sweet corn in NZ. AU label - reg. in peppers for Heliothis.
EMAMECTIN	Proclaim	6A	AU label - reg. in capsicums for Heliothis.
ESFENVALERATE	Sumi-Alpha	3A	Reg. in tomato, cucurbits group, brassicas, potato and onion.
FIPRONIL	Ascend	2C	Reg. in brassicas for various Lepidoptera.
IDOXACARB	Steward	22A	Reg. in 'head' lettuce and brassicas for various Lepidoptera.
METHAMIDOPHOS	Monitor Taron	1B	Reg. for various caterpillars in tomato, brassica and potato. AU label - reg. in capsicums for Heliothis.
PERMETHRIN + PIRIMIPHOS-METHYL	Attack	3A+1B	Reg. in GH tomato, cucurbits group and vegetable brassicas

Active ingredient	Common Trade Name	Resistance group*	Comments
SPINOSAD	Entrust Naturalyte	5A	Reg, in field tomato and brassica. AU label - reg. in capsicums for Heliothis.
TAU-FLUVALINATE	Mavrik	3A	Reg. in cabbage and field tomato.
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFUVALINATE	Guardall	3A	Reg, in tomato and cabbage.
TRICHLORFON	Trifon	1B	Reg, in tomato and brassica.
TRICHLORFON + CYPERMETHRIN	Partna	1B+3A	Reg. in cauliflower, cabbage and tomato.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust

Fipronil (Ascend) efficacy trials are underway in NZ. Fipronil does have some impact on IPM systems.

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Talstar (bifenthrin)
 - MRL in: Aust, EU, Japan, Korea, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Lannate (methomyl)
 - MRL in: Aust, Codex, EU, Germany, indonesia, Israel, Japan, Korea, NZ, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Proclaim (emamectin)
 - MRL in: Aust, Japan, Korea, USA (peppers, fruiting vegetables)
- Ascend (fipronil)
 - MRL in: Aust, EU, Japan, Netherlands (peppers, vegetables)
- Steward (indoxacarb)
 - MRL in: Aust, Austria, EU, France, Germany, Israel, Italy, Japan, Korea, Netherlands, USA (peppers, fruiting vegetables, vegetables)
- Entrust (spinosad)
 - MRL in: Aust, Belgium, Codex, EU, Germany, Israel, Italy, Japan, Netherlands, Switzerland, UK, USA (peppers, fruiting vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

INSECTICIDES ALTERNATIVES IN PEPPERS FOR LEPIDOPTERA (CATERPILLAR)

In reviewing the possible alternatives:

- Talstar (bifenthrin) – is a synthetic pyrethroid with a wide spectrum of activity. Although the SP can be highly prone to developing resistance, **one of the SP used should be pursued**. Bifenthrin is one of the better SP. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. A use pattern should be developed to comply with the residue conditions for overseas countries.

- Lannate (methomyl) – is an old systemic insecticide with activity on various pests. Some impact on beneficial insects Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued**. This will provide a necessary new systemic insecticide.
- Proclaim (emamectin) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, a use pattern should be developed to comply with the residue conditions for overseas countries. **The product should be pursued.**
- Ascend (fipronil) - a contact/systemic insecticide with good efficacy, but can be disruptive to IPM beneficial insects. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. Although there are limited overseas MRL, a use pattern should be developed to comply with the residue conditions for overseas countries. **The product should be pursued.**
- Steward (indoxacarb) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As there are many overseas MRL, **the product should be pursued.**
- Entrust (spinosad) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. It is very effective and has many overseas MRL. There is some resistance risk in some insects due to overuse. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. Crop safety needs to be tested especially in greenhouse pepper crops. As it is very effective in controlling a range of pests both in NZ and Aust **it should be pursued.**

The selection of Proclaim (emamectin), Ascend (fipronil), Entrust (spinosad) and Steward (indoxacarb) will add greatly to the suite of insecticides available to pepper growers for the control of Lepidoptera (caterpillar) pests. This will also relieve some of the resistance pressure on current commonly used products. These four insecticides in combination with Talstar (bifenthrin), Lannate (methomyl) and Bacillus thuringiensis (registered) will add greatly to the lepidoptera control strategy in peppers.

Mites (especially Two-Spotted Mite) (*Tetranychus urticae*)

Mites are considered a major pest on pepper crops in New Zealand. The mites that have been listed as the major problem are Two-Spotted Mite (*Tetranychus urticae*). The other mites present, Tomato Russet Mite (*Aceria lycopersici*) and Broad Mite (*Polyphagotarsonemus latus*) are considered minor pests.

Insecticides registered for mite control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registrations		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
CANOLA OIL	Eco-oil	Mites			0	Occasionally used and effective - field crops.
DICHLORVOS	Divap	Mites		1B	3	

Active ingredient	Common Trade Name	Registrations		Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
DICOFOL	Kelthane 35	No GH use mentioned.	Mites	2B	7	
FATTY ACIDS (K SALTS)	Yeates Mite Killer	No GH use mentioned.	European red mite, Two-spotted mite	Not listed	1	
<i>Phytoseiulus persimilis</i>	Two spotted mite predator	Vegetables		Biological		

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered

Of the registered products only canola oil is recorded as being commonly used and effective on field grown peppers.

In the short to medium term, other insecticides for the control of mites in peppers are required to maintain a high level of control, as resistance can develop quickly.

Insecticides used off-label in peppers for the control of mites are:

Active ingredient	Common Trade Name	Resistance group	Comments
BUPROFEZIN	Applaud Ovation	17A	No reg. for mites. Occasionally used and effective for Broad mite
CLOFENTEZINE	Apollo	10A	NZ & AU label - lists TSM and ERM for various crops but not vegetable crops. Occasionally used and effective - field crops.
ENDOSULFAN	Thionex	2A	Reg. for various mites in fruits. AU label - reg. in capsicums for various mites. Occasionally used and effective - field crops. Used for Broad mite and Strawberry mite.
FENBUTATIN OXIDE	Torque	12A	NZ & AU label - lists TSM and ERM for various crops but not vegetable crops. Occasionally used and effective - field crops.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Used off-label

From the reports received, the current off-label insecticides used for mite control in peppers are working adequately. All of these products are currently registered in other crops in NZ or Australia for mite control, other than Applaud (buprofezin) which has no registration for mites in NZ or Aust., therefore efficacy is questioned. Growers are using these insecticides in both greenhouse and field grown pepper crops.

Growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group. A resistance management system needs to be developed to encourage the adoption of biological control of mites in combination with miticides. In some areas of Australia, Two-spotted mites have already developed resistance to clofentezine and fenbutatin.

Insecticides that are not registered in peppers but control mites in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group	Comments
ABAMECTIN	Avid	6A	TRM, TSM listed for GH Tomato, ERM listed for pipfruit. AU label - reg. in capsicums for various mites.
AZOCYCLOTIN	Peropal		Controls TSM and ERM in various fruit crops
FENPYROXIMATE	Fenamite	21A	Reg. for TSM, ERM in pipfruit
MILBEMECTIN	Mit e mec	6B	Reg for TSM, ERM in apples

Active ingredient	Common Trade Name	Resistance group	Comments
PROPARGITE	Omite	14A	TSM and ERM control in various crops. AU label - reg. in tomato for various mites.
TAU-FLUVALINATE	Mavrik Flo	3A	Reg. for mites in Ornamentals

* Resistance groups combine agrichemicals with the same mode of action.

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Apollo (clofentezine)
 - MRL in: EU, Japan (peppers, vegetables)
- Torque (fenbutatin oxide)
 - MRL in: EU, Indonesia, Japan, Korea, South Africa, Switzerland (peppers, fruiting vegetables, vegetables)
- Avid (abamectin)
 - MRL in: Aust, Canada, Codex, EU, Israel, Japan, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Peropal (azocyclotin)
 - MRL in: EU (vegetables)
- Mit-e-mec (milbemectin)
 - MRL in: Japan, Taiwan (peppers, fruiting vegetables)
- Omite (propargite)
 - MRL in: Aust, Austria, Germany, Israel, Italy, Japan, Netherlands, Switzerland (peppers, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

INSECTICIDES ALTERNATIVES IN PEPPERS FOR MITES

In reviewing the possible alternatives:

- Apollo (clofentezine) – is an old contact ovicide for mites with good efficacy, but is prone to resistance developing. IPM compatible. The impact on beneficial insects needs to be determined. Although there are limited overseas MRL, a use pattern should be developed to comply with the residue conditions for overseas countries. Crop safety needs to be determined, particularly in greenhouse crops. Residue data will be required. **The product should be pursued.**
- Torque (fenbutatin oxide) – is an old contact miticide with good efficacy, but is prone to resistance developing. Not IPM compatible. Although there are limited overseas MRL, a use pattern should be developed to comply with the residue conditions for overseas countries. Crop safety needs to be determined, particularly in greenhouse crops. Residue data will be required. **The product should be pursued.**
- Avid (abamectin) - is a systemic foliar insecticide with activity on various pests. Safe to beneficial insects. Some resistance issues. Efficacy data needs to be generated in the major pepper growing areas. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed.
- Peropal (azocyclotin) and Mit-e-mec (milbemectin) - are new miticide. Given the limited overseas MRL they should not be pursued at this time.
- Omite (propargite) – is a contact and residue miticide. Minor impact on beneficial insects. Efficacy data needs to be generated in the major pepper

growing areas. Residue data may also be necessary. As there are some overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed.

Not all of these miticides may control all the mites of peppers. Any efficacy trials conducted needs to investigate which mites are controlled and their relevance to peppers production. The main target should always be Two-spotted mites.

In reviewing the mite control programs in peppers, ‘mites’ were discussed in general, as no specific information was provided regarding greenhouse and field use. With any development program in mite control, a resistance management program should be developed incorporating all miticides and biological systems to maintain the effectiveness of the products and minimise resistance in greenhouse and field peppers.

Thrips - especially Onion Thrips (*Thrips tabaci*), Western Flower Thrips (*Frankliniella occidentalis*) and Intonsa Flower Thrips (*Frankliniella intonsa*)

Thrips are considered a major problem on peppers in New Zealand. Thrips that have been listed are Onion Thrips (*Thrips tabaci*), Western Flower Thrips (*Frankliniella occidentalis*) and Intonsa Flower Thrips (*Frankliniella intonsa*) and are responsible for the transfer of various viruses including Tomato spotted wilt virus (TSWV).

Although there are several thrips species that affect peppers in New Zealand, rather than discussing each pest individually, they will be discussed as a group. This approach will consider:

- Individual differences between thrips species and pepper varieties affected
- Resistance issues between species
- Insecticides that control all thrips species

Insecticides registered for thrips control in peppers or vegetables are:

Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY
		Greenhouse	Field			
<i>Amblyseius cucumeris</i>	Mite-A Thripex			Biological		
DIAZINON	Diazinon	No GH use mentioned.	Thrips	1B		Commonly used and still effective. Used in GH & field crops.
DICHLORVOS	Divan	Thrips 'GH'		1B	3	Commonly used and still effective. Used in GH & field crops.
<i>Hypoaspis aculeifer</i>	Hypomite	Thrips pupae		Biological	0	
PARATHION METHYL	Folidol	Vegetables - thrips.		1B	14	
PYRETHRUM	Garlic & Pyret. Conc	No GH use mentioned.	Thrips	3A	1	

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered

Of the registered products only diazinon and dichlorvos are recorded as being commonly used and effective on field grown and greenhouse peppers.

In the short to medium term, other insecticides for the control of thrips in peppers is required to maintain a high level of control, as resistance can develop quickly.

Insecticides used off-label in peppers for the control of thrips are:

Active ingredient	Common Trade Name	Resistance group	Comments
ABAMECTIN	Avid	6A	Thrips not listed for any crop. Commonly used and still effective + oil. Used in GH & field crops. AU permit – registered in tomato & other crops for WFT.
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	Reg. in tomato and onions. Commonly used and still effective.
DIAZINON	Diazinon	1B	Registered in field crops only. Commonly used and still effective. Used in GH & field crops.
DICHLORVOS	Divan	1B	Registered in greenhouse crops only. Commonly used and still effective. Used in GH & field crops.
DIMETHOATE	Perfekthion	1B	AU label - registration for thrips in peppers.
ENDOSULFAN	Thiodan	2A	Reg. in kumara for thrips. AU label - registration for thrips in peppers. Commonly used and still effective. Insecticide resistance issues.
FIPRONIL	Ascend	2C	No mention of thrips on NZ label. Commonly used and still effective. AU trials on WFT control.
LUFENURON	Match		Label does not list thrips control for any crop. Commonly used and still effective. Used in export crops. Used in GH & field crops.
SPINOSAD	Success	5A	Thrips only mentioned for stonefruit. AU label - registration for WFT in peppers. Commonly used and still effective. Used in export crops. Used in GH & field crops.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Used off-label

From the reports received, the current off-label insecticides used for thrips control in lettuce are working adequately. All of these products are currently registered in other crops in NZ or Australia for thrips control, other than Match (lufenuron), which has not registration for thrips, therefore efficacy is questioned. Growers are using these insecticides in both greenhouse and field grown lettuce crops.

Growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group. A resistance management system needs to be developed to encourage the adoption of biological control of thrips in combination with insecticides. Western Flower Thrips has already developed resistance to many insecticides from different resistance groups in Australia (eg. abamectin, dimethoate, spinosad, diazinon and SP).

The only ‘soft’ insecticides that are IPM compatible are abamectin and spinosad.

Insecticides that are not registered in peppers but control thrips in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
AZADIRACHTIN	NeemAzal-T/S	Botanical insecticide	Not registered on any vegetable and only on non-fruit bearing trees and vines. Mentions thrips control.
CARBARYL	Sevin	1A	Controls thrips in fruit crops.
CHLORPYRIFOS	Lorsban	1B	Reg. in kumara for 'thrips'.
DELTAMETHRIN	Decis	3A	Reg. in kumara for 'thrips'.
IMIDACLOPRID	Confidor	4A	Reg. for thrips on onion

Active ingredient	Common Trade Name	Resistance group*	Comments
IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	4A+3A	Reg. for 'thrips' on onion
LAMBDA-CYHALOTHRIN	Karate	3A	Reg. for 'onion thrips' on onions
<u>Lecanicillium lecanii</u> blastospores		Biological	
MALDISON	Malathion	1B	Thrips listed on various fruit crops however no vegetables listed.
METHAMIDOPHOS	Monitor Tamaron	1B	Reg. for thrips on onion
METHOMYL	Lannate	1B	Reg. in GH capsicums for whitefly.
TAU-FLUVALINATE	Mavrik	3A	Reg. for thrips on onion
THIACLOPRID	Calypso	4A	Thrips listed on avocado, peach and nectarine, but not any vegetable.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust

Of these products the only selected ones that are registered or have maximum residue limits (MRL) set in overseas countries that could support a registration in New Zealand are:

- Avid (abamectin)
 - MRL in: Aust, Canada, Codex, EU, Israel, Japan, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Ascend (fipronil)
 - MRL in: Aust, EU, Japan, Netherlands (peppers, vegetables)
- Entrust (spinosad)
 - MRL in: Aust, Belgium, Codex, EU, Germany, Israel, Italy, Japan, Netherlands, Switzerland, UK, USA (peppers, fruiting vegetables)
- Confidor (imidacloprid)
 - MRL in: Aust, Austria, Canada, Codex, EU, Germany, Israel, Japan, Korea, NZ, Singapore, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Karate (lambda-cyhalothrin)
 - MRL in: China, EU, Japan, Korea, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Monitor (methamidophos)
 - MRL in: Aust, Canada, China, Codex, EU, Indonesia, Israel, Italy, Japan, Korea, Malaysia, Netherlands, Sweden, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Lannate (methomyl)
 - MRL in: Aust, Codex, EU, Germany, indonesia, Israel, Japan, Korea, NZ, Switzerland, Taiwan, USA (peppers, fruiting vegetables, vegetables)
- Calypso (thiacloprid)
 - MRL in: Austria, EU, Germany, Italy, Japan, Korea, Netherlands, UK (peppers, vegetables)

Please check with the New Zealand Food Safety Authority for the most current MRL in export markets.

INSECTICIDES ALTERNATIVES IN PEPPERS FOR THRIPS

In reviewing the possible alternatives:

- Avid (abamectin) - is a systemic foliar insecticide with activity on various pests. Safe to beneficial insects. IPM compatible. Some resistance issues. Efficacy data needs to be generated in the major pepper growing areas, particularly in greenhouse peppers. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed.
- Ascend (fipronil) - a contact/systemic insecticide with good efficacy, but can be disruptive to IPM beneficial insects. Although there are limited overseas MRL, a use pattern should be developed to comply with the residue conditions for overseas countries. Efficacy data needs to be generated in the major pepper growing areas, particularly in greenhouse peppers. Residue data may also be necessary. **The product should be pursued.**
- Entrust (spinosad) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. It is very effective and has many overseas MRL. There is some resistance risk in some insects due to overuse. Efficacy data needs to be generated in the major pepper growing areas, particularly in greenhouse peppers. Residue data may also be necessary. As it is very effective in controlling a range of pests both in NZ and Aust **it should be pursued.**
- Confidor (imidacloprid) – is a systemic foliar insecticide with activity on various pests. Some impact on beneficial insects. Efficacy and crop safety needs to be determined in peppers, but AU trials show good activity on Onion thrips. Resistance management is an issue, especially in greenhouse use. As there are many overseas MRL, **the product should be pursued.** Residue data will be required. This will provide a necessary new systemic insecticide.
- Karate (lambda-cyhalothrin) – is a synthetic pyrethroid with a wide spectrum of activity. Although the SP can be highly prone to developing resistance, **one of the SP used should be pursued.** In AU trials, Karate shows good activity on Onion thrips. Efficacy data needs to be generated in the major pepper growing areas, particularly in greenhouse peppers. Residue data may also be necessary.
- Monitor (methamidophos) – is an old systemic insecticide with activity on various pests. Some impact on beneficial insects. Efficacy data needs to be generated in the major pepper growing areas, for field peppers only. Residue data may also be necessary. Shows excellent activity against all thrips in Aust. As there are many overseas MRL, **the product should be pursued.** This will provide a necessary new systemic insecticide.
- Lannate (methomyl) – is an old systemic insecticide with activity on various pests. Some impact on beneficial insects. Efficacy data needs to be generated in the major pepper growing areas, for field peppers only. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued.** This will provide a necessary new systemic insecticide.
- Calypso (thiacloprid) – is a systemic insecticide with excellent activity on a range of pests. As it is in the same resistance group as Confidor, it should not be pursued.
- Synthetic pyrethroids – these products should not be pursued, as they are highly susceptible to resistance developing.

In reviewing the thrips control program in peppers, ‘thrips’ were discussed in general, as no specific information was provided regarding the different thrips species or uses in field and greenhouse crops. With any development program in thrips control,

efficacy on specific species and cropping situations will be required with each insecticide.

A resistance management program should be developed for the use of all thrips control insecticides to maintain the effectiveness of the products and minimise resistance. This should also incorporate biological control systems.

Other insects

See **Table 4:** Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.

- Whiteflies (various)
- Sciarid Flies (*Bradysia spp.*)
- Mealy Bugs (*Pseudococcus spp.*)
- Green Vegetable Bug (*Nezara viridula*)
- Potato psyllid (*Psyllidae spp.*)

New insecticides that can be pursued

Product (active)	Target insect	Action
Confidor (imidacloprid)	Aphids Thrips	New uses
Lannate (methomyl)	Aphids Lepidoptera Thrips	New uses New uses Adding to existing registrations
Pirimor (pirimicarb)	Aphids	New use
Chess (pymetrozine)	Aphids	New use
Talstar (bifenthrin)	Aphids Lepidoptera	New uses
Gaucho (imidacloprid)	Aphids	New use
Proclaim (emamectin)	Lepidoptera	New use
Ascend (fipronil)	Lepidoptera Thrips	New uses
Steward (indoxacarb)	Lepidoptera	New use
Entrust (spinosad)	Lepidoptera Thrips	New uses
Apollo (clofentezine)	Mites	New use
Torque (fenbutatin oxide)	Mites	New use
Avid (abamectin)	Mites Thrips	New uses
Omite (propargite)	Mites	New use
Karate (lambda-cyhalothrin)	Thrips	New use
Monitor (methamidophos)	Thrips	New use

Herbicide use in peppers

See **Table 5:** Herbicides registered and used for the control of the weeds in peppers.

Weeds control in peppers is a major activity that leads to a successful crop. Weed control is required prior to sowing (general knockdown), pre-plant (selective weed control) and post-emergent (selective weed control). Weed control is only relevant to field grown peppers.

Herbicides registered for use in peppers are:

Active ingredient	Common Trade Name	Registration Peppers (field)	Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY
CLETHODIM	Arrow	Vegetables	A	35	Grass weeds - early post emergent. Occasionally used and effective on grass weeds.
FLUAZIFOP-P-BUTYL	Fusilade	Vegetables	A	35	Grass weeds - early post emergent. Occasionally used and effective on grass weeds.
SETHOXYDIM	Poast		A	35	Grass weeds - early post emergent
TRIFLURALIN	Trifluralin	Transplanted crops	D	Na	Annual broadleaf and grasses - pre-emergent. Regularly used as a pre-emergent.
GLYPHOSATE	Roundup		M		Used pre-plant. Regularly used pre-plant.
GLYPHOSATE-TRIMESIUM	Touchdown		M		Used pre-plant. Regularly used pre-plant.
DIQUAT	Reglone		L		Used pre-plant
PARAQUAT	Paraquat		L		Used pre-plant. Regularly used pre-plant.
PINE OIL	Organic Interceptor				
OXYFLUORFEN	Burnout		G		Used pre-plant with Roundup.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in Aust
	Registered

All the products indicated are listed as being commonly or occasionally used as either pre-plant weed control (general knockdown herbicides), pre-emergent herbicides or early post-emergent herbicides.

From the reports received, the current herbicides used for weed control in peppers are working adequately. To maintain a high level of weed control, growers must alternate the herbicides used between the different resistance groups, not between products from the same resistance group.

No herbicides were recorded as being used off-label in peppers for the control of weeds.

No specific weeds were identified as being a problem in field grown peppers.

New opportunities for new or alternative agrichemicals in peppers

International collaboration with USA IR-4 program

The follow table lists the USA IR-4 projects for new or existing agrichemicals in peppers. These projects are in various stages of development with some already registered, including agrichemicals that the NZ peppers industry has identified as requiring alternatives to current products or targeting specific plant pests.

Agrichemical	Pest / Status	Relevance to NZ
FUNGICIDES		
CHLOROTHANIL (Bravo)	Peppers (bell & non-bell) - ANTHRACNOSE, BOTRYTIS LEAFMOLD, FRUITROT, CERCOSPORA LEAFSPOT – in progress	Disease control identified as a high priority
CYPRODINIL + FLUDIOXONIL (Switch)	Peppers (bell & non-bell) – POWDERY MILDEW – in progress	Disease control identified as a high priority
FENHEXAMID (Teldor)	Peppers (bell & non-bell) - BOTRYTIS – in progress	Disease control identified as a high priority
QUINOXYFEN (Quintec)	Peppers (bell & non-bell) – POWDERY MILDEW – use registered	Disease control identified as a high priority
TRIFLUMIZOLE (New product)	Peppers (bell & non-bell) – POWDERY MILDEW – in progress	Disease control identified as a high priority
PHOSPHOROUS ACID (Foschek)	Peppers (bell & non-bell) - DOWNY MILDEW – use registered	Disease control identified as a high priority
INSECTICIDES		
ACEQUINOCYL (New product)	Peppers (GH & field) – Broad mite – in progress	Insect control identified as a priority
CHLORANTRANILIPROLE (New product)	Peppers (bell & non-bell) – LEPIDOPTEROUS LARVAE – under evaluation	Insect control identified as a high priority
CINNAMALDEHYDE (New product)	Peppers (non-bell) – THRIPS – use registered	Insect control identified as a priority
ETOXAZOLE (New product)	Peppers (bell & non-bell) – TWO-SPOTTED SPIDER MITE, BROAD MITE – in progress	Insect control identified as a priority
FLONICAMID (New product)	Peppers (non-bell) – APHIDS – use registered	Insect control identified as a priority
METAFLUMIZONE (New product)	Peppers (GH & field, bell & non-bell) – LEPIDOPTEROUS LARVAE – under evaluation	Insect control identified as a high priority
NOVALURON (Rimon)	Peppers (bell & non-bell) – LEPIDOPTEROUS LARVAE – under evaluation	Insect control identified as a high priority
SPIROMESIFEN (New product)	Peppers (bell & non-bell) – POTATO PSYLLID, WHITEFLY, MITES – in progress	Insect control identified as a priority
HERBICIDES		
CARFENTRAZONE-ETHYL (Affinity)	Peppers (bell & non-bell) – BROADLEAF WEEDS – use registered	Pre plant or pre-transplant
FLUMIOXAZIN (New product)	Peppers (bell & non-bell) – BROADLEAF WEEDS – in progress	Hooded sprayer between rows
FOMESAFEN (New product)	Peppers (bell & non-bell) – WEEDS – in progress	Pre-transplant
SULFENTRAZONE (Authority)	Peppers (bell & non-bell) – BROADLEAF WEEDS – use registered	Pre plant or pre-transplant

Many other projects have been identified and are being conducted by IR-4 in peppers. These are not listed, as they do not contain high priority plant pest.

There may be an opportunity to collaborate with IR-4 to assess their data for use in New Zealand. This will require a collaborative and financial commitment from HortNZ.

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Acronyms

ACVM	Agricultural Compounds and Veterinary Medicines
AgAware	AgAware Consulting Pty Ltd
APVMA	Australian Agrichemicals and Veterinary Medicines Authority
dMRL	default Maximum residue limit (mg/kg or ppm)
HortNZ	Horticulture New Zealand
IPM	Integrated pest management
IR-4	Interregional Program 4 (USA)
MRL	Maximum residue limit (mg/kg or ppm)
Plant pests	Diseases, insects, nematodes, viruses, weeds, etc
Agrichemicals ...	Plant protection products (fungicide, insecticide, herbicide, nematicides, etc).
SARP	Strategic Agrichemical Review Process
WHP	Withholding period

Acknowledgement

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Disclaimer

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Appendices

DIAGRAM 1: The Strategic Agrichemical Review Process

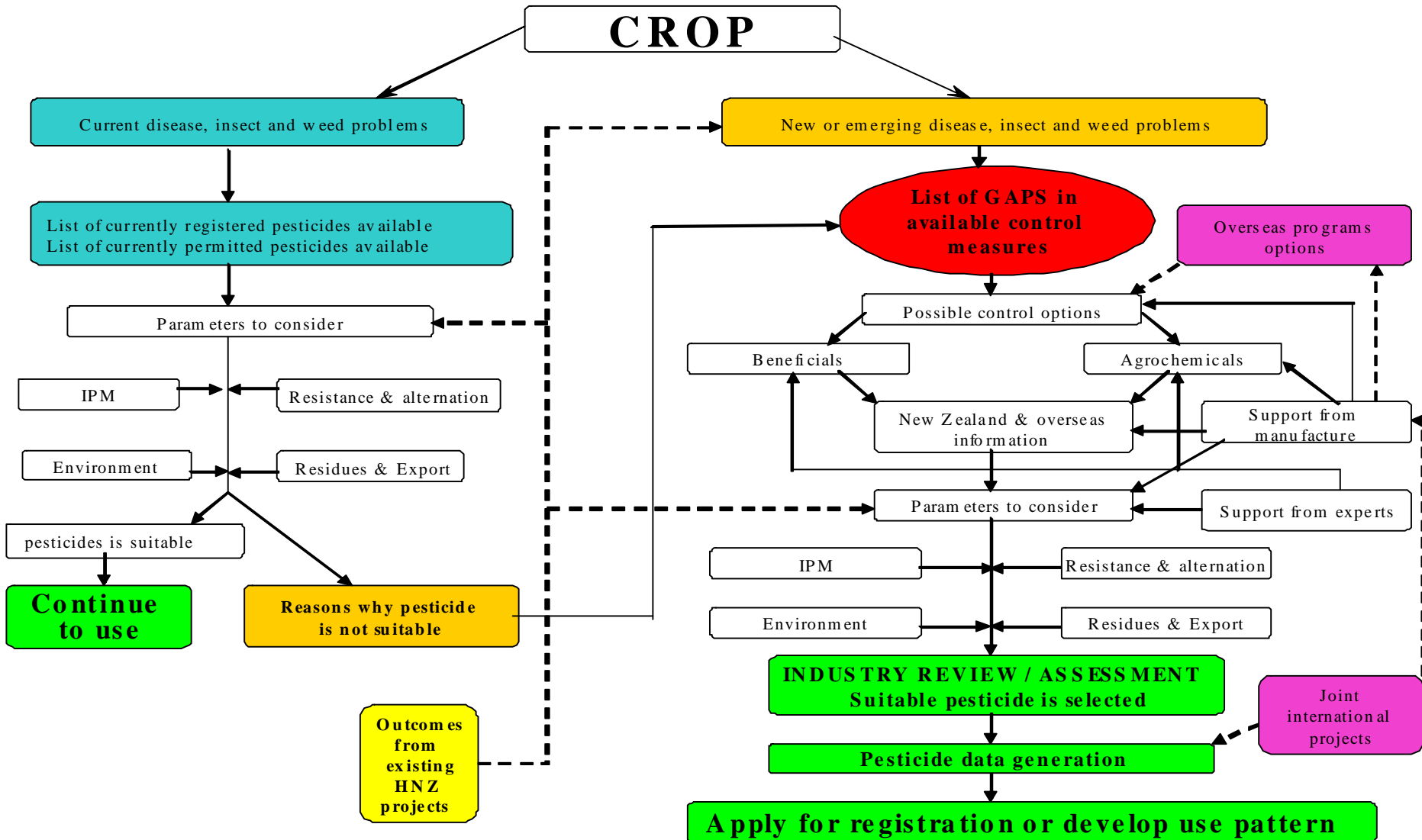


Table 1: Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Botrytis rot <i>Botrytis cinerea</i>	High - major problem in all crops	AZACONAZOLE + IMAZALIL	Scomlid Limb Aerosol	No registration of azaconazole in capsicum		C+C		Commonly used and effective used as wound treatments in GH capsicums.
			AZOXYSTROBIN	Amistar WG	No registration for capsicums. AU label - registered in grapes		K		
			<i>Bacillus subtilis</i>	Serenade	Controls botrytis in vegetables		Bio-fungicide	0	Starting to be used by growers.
			BOSCALID	Filan	New product to be registered in NZ. AU label - registered in grapes, permits in vegetables.		G		
			CAPTAN	Captan	No registration for capsicums. Registered in berries & grapes. AU label - registered in grapes & strawberries		Y		
			CARBENDAZIM	Carbendazim	Registered for botrytis in onion, beans and tomatoes (GH & field).		A		
			CHLOROTHALONIL	Bravo	No registration in capsicum. Registered in field tomatoes. AU label - registered in peppers.		Y		Commonly used and effective.
			CYPRODINIL + FLUDIOXONIL	Switch	No registration in capsicum or any other fruiting vegetables. Controls botrytis in grapes. AU permit - registered in peas.		I		Commonly used and effective.
			FENHEXAMID	Teldor	No registration in tomato or any other fruiting vegetables. Controls botrytis in grapes & berries.		J		
			FLUAZINAM	Shirlan	No registration in capsicum. Registrations in field tomatoes for botrytis control		Y		
			IMAZALIL	Fungaflor 75 WSP	No registration for vegetables or Botrytis.		C		Commonly used and effective used as wound treatments in GH capsicums.
			IPRODIONE	Rovral	No registration in capsicum. Registered for botrytis control in glasshouse tomato		B		Commonly used and effective.
PROCYMIDONE	Sumisclex	No registration in capsicum. Registered for botrytis beans, cucurbits, tomato (field), grapes & strawberries.		B		Commonly used and effective.			

Table 1 (cont): Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Botrytis rot <i>Botrytis cinerea</i> (cont)		PYRIMETHANIL	Scala	No registration in capsicum or any other fruiting vegetables. Controls botrytis in grapes. AU permit - registered in capsicum.		I		Commonly used and effective.
			Scaniavital silica	Scaniavital silica			Bio-fungicide		Clay paste wound treatment is occasionally used in GH capsicums.
			THIOPHANATE-METHYL	Topsin M-4A	No registrations in capsicums/pepper. Registered in tomato (field & GH) for botrytis.		A		
			THIRAM	Thiram	No registrations in capsicums/pepper. Registered in tomato for botrytis.		Y		
			TOLYLFLUANID	Euparean Multi	No registration in capsicum. Registered for botrytis control in grapes.				Used and effective however knocks out predator for whiteflies.
			<i>Trichoderma atroviride</i>	Sentinel	No registration in capsicum. Registered in tomato for 'botrytis stem rot'		Bio-fungicide		Occasionally used however still expensive.
	Powdery Mildew <i>Leveillula taurica</i>	High - major disease	AZOXYSTROBIN	Amistar WG	No registration for Powdery Mildew in capsicum however reg. for Powdery in Peas. AU label - registered in tomatoes.		K		Commonly used and effective, but problem with visible residues.
			BUPIRIMATE	Nimrod	No reg. in capsicums. Reg. for PM control in apples. AU label - reg. for PM in melons & apples.		H		
			CARBENDAZIM	Carbendazim	No reg. in capsicums. Reg. for PM control in cucurbits.		A		
			CHLOROTHALONIL	Bravo 720SC	No reg. in capsicums. Registered for powdery mildew control in cucurbits.		Y		Commonly used and effective, but problem with visible residues.
CYPROCONAZOLE			Alto 100SC	No reg. in capsicums. Reg. for PM control in grapes and peas		C		Occasionally used and effective.	
DIFENOCONAZOLE			Score	No reg. in capsicums. Reg. for PM control in apples		C		Occasionally used and effective.	
EPOXYCONAZOLE			Opus	No reg. in capsicums. Reg. for PM in barley and wheat		C			
FENARIMOL			Rubigan Flo	Not reg. in capsicum. Registered for PM in peas, pipfruit and grapes.		C		Occasionally used and effective.	
FLUSILAZOLE	Nustar	No reg. in vegetables. Registered for Powdery Mildew in pipfruit		C		Occasionally used and effective.			

Table 1 (cont): Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	<i>Botrytis cinerea</i> (cont)		KRESOXIM-METHYL	Stroby WG	No reg. in vegetables. Registered for Powdery Mildew in apples.		K		Commonly used and effective. Stroby only one adequate, other products create visible residue.
			MYCOBUTANIL	Systhane 400WP	No reg. in vegetables. Registered for Powdery Mildew in pipfruit		C		Occasionally used and effective.
			POTASSIUM BICARBONATE	Ecocarb	No reg. in capsicums. Registered for Powdery Mildew in tomatoes. AU permit - registered in peppers.		X		Commonly used and effective.
			QUINOXYFEN	Quintec	No reg. in vegetables. Registered for Powdery Mildew in grapes.		M		
			SPIROXAMINE	Impulse	No reg. for capsicum however reg. for powdery mildew in grapes, wheat and barley		K		
			SULPHUR	Various	Registered for PM control in 'vegetables'. AU label - registered in tomato.		Y	0	Commonly used and effective.
			TEBUCONAZOLE	Orius	No reg. in capsicums. Reg. for PM control in peas and wheat		C		Occasionally used and effective.
			TOLYLFLUANID	Euparean Multi	No reg. in capsicums. Registered for PM in apples and grapes.		X		Commonly used and effective however knocks out predator for whiteflies.
			TRIADEMENOL	Cereous	Not reg. for capsicum or PM. AU permit - powdery mildew control in peppers.		C		
			TRIADIMEFON	Miltek	No reg. in capsicums. Reg. for PM control in grapes and peas and cucumbers		C		Occasionally used and effective.
			TRIFLOXTSTROBIN	Flint	No registration for capsicums. Registered for PM in cucurbits. AU permit - registered for PM in capsicums.				
			TRIFORINE	Saprol	No registration for capsicums. Powdery mildew control only listed for cucurbit		X		Commonly used and effective.
Stem Blight <i>Didymella spp.</i>	High	AZOXYSTROBIN	Amistar WG	No registration for capsicums or Stem Blight. AU label - registered for Gummy stem blight in cucurbits.		K		Commonly used and effective.	
		CHLOROTHALONIL	Bravo 720SC	No registration for capsicums. Registered for Gummy stem blight in cucurbits.		Y		Commonly used and effective.	

Table 1 (cont): Fungicides registered and used for the control of the MAJOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Stem Blight <i>Didymella spp.</i> (cont)		COPPER OXYCHLORIDE	Various	No registration for capsicums. Registered for Gummy stem blight in cucurbits.		Y		
			COPPER HYDROXIDE + MANCOZEB	Mancocide DF	No registration for capsicums or Stem Blight. AU label - registered for Gummy stem blight in cucurbits.		Y		
			MANCOZEB	Manzate 200 DF	No registration for capsicums or Stem Blight. AU label - registered for Gummy stem blight in cucurbits.		Y		
			METIRAM	Polyram	No registration for capsicums or Stem Blight. AU label - registered for Gummy stem blight in cucurbits.		Y		
			PROPINEB	Antracol	No registration for capsicums or Stem Blight. AU label - registered for Gummy stem blight in cucurbits.		Y		
			TOLYLFLUANID	Euparen Multi	No registration for capsicums or Stem Blight. AU label - No registration for capsicums.		X		Used and effective however knocks out predator for whiteflies.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered
	Used off-label

Table 2: Fungicides registered and used for the control of the MINOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Fusarium Dry Rot <i>Fusarium oxysporum</i>	Moderate	METAM SODIUM	Fumazol	No mention of GH use.				
			PROCHLORAZ	Octave	No registration in capsicums/peppers. Only vegetable registration is for Mushrooms for verticillium control		C		Commonly used and effective.
			QUINTOZENE	Terrachlor 75 WP	No mention of GH use.	Pre-sowing soil treatment for all 'vegetables'	Y		Occasionally used and effective.
			THIOPHANATE-METHYL	Topsin M-4A	No registrations in capsicums/pepper. Registered in tomato (GH & field) for botrytis control. No mention of 'Fusarium dry rot' on the label.		A		Commonly used and effective.
	Late Blight <i>Phytophthora capsici</i>	Moderate	AZOXYSTROBIN	Amistar	No registration in capsicum. Registration in field tomatoes and potato for late blight as a foliar applied product.		K		
			CHLOROTHALONIL	Bravo Weather Stik	No registration in capsicum. Registrations in field tomatoes and potato for late blight.		Y		
			COPPER HYDROXIDE	Various	No registration in capsicum. Registrations in field tomatoes and potato for late blight.		Y		
			COPPER HYDROXIDE + MANCOZEB	Mancocide DF	No registration in capsicum. Registrations in potato for late blight.		Y		
			COPPER OXIDE	Nordox 75 WG	No registration in capsicum. Registrations in potato for late blight.		Y		
			COPPER OXYCHLORIDE	Various	No registration in capsicum. Registrations in potato for late blight.		Y		
			DIMETHAMORPH + MANCOZEB	Acrobat MZ	No registration in capsicum. Registrations in potato for late blight.		XY		
			FENAMIDONE + MANCOZEB	Sereno	No registration in capsicum. Registrations in potato for late blight.		Y		
			FLUAZINAM	Shirlan	No registration in capsicum. Registrations in potato & field tomato for late blight.		Y		
			MANCOZEB	Manzate 200 DF	No registration in capsicum. Registrations in potato & field tomato for late blight.		Y		

Table 2 (cont): Fungicides registered and used for the control of the MINOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Late Blight <i>Phytophthora capsici</i> (cont)		METALAXYL-M + MANCOZEB	Ridomil Gold MZ WG	No registration in capsicum. Registrations in potato & field tomato for late blight.		DY		
			METIRAM	Polyram	No registration in capsicum. Registrations in potato & field tomato for late blight.		Y		
			PHOSPHORUS ACID	Foschek	No mention of GH use.	Registered for 'nursery stock' for <i>Phytophthora</i> .	Y		
			PROPINEB	Antracol	No registration in capsicum. Registrations in potato for late blight.		Y		
Phytophthora Rot <i>Phytophthora spp</i>	Low - Seedling problem only.		ETRIDIAZOLE	Terrazole	No mention of GH use.	Apply as a 'dry soil mix in seed box and potting mixes' for <i>Phytophthora</i> control.	X		
			FOSETYL-AL	Aliette	No registration in capsicum. Registrations in fruit for <i>Phytophthora</i> .		Y		
			METALAXYL-M	Ridomil Gold 2.5G	No registration in capsicums.		D		Seedling soil occasionally mixed with Ridomil Gold 2.5G.
			METAM SODIUM	Fumasol	No mention of GH use.		X		
			phosphorus acid	Foschek	No mention of GH use.	Registered for 'nursery stock' for <i>phytophthora</i> control (foliar applied). Listed as a fertiliser soil drench.	Y		
Pythium Root Rot <i>Pythium spp</i>	Low		ETRIDIAZOLE	Terrazole	No mention of GH use.	Apply as a 'dry soil mix in seed box and potting mixes' for <i>Pythium</i> control.	X		Commonly used and effective as a seed treatment.

Table 2 (cont): Fungicides registered and used for the control of the MINOR recorded diseases in peppers.

Crop	Disease name	Priority	Active ingredient	Common Trade Name	Registration		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Peppers (field and greenhouse)	Pythium Root Rot <i>Pythium spp</i> (cont)		METALAXYL-M	Apron XL	Registered for control of Pythium as a seed applied treatment in peas and brassicas.		D		Commonly used and effective as a seed treatment.
			METAM SODIUM	Fumasol	No mention of GH use.		X		
			phosphorus acid	Foschek	No mention of GH use.	Registered for 'nursery stock' for phytophthora control (foliar applied). Listed as a fertiliser soil drench.	Y		Occasionally used and effective as foliar treatment.
			propamocarb	Previcur N	No registrations in any vegetable. Listed for 'ornamentals' only.		Y		Occasionally used and effective as foliar treatment.
			Trichoderma harzianum	Trichopel	Sold as 'biological fertilisers' not fungicides.		Bio-fungicide		Occasionally used and effective as a seed treatment.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered
	Used off-label

Table 3: Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.


Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	APHIDS 	High - major pest as transfers virus. Green peach aphid problem is high.	ACEPHATE	Orthene	No registration in peppers. Reg. for 'aphids' in lettuce and potato. AU label - aphid control in tomato.		1B		
			ACETAMIPRID	Mospilan	AU label - aphid control in potato.		4A		
			ALPHA-CYPERMETHRIN	Dominex Fastac	No registration in peppers. 'Aphids' listed for tomatoes. AU label - aphid control in various crops.		3A		
	Green Peach Aphid (GPA) <i>Myzus persicae</i>		APHID PARASITE'	<i>Aphidius colemani</i>			Bio-insecticides		
	Black Peach Aphid <i>Brachycaudus persicae</i>		APHIDOLETED	<i>Aphidoletes aphidimyza</i>			Bio-insecticides		
	Cabbage Aphid (CA) <i>Brevicoryne brassicae</i>		AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines (aphids).		Botanical insecticide		
	Carrot black aphid <i>Cavariella aegopodii</i>		<i>Beauvaria bassiana</i>	Botanigard ES Naturalis-O			Bio-insecticides		
	Carrot willow aphid <i>Cavariella aegopodii</i>		BIFENTHRIN	Talstar 100EC	No registration in peppers. Reg. on field tomatoes, pumpkins, squash for 'aphids'. AU label - aphid control in various crops.		3A		
	Fox Glove aphid <i>Aulacorthum solani</i>		CANOLA OIL	Eco-oil	GPA. AU label - aphid control in peppers.		Vegetable Oil	3	
	Lettuce Aphid <i>Nasonovia ribis-nigri</i>		CHLORPYRIFOS	Lorsban 50EC	No registration in peppers. Reg for 'aphids' in winter squash and vegetable brassicas. AU label - aphid control in tomato.		1B		
	Melon aphid <i>Aphis gossypii</i>		DELTAMETHRIN	Decis Forte	Reg. for 'aphids' in squash		3A		
	Potato aphid <i>Macrosiphum euphorbiae</i>		DIAZINON	Diazinon 50 WP	No GH listing.	Aphids	1B	14	
			DICHLORVOS	Divap	Aphids		1B	3	

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	APHIDS (cont)		DIMETHOATE	Perfekthion S	No registration in peppers. Reg. for CA in potato, carrots and brassicas. AU label - registration for aphids in peppers.		1B		
			ENDOSULFAN	Thiodan	No registration in peppers. Reg. on tomato, vegetable brassica and potato. AU label - aphid control in peppers.		2A		
			FATTY ACIDS (K SALTS)	Nature's Way Insect Spray	No GH listing.		Unlisted	1	
			IMIDACLOPRID	Gaucho	No registration in peppers. Reg. on potato and squash for 'aphids'.		4A		
			IMIDACLOPRID	Confidor	Registered for aphids on brassicas and vegetable seedlings. AU label - registration for aphids in peppers.		4A		Commonly used and effective. Confidor affects Bombus. Green peach aphid listed on AU label.
			Lecanicillium lecanii blastospores						
			MALDISON	Malathion 50EC	No GH listing.	Aphids	1B	3	
			METHAMIDOPHOS	Monitor/Ta maron	No registration in peppers. Reg. for 'aphids' in potato. AU label - registration for aphids in peppers.		1B		
			METHOMYL	Lannate L	No registration in peppers. Reg. for GPA in tomato, cauliflower, cabbage and lettuce		1A		Occasionally used and effective. Not IPM compatible.
			PARATHION METHYL	Folidol	Vegetables - aphids.		1B	14	
			PERMETHRIN + PIRIMIPHOS-METHYL	Attack	No registration in peppers. Reg. for 'aphids' in GH tomato, cucurbits group and vegetable brassica		3A+1B		
			PERMETHRIN + PIPERONYL BUTOXIDE	Permigas			3A	3	
			PERMETHRINS + PIPERONYL BUTOXIDE	Greenseals Pyrethrum	No GH listing.	Aphids	3A	0	
	PHORATE	Phorate	No registration in peppers. Reg for 'aphids' in cucurbits, brassicas, potato & carrot. AU label - aphid in tomato.		1B				

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.


Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	APHIDS (cont)		PIRIMICARB	Pirimor 50	No registration in peppers. Reg. on tomato, cucurbits group, vegetable brassicas and lettuce. AU label - registration for aphids in peppers.		1A		Commonly used and effective. IPM compatible.
			PIRIMIPHOS-METHYL	Actellic			1B		
			PYMETROZINE	Chess WG	No registration in peppers. Reg. in tomato, vegetable brassica, lettuce and potato		9A		Commonly used and effective. IPM compatible. Chess is the only product compatible with Aphidius.
			PYRETHRINS	Garlic & Pyrethrum Concentrate	No GH listing.	Aphids	3A	1	
			ROTENONE	Derris Dust	No GH listing.	1	21A	1	Label says 'helpful in the control of aphids'
			TAU-FLUVALINATE	Mavrik	No registration in peppers. Reg. on field tomato for GPA. AU label - aphid control in tomato.		3A		
			TERBUFOS	Counter 20G	No registration in peppers. Aphids listed for forage brassicas as a seed/fertiliser treatment.		1B		
			THIACLOPRID	Calapso	No registration for vegetables or aphids.		4A		
			THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFUVALINATE	Guardall	No registration in peppers. Reg. for 'aphids' on tomato		3A		
	CATERPILLARS 	High - major pest. Caterpillar problems include Heliothis, Tomato stem borer and Loopers.	ACEPHATE	Orthene	No reg. in capsicum or peppers. Reg. in tomato, brassicas, lettuce and potato		1B		
			ALPHA-CYPERMETHRIN	Dominex/Fa stac	No reg. in capsicum or peppers. Reg. in tomato and brassica.		3A		Commonly used and effective. Not IPM compatible.
			<i>Bacillus thuringiensis t. sub. Kurstaki</i>	Bacillus thuringiensis	Caterpillars		11C	0	Commonly used and effective. IPM compatible.
			<i>Beauveria bassiana</i>	Botanigard ES, Naturalis-O					Bio-insecticides
		Heliothis or Tomato Fruitworm or Corn Earworm (TFW) <i>Helicoverpa armigera</i>							
	Tomato stem borer <i>Symmetrischema plaesiosoma</i>								

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	Loopers(L) <i>Chrysodeixis spp.</i>	CATERPILLAR (cont)	BIFENTHRIN	Talstar 100EC and Talstar 80 SC	No reg. in capsicum or peppers. Reg. in brassicas and field tomato		3A		Commonly used and effective. Not IPM compatible.
	Army Caterpillar <i>Pseudaletia separata</i>		CARBARYL	Sevin	No GH use mentioned.	L, PTM, TFW + other caterpillars 'Vegetable Crops'	1A	1	
	Copper caterpillar (Kumara) <i>Lycaena salustius</i>		CHLORPYRIFOS	Lorsban 750 WG	No reg. in capsicum or peppers. Corn Earworm is listed for maize/sweet corn in NZ. AU label - reg. in peppers for Heliothis.		1B		
	Cutworm <i>Agrotis spp.</i>		CYPERMETHRIN	Ripcord	No reg. in capsicum or peppers. Reg. in cauliflower, cabbage and tomato		3A		Commonly used and effective. Not IPM compatible.
	Diamond Back Moth (DBM) <i>Plutella xylostella</i>		DELTAMETHRIN	Decis Forte	No reg. in capsicum or peppers. Reg. in field tomato, potato and brassicas.		3A		Commonly used and effective. Not IPM compatible.
	Greasy cutworm(GC) <i>Agrotis ipsilon</i>		DIAZINON	Diazinon 50 WP	No GH use mentioned.	Caterpillars	1B	14	
	Green looper (GL) <i>Thysanoplusia orichalcea</i>		DICHLORVOS	Divap	Caterpillars		1B	3	
	Potato Tuber Moth (PTM) <i>Phthorimaea operculella</i>		EMAMECTIN	Proclaim	No reg. in vegetables. AU label - reg. in capsicums for Heliothis.		6A		
	Soybean looper (SL)		ENDOSULFAN	Thionex	No reg. in capsicum or peppers. Reg. for various caterpillars in brassicas and potato. AU label - reg. in capsicums for Heliothis.		2A		Occasionally used and effective. Not IPM compatible.
	Tropical Caterpillar <i>Spodoptera litura</i> (F.)		ESFENVALERATE	Sumi-Alpha	No reg. in capsicum or peppers. Reg. in tomato, cucurbits group, brassicas, potato and onion.		3A		
	White Butterfly (WB) <i>Pieris rapae</i>		FIPRONIL	Ascend	No reg. in capsicum or peppers. Reg. in brassicas for various Lepidoptera.		2C		
			IDOXACARB	Steward 150SC	No reg. in capsicum or peppers. Reg. in 'head' lettuce and brassicas for various Lepidoptera.		22A		

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	CATERPILLAR (cont)		LAMBDA-CYHALOTHRIN	Karate	No reg. in capsicum or peppers. Reg. in field tomato, brassica and potato.		3A		Commonly used and effective. Not IPM compatible.
			MALDISON	Malathion 50EC	No GH use mentioned.	DBM, TFW, WB	1B	3	
			METHAMIDOPHOS	Monitor/Tamaron	No reg. in capsicum or peppers. Reg. for various caterpillars in tomato, brassica and potato. AU label - reg. in capsicums for Heliothis.		1B		
			METHOMYL	Lannate L	No reg. in capsicum or peppers. Reg. cauliflower, cabbage, lettuce and tomato.		1A		Commonly used and effective. Not IPM compatible.
			PARATHION METHYL	Folidol	Vegetables - caterpillars.		1B	14	
			PERMETHRIN + PIRIMIPHOS-METHYL	Attack	No reg. in capsicum or peppers. Reg. in GH tomato, cucurbits group and vegetable brassicas		3A+1B		
			PYRETHRUM	Garlic & Pyrethrum Concentrate	No GH use mentioned.	Cabbage Moth and caterpillars	3A	1	
			ROTENONE	Derris Dust	No GH use mentioned.	DBM, WB	21A	1	
			SPINOSAD	Entrust Naturalyte	No reg. in capsicum or peppers. Reg. in field tomato and brassica. AU label - reg. in capsicums for Heliothis.		5A		
			TAU-FLUVALINATE	Mavrik	No reg. in capsicum or peppers. Reg. in cabbage and field tomato.		3A		
			THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFUVALINATE	Guardall	No reg. in capsicum or peppers. Reg. in tomato and cabbage.		3A		
			TRICHLORFON	Trifon	No reg. in capsicum or peppers. Reg. in tomato and brassica.		1B		
			TRICHLORFON + CYPERMETHRIN	Partna	No reg. in capsicum or peppers. Reg. in cauliflower, cabbage and tomato.		1B+3A		

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.


Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	<p>MITES</p>  <p>Two-Spotted Mite <i>Tetranychus urticae</i></p> <p>Tomato Russet Mite (TRM) <i>Aceria lycopersici</i> (<i>Wolffenstein</i>)</p> <p>Broad Mite <i>Polyphagotarsonemus latus</i></p> <p>European Red Mite <i>Bradysia spp.</i></p> <p>Strawberry Mite <i>Phytonemus pallidus</i></p>	High – Two-spotted Mite is a major problem. Broad mite and Tomato Russet Mite are minor problems. The predator mites 'persimillus' is common used.	ABAMECTIN	Avid	No reg. in capsicum or peppers. TRM, TSM listed for GH Tomato, ERM listed for pipfruit. AU label - reg. in capsicums for various mites.		6A		
			AZOCYCLOTIN	Peropal	No Reg. in Vegetable Crops. Controls TSM and ERM in various fruit crops				
			BUPROFEZIN	Applaud Ovation	Reg. on GH capsicum for whitefly. No reg. for mites.	17A		Occasionally used and effective for Broad mite	
			CANOLA OIL	Eco-oil	Mites		0	Occasionally used and effective - field crops.	
			CLOFENTEZINE	Apollo 50SC	Label & AU label - lists TSM and ERM for various crops but not vegetable crops	10A		Occasionally used and effective - field crops.	
			DICHLORVOS	Divap	Mites	1B	3		
			DICOFOL	Kelthane 35	No GH use mentioned.	Mites	2B	7	
			ENDOSULFAN	Thionex	No reg. in capsicum or peppers. Reg. for various mites in fruits. AU label - reg. in capsicums for various mites.	2A		Occasionally used and effective - field crops. Used for Broad mite and Strawberry mite.	
			FATTY ACIDS (K SALTS)	Yeates Mite Killer	No GH use mentioned.	ERM, TSM	Not listed	1	
			FENBUTATIN OXIDE	Torque	Label & AU label - lists TSM and ERM for various crops but not vegetable crops	12A		Occasionally used and effective - field crops.	
			FENPYROXIMATE	Fenamite	No reg. in capsicum or peppers. Reg. for TSM, ERM in pipfruit	21A			
			MILBEMECTIN	Mit e mec	No reg. in capsicum or peppers. Reg for TSM, ERM in apples	6B			
			<i>Phytoseiulus persimilis</i>	Two spotted mite predator	Vegetables	Bio-insecticide			
			PROPARGITE	Omite 30W	No Reg. in Vegetable Crops. TSM and ERM control in various crops. AU label - reg. in tomato for various mites.	14A			

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.


Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
					Greenhouse	Field				
Capsicum (field and greenhouse)	MITES (cont)		TAU-FLUVALINATE	Mavrik Flo	No reg. in capsicum or peppers. Reg. for Mites in Ornamentals		3A			
	THRIPS 	High - major pests including Onion, Western Flower and Intonsa Flower thrips.	ABAMECTIN	Avid	No reg. in capsicum or peppers. Thrips not listed for any crop.		6A		Commonly used and still effective + oil. Used in GH & field crops. AU permit – registered in tomato for WFT.	
	Onion Thrips <i>Thrips tabaci</i>		ALPHA-CYPERMETHRIN	Dominex Fastac	No reg. in capsicum or peppers. Reg. in tomato and onions		3A		Commonly used and still effective.	
				<i>Amblyseius cucumeris</i>	Mite-A Thripex		Reg. on GH tomato, GH capsicum and GH cucumber	Bio-insecticides		
	Western Flower Thrips (Cucumerous thrips) <i>Frankliniella occidentalis</i>		AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions thrips control		Botanical insecticide			
	Intonsa Flower Thrips <i>Frankliniella intonsa</i>		CARBARYL	Sevin	No thrips control in any veg. crop however controls thrips in fruit crops		1A			
			CHLORPYRIFOS	Lorsban 750 WG	No reg. in capsicum or peppers. Reg. in kumara for 'thrips'		1B			
			DELTAMETHRIN	Decis Forte	No reg. in capsicum or peppers. Reg. in kumara for 'thrips'		3A			
			DIAZINON	Diazinon 800	No GH use mentioned.	Thrips		1B		Commonly used and still effective. Used in GH & field crops.
			DICHLORVOS	Divan	Thrips 'GH'	Reg. for 'thrips' on GH tomato and GH capsicum		1B	3	Commonly used and still effective. Used in GH & field crops.
			DIMETHOATE	Perfekthion S	No registration in peppers. AU label - registration for thrips in peppers.		1B			
			ENDOSULFAN	Thiodan	No reg. in capsicum or peppers. Reg. in kumara for thrips. AU label - registration for thrips in peppers.		2A		Commonly used and still effective. Insecticide resistance issues.	
			FIPRONIL	Ascend	No reg. in capsicum or peppers. No mention of thrips on NZ label. AU trials on WFT control.		2C		Commonly used and still effective.	

Table 3 (cont): Insecticides registered and used for the control of the MAJOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	THRIPS (cont)		<i>Hypoaspis aculeifer</i>	Hypomite	Thrips pupae		Bio-insecticides	0	
			IMIDACLOPRID	Confidor	No reg. in capsicum or peppers. Reg. for thrips on onion		4A		
			IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	No reg. in capsicum or peppers. Reg. for 'thrips' on onion		4A+3A		
			LAMBDA-CYHALOTHRIN	Karate	No reg. in capsicum or peppers. Reg. for 'onion thrips' on onions		3A		
			<i>Lecanicillium lecanii</i> blastospores						
			LUFENURON	Match	No reg. in capsicum or peppers. Label does not list thrips control for any crop.				Commonly used and still effective. Used in export crops. Used in GH & field crops.
			MALDISON	Malathion 50EC	Thrips listed on various fruit crops however no vegetables listed.		1B		
			METHOMYL	Lannate L	Reg. for 'whitefly' on GH capsicum		1A		
			METHAMIDOPHOS	Monitor Tamaron	Reg. for thrips on onion		1B		
			PARATHION METHYL	Folidol	Vegetables - thrips.		1B	14	
			PYRETHRUM	Garlic & Pyrethrum Concentrate	No GH use mentioned.	Thrips	3A	1	
			SPINOSAD	Success	No reg. in capsicum or peppers. Thrips only mentioned for stonefruit. AU label - registration for WFT in peppers.		5A		Commonly used and still effective. Used in export crops. Used in GH & field crops.
			TAU-FLUVALINATE	Mavrik	No reg. in capsicum or peppers. Reg. for thrips on onion		3A		
	THIACLOPRID	Calypso	Thrips listed on avocado, peach and nectarine, but not any vegetable.		4A				

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered
	Used off-label

Table 4: Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.


Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	WHITEFLIES 	Moderate	AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions whitefly control		Botanical insecticide		Commonly used and effective. Used in GH & field crops.
			BUPROFEZIN	Applaud Ovation	Greenhouse Whitefly	Reg. on GH (tomato, capsicum & cucumber), melon and zucchini	17A	3	Commonly used and effective. Used in GH & field crops. Insecticide resistance issues.
	Greenhouse whitefly (GW) <i>Trialeurodes vaporariorum</i>		CANOLA OIL	Eco-oil	Greenhouse Whitefly		Vegetable Oil	0	Commonly used and effective. Used in GH & field crops.
	Tobacco Whitefly (TW)(Silverleaf) <i>Bemisia tabaci</i> (biotype B)		DICHLORVOS	Divap	White fly	Reg. for 'whitefly' on GH tomato and GH capsicum	1B	3	
			<i>Encarsia formosa</i>	En-force, En-Strip		Reg. on GH tomato, GH capsicum and GH cucumber	Bio-insecticides	0	
			ENDOSULFAN	Thiodan	No reg. in capsicum or peppers. Reg, for whitefly on tomato		2A		
			FATTY ACIDS (K SALTS)	Nature's Way Insect Spray	No GH use mentioned.		Unlisted	1	AU label - lists whitefly. No listing of Whitefly on NZ label
			IMIDACLOPRID	Gaucho	No reg. in capsicum or peppers. No Whitefly control for any crop		4A		
			<i>Lecanicillium lecanii</i> blastospores						
			METHOMYL	Lannate L	Whitefly	Reg. for 'whitefly' on GH tomato, GH capsicum and GH cucumber	1A	2	
			OXAMYL	Vydate	Only vegetable reg. in carrots. Whiteflies not listed.		1B		Common used and effective - as a drench at crop start.
			PARATHION METHYL	Folidol	Vegetables - sucking insects.		1B	14	
			PERMETHRIN + PIRIMIPHOS-METHYL	Attack	No reg. in capsicum or peppers. Reg. for GH tomato		3A+1B		

Table 4 (cont): Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	WHITEFLIES (cont)		PERMETHRUM	Garlic & Pyrethrum Concentrate	No GH use mentioned.	GW	3A	1	
			PIRIMIPHOS-METHYL	Actellic	No reg. in capsicum or peppers. Reg. for 'underglass' tomato and 'underglass' cucurbits group.		1B		
			PYMETROZINE	Chess WG	No reg. in capsicum or peppers. Reg. for 'whitefly' on GH and field tomato		9A		Commonly used and effective. Used in GH & field crops. Insecticide resistance issues.
			THIACLOPRID	Calypso	No reg. in capsicum or peppers. Whitefly not listed on Calypso label		4A		Commonly used and effective. Used in GH & field crops. Insecticide resistance issues. No Whitefly listed on AU label or NZ label
	Sciarid Flies <i>Bradysia spp.</i>	Moderate	<u>Bacillus thuringiensis israelensis</u>	VectoBac 12AS	No reg. in capsicum or peppers. Label lists mosquitoes and blackflies		Bio-insecticide		Commonly used and effective. Used in GH & field crops.
			DIAZINON	Diazinon 800	Registered in field capsicums for thrips. No diazinon label lists sciarid fly for control in any crop.		1B		Commonly used and effective. Used in GH & field crops.
			DICHLORVOS	Divap	Sciarid Fly	Reg. for 'sciarid fly' in GH tomato, GH capsicum	1B	3	
			<u>Hypoaspis aculeifer</u>	Entomite	No reg. in capsicum or peppers. Reg. for GH tomato, GH cucumber, lettuce, potato, kumara, onion and carrot		Bio-insecticides		
			<u>Hypoaspis aculeifer</u>	Hypomite			Bio-insecticides	0	
			IMIDACLOPRID	Gaucho	Sciarid fly control not mentioned for any crop		4A		
		OXAMYL	Vydate	Only vegetable reg. in carrots. Sciarid flies not listed.		1B		Common used and effective - as a drench at crop start. No mention of sciarid flies on Vydate label.	
		<u>Steinermema feltae</u>	Gnatnem	No GH use mentioned.		Bio-insecticides	0	Common used and effective.	
		SYNTHETIC PYRETHROIDS	various	No reg. in capsicum or peppers. Checked the most common SP labels. No Sciarid flies listed.		3A		Common used and effective on adults. No mention of any synthetic pyrethroid for sciarid flies.	

Table 4 (cont): Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	Mealy Bugs <i>Pseudococcus spp.</i>	Moderate	IMIDACLOPRID	Gaucho	No reg. in capsicum or peppers. Mealybug not listed on label in NZ		4A		
			AZADIRACHTIN	NeemAzal-TS	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions mealy bug control		Botanical insecticide		
			BUPROFEZIN	Applaud/Ovation	No reg. in capsicum or peppers. Mealy bug listed for peaches, grapes, persimmons, pipfruit		17A		Commonly used and effective. Used in GH & field crops.
			CARBARYL	Sevin	No reg. in capsicum or peppers. Mealy bug control in pipfruit		1A		
			CRYPTOBUG (Biological)	<i>Cryptolaemus montrouzieri</i>			Bio-insecticide		
			PROTHIOFOS	Tokuthion	No reg. in capsicum or peppers. Controls mealy bug in grapes and pipfruit		1B		
			THIACLOPRID	Calypso	Mealy bug control reg. for apples however no vegetable crop		4A		
	Green Vegetable Bug <i>Nezara viridula.</i>	Moderate	CARBARYL	Sevin	No reg. in capsicum or peppers. Green Veg. Bug not listed for any crop in NZ		1A		
			ENDOSULFAN	Thiodan	No reg. in capsicum or peppers. Reg. for GVB control in tomato		2A		
			IMIDACLOPRID	Confidor	No reg. in capsicum or peppers. Green Vegetable Bug not listed on Confidor label in NZ or AU		4A		Confidor (imidacloprid) commonly used and effective as spot treatment
			IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	No reg. in capsicum or peppers. Lists Green Vegetable Bug for sweet corn		4A+3A		
			METHAMIDOPHOS	Monitor Tamaron	No reg. in capsicum or peppers. Listed on maize/sweet corn for Green veg bug		1B		
			TRICHLORFON	Trifon	Reg. for tomato		1B		
	Potato psyllid <i>Psyllidae spp.</i>	Low - New pest, found in capsicum crop only.	ABAMECTIN	Avid	Psyllids not listed for any crop		6A		Not used, but likely to work.
			BUPROFEZIN	Applaud Ovation	Psyllids not listed for any crop		17A		Not used, but likely to work.
			DIMETHOATE	Dimethoate	AU label - lists psyllid control in eucalypts		1B		
			ENDOSULFAN	Thiodan	Psyllids not listed for any crop		2A		Not used, but likely to work.

Table 4 (cont): Insecticides registered and used for the control of the MINOR recorded insect pests in peppers.

Crop	Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations		Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
					Greenhouse	Field			
Capsicum (field and greenhouse)	Potato psyllid <i>Psyllidae spp.</i> (cont)		ESFENVALERATE	Sumi-Alpha	No mention of Psyllids on label for any crop		3A		
			IMIDACLOPRID	Confidor	AU label - lists psyllid (lerps) control in non-bearing citrus		4A		
			METHOMYL	Lannate L	Psyllids not listed for any crop		1A		Not used, but likely to work.
			ORGANOPHOSPHATES		Checked the most common OP labels. No psyllid mentioned		1B		Not used, but likely to work.
			PYMETROZINE	Chess WG	Psyllids not listed for any crop		9A		Not used, but likely to work.
			SPINOSAD	Entrust Naturalyte	Psyllids not listed for any crop		5A		Not used, but likely to work.
			SYNTHETIC PYRETHROIDS		Checked the most common SP labels. No psyllid mentioned.		3A		Not used, but likely to work.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in NZ
	Actives under review in Aust
	Registered
	Used off-label

Table 5: Herbicides registered and used for the control of the weeds in peppers.

Crop	Active ingredient	Common Trade Name	Registration Peppers (field)	Resistance group	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
Capsicum (field)	CLETHODIM	Arrow	Vegetables	A	35	Grass weeds - early post emergent. Occasionally used and effective on grass weeds.
	FLUAZIFOP-P-BUTYL	Fusilade WG	Vegetables	A	35	Grass weeds - early post emergent. Occasionally used and effective on grass weeds.
	SETHOXYDIM	Poast		A	35	Grass weeds - early post emergent
	TRIFLURALIN	Trifluralin	Transplanted crops	D	Na	Annual broadleaf and grasses - pre-emergent. Regularly used as a pre-emergent.
Vegetables	GLYPHOSATE	Roundup		M	Na	Used pre-plant. Regularly used pre-plant.
	GLYPHOSATE-TRIMESIUM	Touchdown		M	Na	Used pre-plant. Regularly used pre-plant.
	DIQUAT	Reglone		L	Na	Used pre-plant
	PARAQUAT	Paraquat		L	Na	Used pre-plant. Regularly used pre-plant.
	PINE OIL	Organic Interceptor			Na	
	OXYFLUORFEN	Burnout		G	Na	Used pre-plant with Roundup.

* Resistance groups combine agrichemicals with the same mode of action.

	Actives under review in Aust
	Registered