



CUCURBITS

Strategic Agrichemical Review Process

2007

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AgAware Consulting

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Project leaders names:

Mr Peter Dal Santo & Mr Rob Velthuis
AgAware Consulting P/L
21 Rosella Avenue
Strathfieldsaye Victoria Australia 3551
Ph: +61 3 5439 5916
Fax: + 61 3 5439 3391
Email: pds@agaware.com.au

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 cucurbit industry across New Zealand. The information in this report will assist the cucurbits 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 cucurbits 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 option used in cucurbits. 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 issues in cucurbits.

Diseases and fungicides

The high priority diseases are:

Botrytis	<i>Botrytis cinerea</i>
Fusarium Dry Rot (Fusarium Fruit Rot)	<i>Fusarium solani f. sp. cucurbitisae</i> , <i>Fusarium oxysporum f. sp. melonis</i>
Powdery mildew	<i>Sphaerotheca fuligina</i>
Sclerotinia rot	<i>Sclerotinia sclerotiorum</i>

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

Product (active)	Target disease	Action
Bravo (chlorothalonil)	Botrytis Powdery mildew	Adding to existing registrations
Captan (captan)	Botrytis	New use
Switch (cyprodinil + fludioxonil)	Botrytis Sclerotinia rot	New use
Rovral (iprodione)	Botrytis	New use
Filan (boscalid)	Botrytis Sclerotinia rot	New use
Fungaflor (imazalil)	Fusarium	New use
Nimrod (bupirimate)	Powdery mildew	Adding to existing registrations
Ecocarb (potassium bicarbonate)	Powdery mildew	Adding to existing registrations
Flint (trifloxystrobin)	Powdery mildew	Adding to existing registrations
Impulse (spiroxamine)	Powdery mildew	New use
Shirlan (fluazinam)	Sclerotinia rot	New use
Folicur (tebuconazole)	Sclerotinia rot	New use

Steps forward

1. For each of the major diseases identified, efficacy and crop safety trials (especially in greenhouse crops) are required in the major cucurbits growing areas to determine the most efficacious fungicides for the control of Botrytis using chlorothalonil, captan, cyprodinil + fludioxonil, iprodione and boscalid in combination with currently registered products; for the control of Powdery mildew using chlorothalonil, bupirimate, potassium bicarbonate, trifloxystrobin and spiroxamine in combination with currently registered products; for the control of Fusarium using imazalil in combination with currently registered products, and for the control of Sclerotinia using cyprodinil + fludioxonil, boscalid, fluazinam and tebuconazole in combination with currently registered products.

2. Once efficacy and the use pattern (and the withholding period) are determined, residues trials may be required in the major cucurbits growing areas 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. Some confirmatory trials in NZ may be necessary.
3. Provide the cucurbits industry with sound technical information for the control of Botrytis, Powdery mildew, Fusarium and Sclerotinia rot listing fungicides, use patterns and withholding periods. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ pesticide regulations.

Two of the major diseases in NZ cucurbit crops – Botrytis and Powdery mildew, are also fungi that have a history of developing 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 cucurbit industry.

Insects and insecticides

The high priority insects are:

Aphids (especially Green Peach Aphid, Melon aphid, Potato aphid)	<i>Myzus persicae</i> , <i>Aphis gossypii</i> , <i>Macrosiphum euphorbiae</i>
Caterpillars (especially Looper, Tomato fruitworm)	<i>Lepidoptera spp.</i> , <i>Helicoverpa armigera</i> ,
Thrips	<i>various</i>

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

Product (active)	Target insect	Action
Gaucho (imidacloprid)	Aphids	Adding to existing registrations
Confidor (imidacloprid)	Aphids & Thrips	New uses
Pirimor (pirimicarb)	Aphids	Adding to existing registrations
Entrust (spinosad)	Lepidoptera & Thrips	New uses
Ascend (fipronil)	Lepidoptera & Thrips	New uses
Steward (indoxacarb)	Lepidoptera	New use
Proclaim (emamectin)	Lepidoptera	New use
Avid (abamectin)	Thrips	New use

Steps forward

1. For each of the major insect pests identified, efficacy and crop safety trials (especially in greenhouse crops are required in the major cucurbit growing areas to determine the most efficacious insecticides for the control of aphids using imidacloprid seed treatment/foliar and pirimicarb; Lepidoptera using spinosad, fipronil, indoxacarb and emamectin, and Thrips using imidacloprid, spinosad, fipronil and abamectin 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 cucurbits 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. Some confirmatory trials in NZ may be necessary.

3. Provide the cucurbit industry with sound technical information for the control of aphids, Lepidoptera caterpillars and thrips listing insecticides, use patterns and withholding periods. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ agrichemical regulations.

All three of the major insect pests in NZ cucurbit crops – aphids, Lepidoptera 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 cucurbits industry.

Weeds and herbicides

Feedback from growers indicated cucurbit had no weed control gaps.

The New Zealand cucurbits 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 cucurbits growing areas are in (HortResearch¹):

- Auckland (pumpkin)
- Canterbury (pumpkin)
- Gisborne (squash)
- Hawke's Bay (pumpkin, squash)
- Manawata / Wanganui (pumpkin, squash)
- Waikato (melons)

There are (HortResearch¹):

- ~636 cucurbit growers (80 melons, 133 pumpkin, 187 squash, 236 others)
- 8,088 hectares planted (387 melons, 1,093 pumpkin, 6,325 squash, 283 others)
- 155,770+ T produced (? melons, 31K pumpkin, 123K squash, 1,770 others)
- \$51.1+ million from domestic sales (? melons & pumpkin, \$9.8m squash, \$41.3m others)
- \$56.8+ million from fresh export sales (2006) (? melons & pumpkin, \$55.2m squash, \$0.1m others)

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 agrichem manufacturers to bear the high cost of registering agrichemicals for their use. This is also true for large crops, such as cucurbits, 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 cucurbits 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.

¹ HortResearch FreshFacts 2006
AgAware Consulting P/L

- 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

Agrichemicals have always been an important tool in the production of cucurbits. 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 cucurbits industry has access to a range of agrichemicals to control the plant pests that affect the crop, during the establishment phase, during crop development, during head maturity and pre/post harvest.

Strategic Agrichemical Review Process

As a consequence of the issues facing the cucurbits industry regarding limited agrichemical access, AgAware Consulting Pty Ltd in association with Horticulture New Zealand Ltd undertook a review of the agrichemical requirements in cucurbits 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 cucurbits
- 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 in November 2006. This assessment provided a list of key plant pests that are of major concern to the cucurbits 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 cucurbits 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 cucurbits 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 cucurbits but attempts to prioritise the major problems.

Methods

SARP was conducted in Auckland 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 cucurbits and asked to prioritise them into high, moderate and low categories.
- Each of the pests was listed by common and scientific name.
- Participants were asked to list the main agrichemicals and or other control agent used for each pest.
- Each agrichemical active ingredient as well as bio-control agent (biological, 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 was conducted for each control method as to whether the agrichemical was registered for each particular crop. Reference was made to the ACVM Group (ACVM 2007), The New Zealand Agrichemicals Manual (Agrimedia 2007) and Novachem Manual (Novachem Services Ltd, 2006/2007).
- 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 agrichemical grouping and has multi-site activity; it belongs to the Group Y fungicides.
 - The insecticide, diazinon belongs to the organophosphate agrichemical grouping and has contact/stomach activity; it belongs to the Group 1B insecticides.
 - The herbicide, linuron belongs to the photosynthesis inhibitor agrichemical grouping; it belongs to the Group C herbicides.
- The information was circulated to participants for further comments to ensure the accuracy of the information.
- An assessment and evaluation was conducted for each of the plant pests of cucurbits 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 cucurbit industry to pursue are listed.

Results

For the cucurbit vegetables discussed in this SARP report, only the five traditional varieties were reviewed:

Cucumber	<i>Cucumis sativus</i>
Melons	<i>Cucumis melo, Citrullus lanatus var. caffer</i>
Pumpkin	<i>Cucurbita spp.</i>
Squash	<i>Cucurbita spp.</i>
Zucchini	<i>Cucurbita pepo var. melopepo</i>

For ease of management and because the plant pests for each crop are very similar, the five crops will be discussed as a whole and not individually.

Specific differences will be discussed.

Special mention will be made towards greenhouse grown cucumbers, 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 cucurbits Strategic Agrichemical Review Process – Fungicides registered and used for the control of the MAJOR recorded diseases in cucurbits.
- Table 2 – results of the cucurbits Strategic Agrichemical Review Process – Fungicides registered and used for the control of the MINOR recorded diseases in cucurbits.
- Table 3 – results of the cucurbits Strategic Agrichemical Review Process – Insecticides registered and used for the control of the MAJOR recorded insect pests in cucurbits.
- Table 4 – results of the cucurbits Strategic Agrichemical Review Process – Insecticides registered and used for the control of the MINOR recorded insect pests in cucurbits.
- Table 5: Herbicides registered and used for the control of the weeds in cucurbits.

Discussions

Diseases of cucurbits

The major diseases of cucurbits recorded are:

Common name

Scientific name

HIGH PRIORITY

Botrytis	<i>Botrytis cinerea</i>
Fusarium Dry Rot (Fusarium Fruit Rot) ..	<i>Fusarium solani f. sp. cucurbitisae</i> , <i>Fusarium oxysporum f. sp. melonis</i>
Powdery mildew	<i>Sphaerotheca fuligina</i>
Sclerotinia rot	<i>Sclerotinia sclerotiorum</i>

MODERATE PRIORITY

Angular Leafspot	<i>Pseudomonas syringae</i>
Gummy Stem Blight	<i>Didymella bryoniae</i>

LOW PRIORITY

Anthracnose	<i>Colletotrichum obiculare</i> , <i>Colletotrichum lagenarium</i>
Downy Mildew	<i>Pseudoperonospora cubensis</i>
Fusarium Wilt, Fusarium Crown and Foot Rot	<i>Fusarium oxysporum f. sp. melonis</i> , <i>Fusarium solani f. sp. cucurbitisae</i>
Phytophthora Rot	<i>Phytophthora capsici</i>
Pythium Root Rot	<i>Pythium spp.</i>

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

High priority disease

Botrytis (*Botrytis cinerea*)

Botrytis is considered a major problem in all cucurbits varieties (greenhouse and field).

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

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
PROCYMIDONE	Sumislex		Listed on label as for 'field cucurbits'					B	3	Commonly used and still effective.

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

	Actives under review in Aust
	Registered

Sumislex is commonly used as foliar treatment in cucurbits. There is some risk of resistance developing in the future with the continued use of this fungicide alone.

From the reports received, procymidone used for Botrytis (*Botrytis cinerea*) control in cucurbits is working adequately. Although it was identified that alternatives are required.

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

Active ingredient	Common Trade Name	Resistance group*	WHP (days)	Comments
AZACONAZOLE + IMAZALIL	Scromrid Limb Aerosol			Occasionally used in GH cucumber.
BACILLUS SUBTILIS	Serenade	Biological		Occasionally used in GH cucumber.
CHLOROTHALONIL	Bravo	Y	1	Commonly used in GH cucumber and still effective. Registered for other diseases.
CAPTAN	Captan	Y	3	Occasionally used in GH cucumber. Registered for other diseases.
CYPRODINIL + FLUDIOXONIL	Switch	I+L		Occasionally used in GH cucumber. AU permit in peas for Botrytis.
IPRODIONE	Rovral	B		Commonly used in GH cucumber and still effective.
PYRIMETHANIL	Scala	I		Occasionally used in GH cucumber.
THIABENDAZOLE	Tecto	A		Occasionally used in field grown pumpkins, squash & cucumber.
TOLYFLUANID	Euparen Multi	X		Occasionally used in GH cucumber, but knocks out predator for whitefly.
Trichoderma	Sentinel	Biological		Occasionally used in GH cucumber, but expensive.

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

	Actives under review in NZ
	Registered
	Used off-label

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

- Scromrid is used as a wound treatment in GH cucumber.
- Bravo, Captan and Euparen are all protectant fungicides used in GH cucumber. Captan is disruptive to IPM systems. Bravo and Captan are registered in cucurbits, but for other diseases and have no greenhouse listing.
- Tecto is a protectant fungicides used in field grown cucurbits.
- Rovral, Switch and Scala are protectant/curative systemic fungicides with good activity on Botrytis in other crops. Used in GH cucumber.
- Serenade and Sentinel are bio-fungicides used in GH cucumber.

From the information provided, Botrytis appears to be a major disease in greenhouse cucumbers where many different products are used. There appears to be less of a concern in field-grown cucurbits.

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

Active ingredient	Common Trade Name	Resistance group*	WHP (days)	Comments
AZOXYSTROBIN	Amistar	K		AU label - registered in all cucurbits for other diseases. Registered for Botrytis in grapes.
BOSCALID	Filan	G		AU label - registered for Botrytis in grapes.

* 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:

- Bravo (chlorothalonil)
 - MRL in: Aust, Canada, China, Codex, EU, Indonesia, Israel, Japan, Korea, Malaysia, NZ, Singapore, South Africa, Switzerland, Taiwan, USA (cucumber, pumpkins, cucurbits, vegetables)
- Captan (captan)
 - MRL in: Codex, EU, Indonesia, Japan, Korea, NZ, Singapore, Switzerland, Thailand, Taiwan, USA (cucumber, pumpkin, vegetables)
- Switch (cyprodonil)
 - MRL in: Austria, Codex, EU, Israel, Japan, Netherlands, Switzerland, (cucumber, pumpkins, vegetables) (fludioxonil)
 - MRL in: Austria, EU, Germany, Israel, Italy, Japan, Korea, Netherlands, Switzerland, USA (cucumber, pumpkins, vegetables)
- Rovral (iprodione)
 - MRL in: Canada, China, Codex, EU, Indonesia, Israel, Japan, Korea, Malaysia, Singapore, Switzerland (cucumber, cucurbits, pumpkin, vegetables)
- Scala (pyrimethanil)
 - MRL in: EU, Israel, Japan, Korea, Switzerland (cucumber, pumpkin, vegetables)
- Amistar (azoxystrobin)
 - MRL in: Aust, EU, Japan, Korea, Malaysia, Switzerland, Taiwan, USA (cucumber, cucurbits, pumpkin, vegetables)
- Filan (boscalid)
 - MRL in: Germany, Japan, Korea, Taiwan, USA (cucumber, cucurbits, pumpkin)

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

FUNGICIDE ALTERNATIVES IN CUCURBITS FOR BOTRYTIS

In reviewing the possible alternatives:

- Bravo (chlorothalonil) - is an effective protectant fungicide with a wide disease spectrum. Crop safety needs to be tested in greenhouse cucurbits. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas. Residue data may also be necessary. As there are MRL in NZ and many overseas countries; **the product should be pursued** after efficacy is confirmed. This will provide a necessary new protectant fungicide.
- Captan - an old protectant fungicide with a wide disease control spectrum. Crop safety needs to be tested in greenhouse cucurbits. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas. Residue data may also be necessary. As there are MRL in NZ and many overseas countries; **the product should be pursued** after efficacy is confirmed.
- Switch (cyprodinil + fludioxonil) – is a protectant/curative systemic fungicide with excellent activity on Botrytis. Crop safety needs to be tested in greenhouse cucurbits. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas. Residue data may also be necessary. As there are MRL in many overseas countries; **the product should be pursued** after efficacy is confirmed. This will provide a necessary new protectant/curative fungicide.
- Rovral (iprodione) – is a protectant/curative systemic fungicide with good activity on Botrytis. Crop safety needs to be tested in greenhouse cucurbits. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. As there are MRL and

many overseas countries; **the product should be pursued** after efficacy is confirmed.

- Amistar (azoxystrobin) – is a protectant/curative systemic fungicide with good activity on Botrytis. Resistance management is an issue, especially in greenhouse use. 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. Crop safety needs to be tested in greenhouse cucurbits. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. As there are MRL in many overseas countries; **the product should be pursued** after efficacy is confirmed. A use pattern is developed to fit the residue requirements.

Fusarium Dry Rot (*Fusarium solani*, *Fusarium oxysporum*)

Fusarium Dry Rot or Fusarium Fruit Rot (*Fusarium solani*, *Fusarium oxysporum*) is considered a major disease of cucurbits. These are post harvest rots. Fusarium can be associated with Alternaria alternata as a secondary infection in melons.

No fungicides are registered for the control of Fusarium in cucurbits.

Fungicides that are used off-label in cucurbits for the control of Fusarium are:

Active ingredient	Common Trade Name	Resistance group*	Comments
THIABENDAZOLE	Tecto	A	Occasionally used in field grown pumpkins, squash & cucumber.
CARBENDAZIM	Spin Flo	A	Occasionally used in field grown pumpkins, squash & cucumber.
THIOPHANATE-METHYL	Topsin	A	Occasionally used
PROCHLORAZ	Sportak	C	GH cucumbers - Occasionally used and effective.

* 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 occasionally used and considered effective.

- All of these fungicides are old protectant or systemic fungicide with extensive uses patterns.
- All are effective fungicides with no reports of resistance.
- Carbendazim and thiophanate-methyl are under review; therefore their future registrations are unknown.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
IMAZALIL	Fungaflor	C	AU label - post harvest control of 'Fusarium Fruit Rot (<i>Fusarium</i> spp) and other post-harvest diseases in rockmelons.

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

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

- Tecto (thiabendazole)
 - MRL in: EU, Japan, Singapore (vegetables)
- Sportak (prochloraz)
 - MRL in: EU, Japan (vegetables)
- Fungaflor (imazalil)
 - MRL in: Codex, EU, Indonesia, Japan, Korea, Singapore, South Africa, Switzerland (cucumber, cucurbits, vegetables)

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

FUNGICIDE ALTERNATIVES IN CUCURBITS FOR FUSARIUM

In reviewing the possible alternatives:

- Tecto (thiabendazole) - is a protectant/curative fungicide. Limited registrations in vegetables and limited overseas MRL. Given it will be used as a post-harvest treatment; the use of thiabendazole will result in residues that will not comply with overseas MRL and the NZ dMRL. Thiabendazole should not be pursued.
- Sportak (prochloraz) - is a protectant/curative fungicide. Limited registrations in vegetables and limited overseas MRL. Given it will be used as a post-harvest treatment; the use of thiabendazole will result in residues that will not comply with overseas MRL and the NZ dMRL. Prochloraz should not be pursued.
- Fungaflor (imazalil) - is a protectant/curative systemic fungicide. Controls a wide range of post-harvest diseases. Aust registrations in rockmelons. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas. Residue data will be necessary. Some Aust residue data may be available. As there are many overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed. A use pattern is developed to fit the residue requirements. This will provide a necessary new protectant/curative fungicide.

Powdery mildew (*Sphaerotheca fuliginea*)

Powdery mildew is considered a major problem in all cucurbit varieties (greenhouse and field).

Agrichemicals registered for Powdery mildew (*Sphaerotheca fuliginea*) control in cucurbits or vegetables are:

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
SULPHUR	Kumulus							Y	0	Use in field grown pumpkins, squash & cucumber
POTASSIUM BICARBONATE	Ecocarb	No GH listing.						X	0	Use in GH cucumbers.
BUPIRIMATE	Nimrod Neptune	Used on cucumber but not registered.						H	14	Use in field grown pumpkins, squash & cucumber.
CHLOROTHALONIL	Bravo	No GH listing.						Y	1	Occasionally used

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
CHLOROTHALONIL + THIOPHANATE METHYL	Taratek							Y+A	7	
TRIFLOXYSTROBIN	Flint	Used on cucumber but not registered.						K	14	Use in field grown pumpkins, squash & cucumber.
TRIADIMEFON	Bayleton	No GH listing.						C	3	Occasionally used.
PENCONAZOLE	Topas	No GH listing.						C		Occasionally used. Use in field pumpkins squash & cucumber.
TRIFORINE	Saprol	No GH listing.						X	3	Use in field pumpkins squash & cucumber. Use in GH cucumber.
CARBENDAZIM	Protek							A		Only Protek registered in cucurbits for Powdery mildew.

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

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

All the listed products are occasionally used in greenhouse or field grown crops. Sulphur is the most commonly used Powdery mildew fungicide, although it can cause plant phytotoxicity in cucumber and melons. There is little risk of resistance developing in the future if growers continue to use a wide range of fungicides from different resistance groups. But the overuse of triadimefon, penconazole and other group C fungicides (triazoles) can lead to an increase risk of resistance developing as has been identified in New Zealand and Australia.

Feedback indicated the current fungicides used for Powdery mildew (*Sphaerotheca fuliginea*) control in cucurbits are working adequately. But it was identified that alternatives are required, particularly new systemic/curative fungicides.

Plant phytotoxicity in melons was observed with the use of sulphur, bupirimate, trifloxystrobin, penconazole and triforine. Before using any fungicide on melons, growers should test for crop safety on a small area.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
POTASSIUM BICARBONATE	Ecocarb	X	Registered in field cucurbits. Use in GH cucumbers.
BUPIRIMATE	Nimrod	H	Occasionally used. Use in cucumbers.
TRIFLOXYSTROBIN	Flint	K	Registered in field cucurbits. Use in cucumbers.
AZOXYSTROBIN	Amistar	K	Occasionally use in field grown pumpkins, squash & cucumber.
TRIADEMENOL	Cereous	C	Occasionally used.
KRESOXIM-METHYL	Stroby	K	Commonly used in field grown pumpkins, squash & cucumber.
TOLYFLUANID	Euparean	X	Occasionally used

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

	Used off-label
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Feedback indicated, the current off-label fungicides used for Powdery mildew (*Sphaerotheca fuliginea*) control in cucurbits are working adequately.

Great care is required in the continued use of the Group K fungicides (strobilurin group – trifloxystrobin, azoxystrobin, kresoxim-methyl) as they are highly prone to resistance developing with overuse. These products should be used sparingly in combination with fungicides from many different resistance groups.

Plant phytotoxicity in melons was observed with the use of azoxystrobin. Before using any fungicide on melons, growers should test for crop safety on a small area.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
PYRACLOSTROBIN	Cabrio	C	To be registered in AU in cucurbits
THIOPHANATE-METHYL	Topsin M	A	Registered for powdery mildew is for ornamentals.
MYCOBUTANIL	Systhane	C	Registered for Powdery Mildew in grapes and pipfruit
SPIROXAMINE	Impulse	E	Registered for Powdery Mildew in grapes wheat and barley
BACILLUS SUBTILIS	Serenade	Biological	Registered for powdery mildew & Botrytis in grapes
FLUSILAZOLE	Nustar	C	Registered for Powdery Mildew in pipfruit
CYPROCONAZOLE	Alto	C	Registered for PM control in grapes and peas.
EPOXYCONAZOLE	Opus	C	Registered for PM in barley and wheat
TEBUCONAZOLE	Orius	C	Registered for PM control in peas and wheat
DIFENOCONAZOLE	Score	C	Registered for PM control in apples
FENARIMOL	Rubigan Flo	C	Registered for PM control in peas, pipfruit and grapes.

* 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:

- Nimrod (bupirimate)
 - Already registered in field cucurbits, needed for field and GH cucumber.
- Ecocarb (potassium bicarbonate)
 - Residues exempt. Already registered in field cucurbits, needed for GH cucumber.
- Bravo (chlorothalonil)
 - Already registered in field cucurbits, needed for GH cucumber.
- Flint (trifloxystrobin)
 - MRL in: Aust, EU, Israel, Japan, Korea, NZ, South Africa, Switzerland, USA (cucumber, pumpkins, cucurbits, vegetables)
- Impulse (spiroxamine)
 - MRL in: EU (vegetables)

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

FUNGICIDE ALTERNATIVES IN CUCURBITS FOR SPHAEROTHECA

In reviewing the possible alternatives:

- Nimrod (bupirimate) - a systemic protectant/curative fungicide. Registered in field grown cucurbits. Efficacy and crop safety trials are required in greenhouse crops. As the product is already registered in NZ, **it should be pursued**. This will provide a necessary systemic fungicide for all cucurbits.
- Ecocarb (potassium bicarbonate) - an organic protectant fungicide. Registered in field grown cucurbits. Efficacy and crop safety trials are required in greenhouse crops. As the product is MRL exempt, **it should be pursued**, provided. This will provide a protectant fungicide for all cucurbits.
- Bravo (chlorothalonil) - is an effective protectant fungicide with a wide disease spectrum. Registered in field grown cucurbits. Efficacy and crop safety trials are required in greenhouse crops. As the product is already registered in NZ, **it should be pursued**. This will provide a protectant fungicide for all cucurbits.
- Flint (trifloxystrobin) - a systemic protectant/curative fungicide. Registered in field grown cucurbits. Efficacy and crop safety trials are required in greenhouse crops. As the product is already registered in NZ, **it should be pursued**. This will provide a necessary systemic fungicide for all cucurbits.
- Impulse (spiroxamine) - is an effective protectant/curative systemic fungicide for Powdery mildew. Efficacy and crop safety trials are required in greenhouse and field cucurbits. Although there are few overseas MRL, **the product should be pursued**, provided a use pattern is developed to fit the residue requirements. This will provide a necessary new systemic fungicide.
- Strobilurins (azoxystrobin, kresoxim-methyl, pyraclostrobin) - should not be pursued as Flint (trifloxystrobin) is already registered.
- Triazoles (triadimenol, cyproconazole, epoxyconazole, tebuconazole, difenoconazole, fenarimol) - should not be pursued as Bayleton (triadimefon) and Topas (penconazole) are already registered.

Sclerotinia rot (*Sclerotinia sclerotiorum*)

Sclerotinia rot (*Sclerotinia sclerotiorum*) is considered the major problem in all field grown cucurbit crops. The severity of the disease is dependent on the rotations practiced and the weather.

Fungicides registered for Sclerotinia rot (*Sclerotinia sclerotiorum*) control in cucurbits or vegetables are:

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
PROCYMIDONE	Sumisclex		Listed on label as for 'field cucurbits'					B	3	Occasionally used as disease occurs late in the crop.

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

	Actives under review in Aust
	Registered

Sumisclex is occasionally used as a foliar treatment in cucurbits. There is some risk of resistance developing in the future with the continued use of this fungicide alone.

Feedback indicated procymidone used for Sclerotinia rot (*Sclerotinia sclerotiorum*) control in cucurbits is working adequately. However it was identified that alternatives are required.

Fungicides that are used off-label in cucurbits for the control of Sclerotinia rot are:

Active ingredient	Common Trade Name	Resistance group*	Comments
CHLOROTHALONIL	Bravo	Y	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, chlorothalonil used for Sclerotinia rot (*Sclerotinia sclerotiorum*) control in cucurbits is working adequately. But as chlorothalonil is not registered to control Sclerotinia in any crop, efficacy is questioned.

Fungicides that are not registered in cucurbits but control Sclerotinia Rot in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
FLUAZINAM	Shirlan	Y	Reg. for Sclerotinia control in tomatoes.
CARBENDAZIM	Carbendazin	A	Reg. for Sclerotinia control on Tomato (Greenhouse and Field), cucurbits and beans
AZOXYSTROBIN	Amistar	K	AU label – registered for Sclerotinia control in field tomatoes.
THIOPHANATE-METHYL	Topsin	A	Reg. for Sclerotinia in beans, field tomatoes.
CYPRODINIL + FLUDIOXONIL	Switch	I+K	AU permit in peas for Sclerotinia
TEBUCONAZOLE	Folicur	C	AU label - registered in pyrethrum for Sclerotinia sclerotiorum. AU permit in cucurbits for Sclerotinia rot.
IPRODIONE	Rovral	B	Label lists Sclerotinia control in kiwi fruit.
BOSCALID	Filan	G	AU label - permits for Sclerotinia control in peas (snow and green), leafy brassica vegetables, cucurbits, brassicas and beans.
THIABENDAZOLE	Tecto	A	AU label - Sclerotinia control in turf.

* 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:

- Bravo (chlorothalonil)
 - MRL in: Aust, Canada, China, Codex, EU, Indonesia, Israel, Japan, Korea, Malaysia, NZ, Singapore, South Africa, Switzerland, Taiwan, USA (cucumber, pumpkins, cucurbits, vegetables)
- Shirlan (fluazinam)
 - MRL in: EU, Germany (vegetables)
- Carbendazim (carbendazim)
 - MRL in: Aust, Canada, China, EU, Indonesia, Israel, Japan, Korea, Malaysia, NZ, Singapore, South Africa, Switzerland, Taiwan, (cucumber, pumpkins, cucurbits, vegetables)

- Switch (cyprodonil)
 - MRL in: Austria, Codex, EU, Israel, Japan, Netherlands, Switzerland, (cucumber, pumpkins, vegetables) (fludioxonil)
 - MRL in: Austria, EU, Germany, Israel, Italy, Japan, Korea, Netherlands, Switzerland, USA (cucumber, pumpkins, vegetables)
- Folicur (tebuconazole)
 - MRL in: Austria, Codex, EU, Germany, Japan, netherlands, (cucumber, pumpkin, vegetables)
- Rovral (iprodione)
 - MRL in: Canada, China, Codex, EU, Indonesia, Israel, Japan, Korea, Malaysia, Singapore, Switzerland (cucumber, cucurbits, pumpkin, vegetables)
- Filan (boscalid)
 - MRL in: Germany, Japan, Korea, Taiwan, USA (cucumber, cucurbits, pumpkin)

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

FUNGICIDE ALTERNATIVES IN CUCURBITS FOR SCLEROTINIA

In reviewing these possible alternatives:

- Bravo (chlorothalonil) - is a protectant fungicide with good IPM fit. As chlorothalonil is not registered to control Sclerotinia in any crop in NZ or AU, this product should not be pursued.
- Shirlan (fluazinam) – is a protectant fungicide. Efficacy and crop safety needs to be tested in greenhouse and field cucurbit crops. Residue data may also be necessary. As there are limited overseas MRL, a use pattern needs to be developed to fit the residue requirements. **This product should be pursued.** This will provide a necessary new protectant fungicide.
- Carbendazim – as this product is under review in NZ and Australia, it should not be pursued until the results of the review are completed.
- Switch (cyprodinil + fludioxonil) – is a protectant/curative systemic fungicide with good activity on Sclerotinia. Efficacy and crop safety needs to be tested in greenhouse and field cucurbit crops. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided efficacy is confirmed. A use pattern needs to be developed to fit the residue requirements. This will provide a necessary new protectant/curative fungicide.
- Folicur (tebuconazole) - is an effective protectant/curative systemic fungicide with a wide disease spectrum. Some resistance risk. Efficacy and crop safety needs to be tested in greenhouse and field cucurbit crops. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed.
- Rovral (iprodione) – is a protectant/curative systemic fungicide with good activity on Botrytis. Iprodione is in the same resistance group as procymidone, therefore should not be pursued.
- Filan (boscalid) – is a curative systemic fungicide with excellent activity on Sclerotinia. Efficacy and crop safety needs to be tested in greenhouse and field cucurbit crops. Residue data may also be necessary. Although there are limited overseas MRL, **the product should be pursued**, provided efficacy and crop safety are confirmed. A use pattern is developed to fit the residue requirements.

Other diseases

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

- Angular Leafspot (*Pseudomonas syringae*)
- Anthrachnose (*Colletotrichum obiculare* and *Colletotrichum lagenarium*)
- Downy Mildew (*Pseudoperonospora cubensis*)
- Fusarium Wilt of melon (*Fusarium oxysporum f. sp. melonis*)
- Fusarium Crown and Foot Rot of Squash & pumpkin (*Fusarium solani f. sp. cucurbitisae*)
- Gummy Stem Blight (*Didymella bryoniae*)
- Phytophthora Rot (*Phytophthora capsici*)
- Pythium Root Rot (*Pythium spp.*)

New fungicide that can be pursued

Product (active)	Target disease	Action
Bravo (chlorothalonil)	Botrytis Powdery mildew	Adding to existing registrations
Captan (captan)	Botrytis	New use
Switch (cyprodinil + fludioxonil)	Botrytis Sclerotinia rot	New use
Rovral (iprodione)	Botrytis	New use
Filan (boscalid)	Botrytis Sclerotinia rot	New use
Fungaflor (imazalil)	Fusarium	New use
Nimrod (bupirimate)	Powdery mildew	Adding to existing registrations
Ecocarb (potassium bicarbonate)	Powdery mildew	Adding to existing registrations
Flint (trifloxystrobin)	Powdery mildew	Adding to existing registrations
Impulse (spiromoxamine)	Powdery mildew	New use
Shirlan (fluazinam)	Sclerotinia rot	New use
Folicur (tebuconazole)	Sclerotinia rot	New use

Insects of cucurbits

The insects of cucurbits recorded are:

Common name	Scientific name
<u>HIGH PRIORITY</u>	
Aphids (especially Green Peach Aphid, Melon aphid, Potato aphid)	<i>Myzus persicae</i> , <i>Aphis gossypii</i> , <i>Macrosiphum euphorbiae</i>
Caterpillars (especially Looper, Tomato fruitworm)	<i>Lepidoptera spp.</i> , <i>Helicoverpa armigera</i> ,
Thrips	<i>various</i>
<u>MEDIUM PRIORITY</u>	
Greasy cutworm	<i>Agrotis ipsilon</i>
Grass Grub Beetle	<i>Oncopera spp.</i>
Mites	<i>various</i>
Springtails	<i>Collembola spp.</i>
Sciarid Flies	<i>Bradysia spp.</i>
Greenhouse whitefly, Tobacco whitefly .	<i>Trialeurodes vaporariorum</i> , <i>Bemisia tabaci</i> (biotype B)
Green Vegetable Bug	<i>Nezara viridula</i>
<u>LOW PRIORITY</u>	
Wireworm	<i>Heteroderus spp.</i>
Weevils	<i>various</i>
Slugs & snails	<i>Gastropoda spp.</i>
<u>NO PRIORITY</u>	
Cabbage Leaf Miner	<i>Psyllidae spp.</i>
Rats	<i>Ratus spp.</i>
Leafroller	<i>Trotricidae spp.</i>

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

High priority insects

Aphids - Green Peach Aphid (*Myzus persicae*); Melon aphid (*Aphis gossypii*); Potato aphid (*Macrosiphum euphorbiae*)

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

- Individual differences between aphid species and cucurbit varieties affected
- Resistance issues between species
- Insecticides that control all aphid species

Insecticides registered for aphid control in cucurbits or vegetables are:

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
PYRETHRINS	Garlic & Pyreth Conc.		Aphids					3A	1	
CANOLA OIL	Eco-oil	GPA						Vegetable Oil	0	Occasionally used.
BIFENTHRIN	Talstar							3A	3	Commonly used and effective. Used on all cucurbits.
DIAZINON	Diazinon		Aphids					1B	14	
IMIDACLOPRID	GaUCHO							4A	42	Used by some seedling producers – all cucurbits
PERMETHRINS + PPO	Greenseals Pyrethrum		Aphids					3A	3	
PIRIMICARB	Pirimor		Aphids					1A	7	Commonly used and effective. Used in GH cucumbers
PERMETHRIN + PIRIMIPHOS-METHYL	Attack		Aphids					3A+1B	3	
DICHLORVOS	Divap		Aphids Vegetables					1B	3	
FATTY ACIDS (K SALTS)	Nature's Way Insect Spray								1	
APHID PARASITE	<i>Aphidius colemani</i>							Biological	0	
APHIDOLETED	<i>Aphidoletes aphidimyza</i>							Biological	0	
MALATHION	Malathion	Aphids						1B	3	
DELTAMETHRIN	Decis					Aphids		3A		
ROTENONE	Derris Dust							21A	1	
PHORATE	Phorate		Aphids					1B	70	Commonly used and effective.
CHLORPYRIFOS	Lorsban					Aphids		1B	10	

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

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

All the products indicated are commonly used as foliar insecticides in cucurbits. Many of the insecticides used and available are quite old, suggesting that resistance may be an issue. There is some risk of resistance developing in the future with some aphid species (especially GPA) with the continued use of some insecticides. Resistance has been recorded in GPA to pirimicarb in Australia.

Feedback indicated that the current insecticides used for aphid control in cucurbits 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.

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

Active ingredient	Common Trade Name	Resistance group*	Comments.
BIFENTHRIN	Talstar	3A	Commonly used and effective. Registered on field cucurbits. Used on all cucurbits.

Active ingredient	Common Trade Name	Resistance group*	Comments.
ENDOSULFAN	Thiodan	2A	Commonly used and effective. Field cucurbits only.
IMIDACLOPRID	Gaucho	4A	Used by some seedling producers – all cucurbits. Registered in squash only.
IMIDACLOPRID	Confidor	4A	Commonly used and effective. All cucurbits.
PIRIMICARB	Pirimor	1A	Commonly used and effective. Registered on field cucurbits. Used in GH cucumbers
PYMETROZINE	Chess	9A	Commonly used and effective. All cucurbits.
THIACLOPRID	Calypso	4A	Used by some growers.
METHAMIDOPHOS	Monitor Tamaron	1B	Occasionally used. Field cucurbits only.
DIMETHOATE	Perfekthion	1B	Occasionally used. Field cucurbits only.

* 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 aphid control in cucurbits are working adequately.

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

Active ingredient	Common Trade Name	Resistance group*	Comments.
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	Registered for 'Aphids' in tomatoes
<u>Beauvaria bassiana</u>	Botanigard	Biological	Not used yet in cucurbits, product in development
AZADIRACHTIN	NeemAzal	Botanical insecticide	
<u>Lecanicillium lecanii blastospores</u>		Biological	Not used.
TAU-FLUVALINATE	Mavrik	3A	Registered on field tomato for GPA
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	3A	Registered for 'aphids' on tomato
METHOMYL	Lannate L	1A	Registered for GPA n brassicas.
TERBUFOS	Counter	1B	Aphids listed for forage brassicas as seed/fertiliser treatment
ACEPHATE	Orthene	1B	Reg. for 'aphids' in cucurbits and potato

* 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:

- Gaucho & Confidor (imidacloprid)
 - MRL in: Aust, Austria, Canada, Codex, EU, Germany, Israel, Japan, Korea, Netherlands, South Africa, USA (cucumber, pumpkins, vegetables)
- Pirimor (pirimicarb)
 - MRL in: Aust, Austria, Belgium, Codex, EU, France, Germany, Indonesia, Israel, Italy, Japan, Korea, Netherlands, NZ, Sweden, Switzerland, Taiwan (cucumber, pumpkins, cucurbits, vegetables)

- Chess (pymetrozine)
 - MRL in: Aust, EU, Japan, Korea, Switzerland, Taiwan, USA (cucumber, pumpkins, cucurbits, vegetables)
- Calypso (thiacloprid)
 - MRL in: Austria, EU, Japan, Korea, Netherlands, UK (cucumber, pumpkins, cucurbits, vegetables)
- Lannate (methomyl)
 - MRL in: Aust, Codex, EU, Indonesia, Israel, Japan, Korea, NZ, Singapore, Switzerland, Taiwan, Thailand, USA (cucumber, pumpkins, cucurbits, vegetables)

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

INSECTICIDES ALTERNATIVES IN CUCURBITS FOR APHIDS

In reviewing the possible alternatives:

- Gaucho (imidacloprid) – is a systemic seed treatment with activity on various pests. As it is already registered in squash **it should be pursued** for all cucurbit crops. But a resistance management program should be developed for the use of Gaucho and Confidor.
- Confidor (imidacloprid) – is a systemic foliar insecticide with activity on various pests. Some impact on beneficial insects. Some resistance risk. Efficacy and crop safety data needs to be generated in the major cucurbit 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. A resistance management program should be developed for the use of Gaucho and Confidor.
- Pirimor (pirimicarb) – is a systemic foliar insecticide with good IPM properties. Some resistance risk. As it is already registered in field cucurbits it should be pursued for all greenhouse cucurbits crops. Crop safety needs to be determined. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided crop safety is confirmed.
- 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.
- Carbamates & organophosphates (methomyl, methamidophos, tebufos, acephate) – are old systemic, broad-spectrum insecticides. Although very effective and have many overseas MRL, most of these products are under review in NZ and Aust, therefore they should not be pursued.
- Synthetic pyrethroids – these products should not be pursued as they are highly susceptible to resistance developing and some SP are already registered – pyrethrum, bifenthrin, deltamethrin.

Caterpillars - Looper (*Lepidoptera spp*); Tomato fruitworm (*Helicoverpa armigera*)

Various Lepidoptera species are a major pest of cucurbits in New Zealand. Looper (*Lepidoptera spp*) and Tomato fruitworm (*Helicoverpa armigera*) can be a problem on squash stem end at harvest and in pumpkins. Need to check stem for feeding caterpillars.

Although there are several Lepidoptera (caterpillar) species that affect cucurbit 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 cucurbits varieties affected
- Resistance issues between species
- Insecticides that control all Lepidoptera species

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

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
CARBARYL	Sevin		Caterpillars				1A	1	not used	
DIAZINON	Diazinon		Caterpillars				1B	14	Occasionally used in field cucurbits.	
PYRETHRUM	Garlic & Pyrethrum Concentrate		Cabbage Moth and caterpillars				3A	1		
DICHLORVOS	Divap	Caterpillar	Caterpillars in vegetables				1B	3		
<i>Bacillus thuringiensis t sub. Kurstaki</i>	Bacillus thuringiensis		Caterpillars				11C	0	Commonly used and effective.	
PERMETHRIN + PIRIMIPHOS-METHYL	Attack						3A+1B	3		
ESFENVALERATE	Sumi-Alpha						3A			
MALATHION	Malathion		Diamondback moth, Tomato Fruitworm, White butterfly				1B	3		
ROTENONE	Derris Dust		Diamondback moth, White butterfly				21A	1		
PARATHION METHYL	Folidol		Reg, in vegetables				1B	14		

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

	Actives under review in NZ
	Actives under review in Aust
	Registered

All the products indicated are commonly used as foliar insecticides for a range of Lepidoptera pests in cucurbits. Noticeably, most of the insecticides registered in cucurbits for Lepidoptera are very old carbamates (1A), organophosphates (1B) and synthetic pyrethroids (3A). Unfortunately most of these are quite disruptive of IPM programs.

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

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

Active ingredient	Common Trade Name	Resistance group*	Comments
ACEPHATE	Orthene	1B	Greasy cutworm - commonly used and effective. Registered in various vegetables.
CHLORPYRIFOS	Lorsban	1B	Greasy cutworm occasionally used and effective
ENDOSULFAN	Thionex	2A	Occasionally used in field cucurbits.
DELTAMETHRIN	Decis	3A	Occasionally used in field cucurbits. Registered in various vegetables.

Active ingredient	Common Trade Name	Resistance group*	Comments
BIFENTHRIN	Talstar	3A	Occasionally used in field cucurbits. Registered in various vegetables.
LAMBDA-CYHALOTHRIN	Karate	3A	Occasionally used in field cucurbits. Registered in various vegetables.
METHOMYL	Lannate L	1A	Occasionally used in field cucurbits. Registered in various vegetables.
SPINOSAD	Entrust Naturalyte	5A	Commonly used and effective. Greenhouse and field crops. Registered in various vegetables.
FIPRONIL	Ascend	2C	Occasionally used in field cucurbits. Registered in various vegetables.
IDOXACARB	Steward	22A	Occasionally used in field cucurbits. Registered in various vegetables.

* 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 cucurbits are working adequately. All of these products are currently registered in other crops for lepidoptera control. Growers are using these insecticides mostly in field grown cucurbit crops. No comments were received on the insecticides used for Lepidoptera control in greenhouse cucurbit crops.

Again, many of the insecticides used off-label in cucurbits for Lepidoptera are very old carbamates (1A), organophosphates (1B) and synthetic pyrethroids (3A). These are quite disruptive of IPM programs even though they are effective.

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

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

Active ingredient	Common Trade Name	Resistance group*	Comments
METHAMIDOPHOS	Monitor Tamaron	1B	Registered in various vegetables.
TAU-FLUVALINATE	Mavrik	3A	Registered in various vegetables.
<i>Bacillus thuringiensis sub.Xen tari</i>	Bacillus thuringiensis	11C	Registered in various vegetables.
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	Registered in various vegetables.
CYPERMETHRIN	Ripcord	3A	Registered in various vegetables.
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	3A	Registered in various vegetables.
TRICHLORFON	Trifon	1B	Registered in various vegetables.
EMAMECTIN	Proclaim	6A	Registered in fruit for leafroller. Needs to be registered as good IPM. AU label - in brassicas for lepidoptera.
TRICHLORFON + CYPERMETHRIN	Partna	1B+3A	Registered in various vegetables.
<i>Beauvaria bassiana</i>	Botanigard ES,	Biological	

* 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:

- Entrust (spinosad)
 - MRL in: Aust, Codex, EU, Israel, Japan, Korea, Netherlands, South Africa, Sweden, Switzerland, UK, USA (cucumber, pumpkins, cucurbits)
- Ascend (fipronil)
 - MRL in: EU, Japan, Korea, Netherlands (cucumber, cucurbits, vegetables)
- Steward (indoxacarb)
 - MRL in: Austria, EU, Germany, Japan, Korea (cucumber, pumpkins, cucurbits, vegetables)
- Proclaim (emamectin)
 - MRL in: Japan, Korea (cucumber, pumpkins)

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

INSECTICIDES ALTERNATIVES IN CUCURBITS FOR LEPIDOPTERA (CATERPILLAR)

In reviewing the possible alternatives:

- 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 and crop safety data needs to be generated in the major cucurbit areas (field and greenhouse). 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.**
- Ascend (fipronil) - a contact/systemic insecticide with good efficacy, but can be disruptive to IPM beneficial insects. Efficacy and crop safety data needs to be generated in the major cucurbit areas (field and greenhouse). Residue data may also be necessary. 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 and crop safety data needs to be generated in the major cucurbit areas (field and greenhouse). Residue data may also be necessary. 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.**
- Proclaim (emamectin) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. Efficacy and crop safety data needs to be generated in the major cucurbit areas (field and greenhouse). Residue data may also be necessary. 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.**
- Carbamates & organophosphates (methomyl, acephate, chlorpyrifos, methamidophos, trichlorfon) – are old systemic, broad-spectrum insecticide. Although very effective and have many overseas MRL, most of these products are under review in NZ and Aust, so should not be pursued.
- Synthetic pyrethroids – these products should not be pursued as they are highly susceptible to resistance developing and some SP are already registered – pyrethrum, esfenvalerate.

The selection of Entrust (spinosad), Ascend (fipronil), Steward (indoxacarb) and Proclaim (emamectin) will add greatly to the suite of insecticides available to cucurbit growers for the control of Lepidoptera (caterpillar) pests. These products will also add to the IPM compatibility when used with *Bacillus thuringiensis*.

Thrips (Thrips spp.)

Thrips are considered a major problem on cucurbit crops in New Zealand. Thrips that have been listed are Onion Thrips (*Thrips tabaci*), Western Flower Thrips (*Frankliniella occidentalis*) and Intonsa Flower Thrips (*Frankliniella intonsa*).

Although there are several thrips species that affect cucurbit crops 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 cucurbits varieties affected
- Resistance issues between species
- Insecticides that control all thrips species

Insecticides registered for thrips control in cucurbits or vegetables are:

Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
AZADIRACHTIN	NeemAzal	Not registered on all crops- thrips control						Botanical insecticide	0	
<i>Amblyseius cucumeris</i>	Mite-A, Thripex							Biological	0	
<i>Hypoaspis aculeifer</i>	Hypomite	Thrips pupae						Biological	0	
DIAZINON	Diazinon			Reg. for 'thrips' on vegetable				1B	14	Commonly used and effective. Poor IPM. Field cucurbits only.
PYRETHRUM	Garlic & Pyre Concentrate			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 is recorded as being commonly used and effective on field grown cucurbits.

In the short to medium term, many other insecticides for the control of thrips in cucurbits is required to maintain a high level of control, as resistance can develop quickly. Growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group. A program needs to be developed to encourage the adoption of biological control of thrips.

Western Flower Thrips has already developed resistance to many insecticides from different resistance groups in Australia (eg. diazinon and pyrethrin).

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

Active ingredient	Common Trade Name	Resistance group*	Comment
ABAMECTIN	Avid	6A	Occasionally used with oil. Good IPM compatibility. No registration for thrips. AU permits in tomato, cucumber & eggplant for WFT and ornamentals for melon thrips (<i>T. palmi</i>).
ENDOSULFAN	Thionex	2A	Commonly used and effective. Poor IPM compatibility. Reg. in kumara and tomato for 'thrips'
FIPRONIL	Ascend	2C	Commonly used and effective. Poor IPM compatibility. AU label – thrips in bananas & cotton.
LUFENURON	Match	IGR	Occasionally used. No registrations in vegetables or thrips.
DICHLORVOS	Divan	1B	Commonly used and effective. Poor IPM compatibility. Reg. for 'thrips' on GH tomato and GH capsicum
SPINOSAD	Entrust Naturalyte	5A	Commonly used and effective. Good IPM compatibility. Reg. in field tomato and vegetable brassica for other pests. AU label – thrips in many vegetable crops including cucurbits.
DIMETHOATE	Perfekthion	1B	Occasionally used. Field cucurbits only. AU label – thrips in many vegetable crops including cucurbits.

* 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 thrips control in cucurbits are working adequately. All of these products are currently registered in other crops in NZ or in Australia for thrips control, other than Match (lufenuron). Growers are using these insecticides in both greenhouse and field grown cucurbits.

Again, there is great care required to maintain the effectiveness of these insecticides and minimise any resistance developing with the alternation of insecticides across different resistance groups. In some areas of Australia, Western Flower Thrips has already developed resistance to abamectin, dimethoate and spinosad.

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

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

Active ingredient	Common Trade Name	Resistance group*	Comment
ALPHA-CYPERMETHRIN	Dominex Fastac	3A	Reg. in tomato and onions. AU label – plague thrips in tomatoes.
CHLORPYRIFOS	Lorsban	1B	Reg. in kumara for 'thrips'
DELTA-METHRIN	Decis	3A	Reg. in kumara for 'thrips'
IMIDACLOPRID	Confidor	4A	Reg. for thrips on onion. AU label – thrips in eggplant and ornamentals.
IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	4A+3A	Reg. for 'thrips' on onion
LAMBDA-CYHALOTHRIN	Karate	3A	Reg. for 'onion thrips' on onions
METHAMIDOPHOS	Monitor Tameron	1B	Reg. for thrips on onion
TAU-FLUVALINATE	Mavrik	3A	Reg. for thrips on onion
CARBARYL	Sevin	1A	Reg. for thrips control in fruit crops
<i>Lecanicillium lecanii</i> blastospores		Biological	
THIACLOPRID	Calypso	4A	Reg. for thrips control in avocados, peaches and nectarines

Active ingredient	Common Trade Name	Resistance group*	Comment
MALATHION	Malathion	1B	Reg. for thrips control in various fruit crops

* 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, Korea, Switzerland, USA (cucumber, cucurbits, vegetables)
- Ascend (fipronil)
 - MRL in: EU, Japan, Korea, Netherlands (cucumber, cucurbits, vegetables)
- Entrust (spinosad)
 - MRL in: Aust, Codex, EU, Israel, Japan, Korea, Netherlands, South Africa, Sweden, Switzerland, UK, USA (cucumber, pumpkins, cucurbits)
- Confidor (imidacloprid)
 - MRL in: Aust, Austria, Canada, Codex, EU, Germany, Israel, Japan, Korea, Netherlands, South Africa, USA (cucumber, pumpkins, vegetables)
- Calypso (thiacloprid)
 - MRL in: Austria, EU, Japan, Korea, Netherlands, UK (cucumber, pumpkins, cucurbits, vegetables)

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

INSECTICIDES ALTERNATIVES IN CUCURBITS FOR THRIPS

In reviewing the possible alternatives:

- Avid (abamectin) - is a systemic insecticide with activity on various pests. Safe to beneficial insects. Some resistance issues. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas (field and greenhouse). Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided use pattern is confirmed.
- Ascend (fipronil) - a contact/systemic insecticide with good efficacy, but can be disruptive to IPM beneficial insects. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas (field and greenhouse). Residue data may also be necessary. 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.**
- Entrust (spinosad) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. Efficacy and crop safety data needs to be generated in the major cucurbit growing areas (field and greenhouse). Residue data may also be necessary. It is very effective and has many overseas MRL. There is some resistance risk in some insects due to overuse. 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. Some resistance risk.

Efficacy and crop safety data needs to be generated in the major cucurbit growing areas (field and greenhouse). Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided use pattern is confirmed.

- Calypso (thiacloprid) – is a systemic insecticide with activity on a range of pests. It is in the same resistance group as Confidor, so should not be pursued.
- Carbamates & organophosphates (dichlorvos, dimethoate, carbaryl, chlorpyrifos, methamidophos, malathion) – are old systemic, broad-spectrum insecticide. Although very effective and have many overseas MRL, most of these products are under review in NZ and Aust, so 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 cucurbits, ‘thrips’ were discussed in general, as no specific information was provided regarding for the different thrips species. Efficacy and impact in greenhouse cucurbits were not discussed either. With any development program in thrips control, efficacy on specific species is required with each insecticide in field and greenhouse cucurbits.

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.

Other insects

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

- Greasy cutworm (*Agrotis ipsilon*)
- Grass grub Beetle (*Oncopera spp.*)
- Mites (various spp.)
- Springtails (*Collembola spp.*)
- Sciarid Flies (*Bradysia spp.*)
- Greenhouse whitefly, Tobacco Whitefly (*Trialeurodes vaporariorum*, *Bemisia tabaci* (biotype B))
- Green Vegetable Bug (*Nezara viridula*)
- Wireworm (*Heteroderus spp.*)
- Weevils (various spp.)
- Slugs & snails (*Gastropoda spp.*)

New insecticides that can be pursued

Product (active)	Target insect	Action
Gaucho (imidacloprid)	Aphids	Adding to existing registrations
Confidor (imidacloprid)	Aphids & Thrips	New uses
Pirimor (pirimicarb)	Aphids	Adding to existing registrations
Entrust (spinosad)	Lepidoptera & Thrips	New uses
Ascend (fipronil)	Lepidoptera & Thrips	New uses
Steward (indoxacarb)	Lepidoptera	New use
Proclaim (emamectin)	Lepidoptera	New use
Avid (abamectin)	Thrips	New use

Herbicide use in cucurbits

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

Herbicides registered for use in cucurbits are:

Active ingredient	Common Trade Name	Registrations (field)					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
		Cucumber	Melon	Pumpkin	Squash	Zucchini			
ALACHLOR	Alanex Lasso							NA	common used and effective, even under plastic
CLOMAZONE	Magister						F	NA	common used and effective
DIMETHENAMID	Frontier							NA	occasionally used
FLUAZIFOP-P-BUTYL	Fusilade						A	35	common used and effective
CLETHODIM	Arrow						A	35	
HALOXYFOP	Gallant						A	35	occasionally used
METOLACHLOR	Finale						K	NA	common used and effective, used in squash
OXYFLUORFEN	Goal						G	NA	Used as a pre-plant knockdown with Roundup.
QUIZALOFOP-P-ETHYL	Targa						A	35	common used and effective
SETHOXYDIM	Poast						A	35	common used and effective
S-METOLACHLOR	Dual Gold						K	NA	common used and effective, used in squash
SULFENTRAZONE	Authority							NA	
TRIFLURALIN	Trifluralin						D	NA	common used and effective, even under plastic
GLYPHOSATE	Roundup						M	NA	Always used pre-em and post em inter-row with shields
GLYPHOSATE-TRIMESIUM	Touchdown						M	NA	Used pre plant
DIQUAT	Reglone						L	NA	
PARAQUAT	Paraquat						L	NA	Pre-emergent and inter-row weed control
PINE OIL	Organic Interceptor							NA	Pre-emergent weed control

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

	Actives under review in Aust
	Registered
	Used off-label

Feedback indicated no weed gaps were identified by cucurbits growers.

No other herbicides could be identified for the control of specific weeds in field cucurbits.

New opportunities for new or alternative agrichemicals in cucurbits

International collaboration with USA IR-4 program

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

Agrichemical	Pest / Status	Relevance to NZ
FUNGICIDES		
AZOXTSTROBIN (Amistar)	Cucurbits - POWDERY MILDEW, DOWNY MILDEW – use registered	Disease control identified as a high priority
CYPRODINIL + FLUDIOXONIL (Switch)	Cucumber & squash – POWDERY MILDEW, ALTERNARIA LEAF BLIGHTS – in progress	Disease control identified as a high priority
IODOMETHANE (New product) - fumigant	Cucurbits - PHYTOPHTHORA CAPSICI, FUSARIUM SPP, SOILBORNE ROOT-INFECTING PATHOGENS – in progress	Disease control identified as a high priority
METAFLUMIZONE (New product)	Cucumber, melon, squash - LEPIDOPTERA LARVAE – in progress	Disease control identified as a high priority
MILSANA (New product)	Cucurbits - POWDERY MILDEW - in progress	Disease control identified as a high priority
NF-149 (New product)	Cucurbits - POWDERY MILDEW – manufacturer to register	Disease control identified as a high priority
QUINOXTFEN (Quintec)	Squash - POWDERY MILDEW – manufacturer to register	Disease control identified as a high priority
V-10118 (New product)	Cucumber, squash - POWDERY MILDEW – in progress	Disease control identified as a high priority
INSECTICIDES		
EMAMECTIN (Proclaim)	Cucumber, pumpkin, squash - PICKLEWORM, CABBAGE LOOPERS, ARMYWORMS – in progress	Insect control identified as a high priority
FLONICAMID (New product)	Cucumber - PLANT/STINK BUGS, THRIPS, APHIDS – under assessment	Insect control identified as a high priority
IMIDACLOPRID (Confidor)	Cucumber - APHIDS, THRIPS, CUCUMBER BEETLES, WHITEFILES – registered (soil drench)	Insect control identified as a high priority
NOVALURON (New product)	Cucumber, squash - WHITEFLIES, LEP.LARVAE, PICKLEWORM, SQUASH BUG – in progress	Insect control identified as a high priority
PIRIMICARB (Pirimor)	cucumber, squash – APHIDS – no manufacturer support	Insect control identified as a high priority
PYMETROZINE (Chess)	Cucumber – APHIDS, WHITEFLIES – no manufacturer support	Insect control identified as a high priority
HERBICIDES		
FOMESAFEN (New product)	Cucumber, squash - BLACK NIGHTSHADE, BROADLEAF WEEDS – in progress	Pre-emergent or just prior to transplant
IMAZOSULFURON (New product)	Squash – NUTSEDGE – in progress	Post-emergent

Many other projects have been identified and are being conducted by IR-4 in cucurbits crops. 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

Contributors:

SARP meeting participants

Horticulture New Zealand:

Peter Ensor and Ron Gall

Work colleagues:

Eileen Dal Santo and Rob Velthuis (Xeron)

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Appendices

DIAGRAM 1: The Strategic Agrichemical Review Process

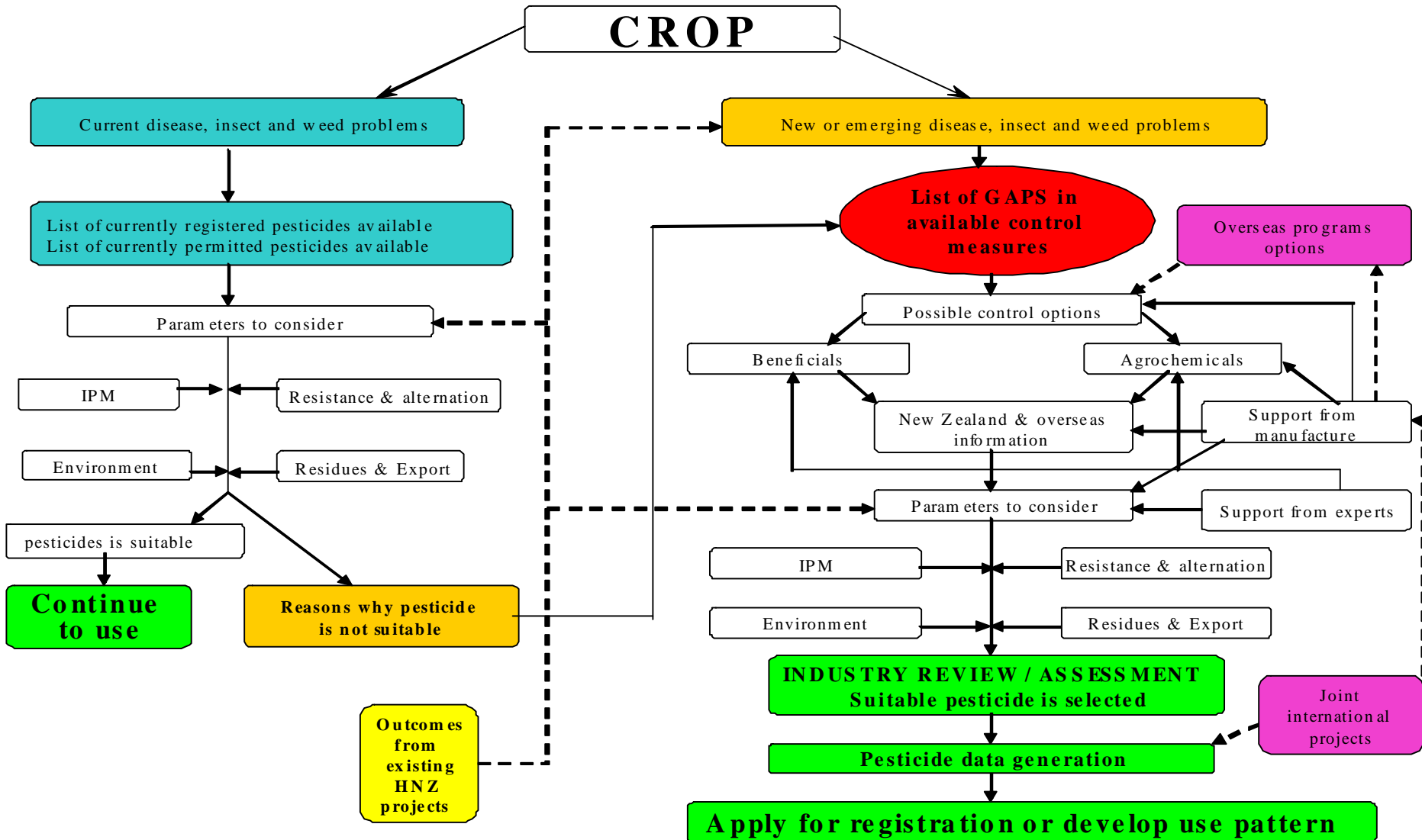


Table 1: Fungicides registered and used for the control of the MAJOR recorded diseases in cucurbits.

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Botrytis <i>Botrytis cinerea</i>	High - major problem in all crops	PROCYMIDONE	Sumislex 500 SC		Listed on label as for 'field cucurbits'						B	3	Commonly used and still effective.
		AZACONAZOLE + IMAZALIL	Scromrid Limb Aerosol	Not registered in any cucurbits crop.								Registered in GH tomatoes for wound treatment. Occasionally used in GH cucumber.	
		AZOXYSTROBIN	Amistar WG	Not registered for any cucurbits crop.						K		AU label - registered in all cucurbits for other diseases. Registered for Botrytis in grapes.	
		BACILLUS SUBTILIS	Serenade	No registration for cucurbits						Bio fungicide		Registered for Botrytis in grapes. Occasionally used in GH cucumber.	
		BOSCALID	Filan							G		AU label - registered for Botrytis in grapes	
		CHLOROTHALONIL	Bravo	No GH listing.	Registered for other diseases.						Y	1	Commonly used in GH cucumber and still effective. AU label - registered in peppers, endive & tomatoes for Botrytis.
		CAPTAN	Captan	No GH listing.	Registered for other diseases.						Y	3	Occasionally used in GH cucumber. AU label - registered in strawberries & grapes for Botrytis.
		CYPRODINIL + FLUDIOXONIL	Switch	Not registered for any vegetable crop.						I+L		Registered for Botrytis in grapes. Occasionally used in GH cucumber. AU permit in peas for Botrytis.	
		IPRODIONE	Rovral WP	Not registered in any cucurbits crop.						B		Commonly used in GH cucumber and still effective. Registered for Botrytis in other crops including tomatoes. AU label - registered in cucurbits & tomatoes for Botrytis.	
		PYRIMETHANIL	Scala	Not registered for any vegetable crop.						I		Registered for Botrytis in grapes. Occasionally used in GH cucumber.	
		THIABENDAZOLE	Tecto SC	No registration for any cucurbits crop in NZ.						A		Occasionally used in field grown pumpkins, squash & cucumber.	
		TOLYFLUANID	Euparen Multi	No registration in vegetables. Controls PM in grapes						X		Occasionally used in GH cucumber, but knocks out predator for whitefly. AU label - in strawberries for Botrytis.	
Trichoderma	Sentinel	No registration in vegetables. Controls Botrytis in grapes						Bio fungicide		Registered for Botrytis in grapes. Occasionally used in GH cucumber, but expensive.			

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Fusarium Dry Rot (Fusarium Fruit Rot) Post-harvest rots <i>Fusarium solani</i> f. <i>sp. cucurbitsae</i> in pumpkin in <i>Fusarium oxysporum</i> f. <i>sp. melonis</i> in melons.	High - major disease. Can be associated with <i>Alternaria alternata</i> as a secondary infection in melons.	THIABENDAZOLE	Tecto SC	No registration for any cucurbits crop in NZ. Controls Fusarium dry rot in potatoes.						A		Occasionally used in field grown pumpkins, squash & cucumber. AU label - thiabendazole registered for Fusarium Dry Rot in potatoes.	
		CARBENDAZIM	Spin Flo	Only Protek registered in cucurbits for Powdery mildew.						A		Occasionally used in field grown pumpkins, squash & cucumber. AU label - Carbendazim registered for Fusarium Fruit Rot in rockmelons and other diseases.	
		THIOPHANATE-METHYL	Topsin M-4 A	Not registered on any cucurbits. Reg. in beans, field tomatoes.						A		Occasionally used	
		PROCHLORAZ	Sportak	No registration in cucurbits or vegetables.						C		GH cucumbers - Occasionally used and effective.	
		IMAZALIL	Fungaflor	No registrations in any cucurbits crop in NZ						C		AU label - post harvest control of 'Fusarium Fruit Rot (F. spp), Sour Rot (Geotrichum candidum), Alternaria Fruit Rot (Alternaria spp.), Rhizopus soft rot (Rhizopus), Pink mould rot (Trichothecium roseum) in rockmelons.	
Powdery Mildew <i>Sphaerotheca fuligina</i>	High - major disease	SULPHUR	Kumulus DF	Label lists 'Vegetables' however labels say 'do not apply to cucumbers or rockmelons.		Phyto toxicity observed					Y		Use in field grown pumpkins, squash & cucumber. Sulphur is the major product used. Not used on melons because of phytotoxicity. Sulphur used on squash up to 5kg/ha, when label says 3kg/ha.
		POTASSIUM BICARBONATE	Ecocarb	No GH listing.							X	0	Use in GH cucumbers.
		BUPIRIMATE	Nimrod EW, Neptune	Used on cucumber but not registered.		Phytotoxicity observed		Winter squash' on Neptune label			H	14	Use in field grown pumpkins, squash & cucumber. Not used on melons because of phytotoxicity. AU - Permit 8604 for powdery mildew on watermelon, zucchini, squash, gherkins, cucumber, bitter melons. Registration for 'melon (except watermelons).
		CHLOROTHALONIL	Bravo 720SC	No GH listing.							Y	1	Occasionally used
		CHLOROTHALONIL + THIOPHANATE METHYL	Taratek 5F								Y+A	7	
		TRIFLOXYSTROBIN	Flint	Used on cucumber but not registered.		Phytotoxicity observed		winter squash'			K	14	Use in field grown pumpkins, squash & cucumber. Not used on melons because of phytotoxicity.

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Powdery Mildew (cont)		TRIADIMEFON	Bayleton	No GH listing.						C	3	Occasionally used.	
		PENCONAZOLE	Topas 200EW	No GH listing.	Phytotoxicity observed in melons						C		Occasionally used. Use in field grown pumpkins, squash & cucumber. Not used on melons because of phytotoxicity.
		TRIFORINE	Saprol	No GH listing.		Phytotoxicity observed in melons				X	3	Use in field grown pumpkins, squash & cucumber. Use in GH cucumbers. Not used on melons because of phytotoxicity.	
		CARBENDAZIM	Protek	Only Protek registered in cucurbits for Powdery mildew.						A			
		PYRACLOSTROBIN	Cabrio							K		Cabrio to be registered in NZ, crops unknown. To be registered in AU in cucurbits	
		AZOXYSTROBIN	Amistar WG	No registration for Powdery Mildew in cucumber or any other cucurbits however reg. for powdery mildew in Peas. Phytotoxicity observed in melons						K		Occasionally use in field grown pumpkins, squash & cucumber. Not used on melons because of phytotoxicity. AU label - registered in cucurbits for Powdery mildew, Downy mildew and Gummy stem blight.	
		TRIADEMENOL	Cereous	No cucurbits registration. Controls Powdery mildew in peas.						C		Occasionally used.	
		THIOPHANATE-METHYL	Topsin M-4 A	Not registered on any cucurbits. Only mention of powdery mildew is for ornamentals						A			
		MYCOBUTANIL	Systhane 400WP	No registered for any vegetable crop however reg. for Powdery Mildew in grapes and pipfruit						C			
		KRESOXIM-METHYL	Stroby WG	No registration for any vegetable crop however registered for powdery mildew control in apples						K		Commonly used in field grown pumpkins, squash & cucumber. Stroby only one adequate, other products create visible residue. Some resistance concerns.	
		SPIROXAMINE	Impulse	No registration for cucurbits however reg. for powdery mildew in grapes, wheat and barley						E			
		BACILLUS SUBTILIS	Serenade	No registration for cucurbits however reg. for powdery mildew & Botrytis in grapes						Bio fungicide			
		FLUSILAZOLE	Nustar	No registration for any vegetable crop however reg. for Powdery Mildew in pipfruit						C			
		CYPROCONAZOLE	Alto 100SC	No registration in cucurbits. Reg. for PM control in grapes and peas						C			
	EPOXYCONAZOLE	Opus	No registration in cucurbits. Reg. for PM in barley and wheat						C				

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
Powdery Mildew (cont)		TEBUCONAZOLE	Orius	No registration in cucurbits. Reg. for PM control in peas and wheat						C		
		DIFENOCONAZOLE	Score	No registration in cucurbits. Reg. for PM control in apples						C		
		TOLYFLUANID	Euparen Multi	No registration in cucurbits. Controls PM in grapes and apples. Aust. Label lists powdery Mildew suppression in Strawberries						X		Occasionally used
		FENARIMOL	Rubigan Flo	No registration in cucurbits however reg. for PM control in peas, pipfruit and grapes.						C		
Sclerotinia Rot <i>Sclerotinia sclerotiorum</i>	High - can be a major disease, rotation and weather dependent.	PROCYMIDONE	Sumislex 500 SC		Listed on label as for 'field cucurbits'				B	3	Occasionally used as disease occurs late in the crop.	
		CHLOROTHALONIL	Bravo 720SC	Sclerotinia not listed on label however product registered for 'Cucurbits - cucumber, melons, squash'.						Y		Commonly used and effective. Not registered for Sclerotinia in any crop.
		FLUAZINAM	Shirlan	Not registration in any cucurbits crop. Reg. for Sclerotinia control in potatoes and tomatoes.						Y		
		CARBENDAZIM	Carbendazim	Not registered in any cucurbits crop. Reg. for Sclerotinia control on Tomato (Greenhouse and Field), cucurbits and beans; only on Bayer label. Other labels differ.						A		
		AZOXYSTROBIN	Amistar WG	Not registered for any cucurbits crop.						K		AU label – registered for Sclerotinia control in field tomatoes.
		THIOPHANATE-METHYL	Topsin M-4 A	Not registered on any cucurbits. Reg. for Sclerotinia in beans, field tomatoes.						A		
		CYPRODINIL + FLUDIOXONIL	Switch	Not registered for any vegetable crop.						I+L		Registered for Botrytis in grapes. AU permit in peas for Sclerotinia
		TEBUCONAZOLE	Folicur	No registration for any cucurbits crop in NZ.						C		AU label - registered in pyrethrum for Sclerotinia sclerotiorum. AU permit in cucurbits for Sclerotinia rot.
		IPRODIONE	Rovral WP	Not registered for Sclerotinia control in any cucurbits crop. Label lists Sclerotinia control in kiwi fruit.						B		
		BOSCALID	Filan							G		No product available in NZ, but will be registered. AU label - permits for Sclerotinia control in peas (snow and green), leafy brassica vegetables, cucurbits, brassicas and beans.
		THIABENDAZOLE	Tecto SC	No registration for any cucurbits crop in NZ.						A		AU label - Sclerotinia control in turf.

* 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 cucurbits.

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini			
Angular Leafspot <i>Pseudomonas syringae</i>	Moderate - weather related	COPPER OXIDE	Nordox 75WG							Y	1	
		COPPER HYDROXIDE	Kocide 2000 DF	No GH listing.						Y	Na	Commonly used and effective - control and appearance is weather related.
		MANCOZEB	Manzate 200 DF							Y	Field 14 Indoor 2	
		MANCOZEB + COPPER HYDROXIDE	Mancocide DF						Y	1		
		BORDEAUX MIXTURE	Cuprofix	Lists Downy Mildew control in grapes however no cucurbits crop mentioned.						Y		
		COPPER OXYCHLORIDE	Agpro 800 WP	No registration for any cucurbits crop. Label lists Downy Mildew control in Vegetable brassicas, peas, garlic, leek, onions and cucurbits.						Y		
Anthracnose <i>Colletotrichum obiculare</i> and <i>Colletotrichum lagenarium</i>	Low - can be a late season problem	CAPTAN	Captan	No GH listing.						Y	3	
		MANCOZEB	Manzate 200 DF	WHP lists 'indoor' for cucurbits						Y	Field 14 days, Indoor 2 days	Water melon only - mancozeb commonly used and effective
		CHLOROTHALONIL	Bravo 720SC	Mentioned in comments that Bravo is used and effective however not registered for anthracnose						Y		Water melon only - Bravo commonly used and effective
		COPPER OXIDE	Nordox 75WG	No reg for anthracnose in cucurbits however reg. for anthracnose in avocados						Y		
		COPPER OXYCHLORIDE	Agpro 800 WP	No registration for any cucurbits crop.						Y		AU label - registered all cucurbits for anthracnose and other diseases
		PROPINEB	Antracol	No registration for cucurbits						Y		Label lists anthracnose control in watermelon and rockmelon.
Downy Mildew <i>Pseudoperonospora cubensis</i>	Low - occasional problem	COPPER HYDROXIDE	Kocide 2000 DF	No GH listing.						Y	None listed for cucurbits	In rockmelon, Bravo, Mancozeb, Ridomil used when needed and effective. In pumpkin - Mancozeb, Ridomil used when needed and effective. Metalaxyl not allowed to be used in Aust for resistance reasons.
		COPPER OXIDE	Nordox 75WG							Y	1	
		METALAXYL-M + MANCOZEB	Ridomil Gold MZ						D	4		

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Downy Mildew (cont)		CHLOROTHALONIL	Bravo 720SC	Registered for 'Cucurbits - cucumber, melons, squash'						Y	1		
		MANCOZEB	Manzate 200 DF	WHP lists 'indoor' for cucurbits							Y		Field 14, Indoor 2
		MANCOZEB + COPPER HYDROXIDE	Mancocide DF						Y	1			
		CAPTAN	Captan							Y	3		
		BORDEAUX MIXTURE	Cuprofix	Lists Downy Mildew control in grapes however no cucurbits crop mentioned.						Y			
		COPPER OXYCHLORIDE	Agpro 800 WP	No registration for any cucurbits crop. Label lists Downy Mildew control in Vegetable brassicas, peas, garlic, leek, onions and cucurbits.						Y			
		PROPINEB	Antracol	No NZ label could be found with propineb alone. Aust. Labe lists Downy Mildew control in cucurbits						Y			
		DIMETHOMORPH	Acrobat MZ 690	No registration for cucurbits however registered in grapes for Downy Mildew (<i>Plasmopara viticola</i>) in grapes and Downy Mildew (<i>Peronospora destructor</i>) in onions						X			
		METIRAM	Polyram DF	No registration for cucurbits however controls DM in grapes						Y			
	METALAXYL-M		Metalaxyl-M alone is not registered on any cucurbits ie Ridomil Gold 2.5G or Ridomil Gold EC						D				
Fusarium Wilt <i>Fusarium oxysporum f. sp. Melonis</i> of melon and Fusarium Crown and Foot Rot of Squash and Pumpkin <i>Fusarium solani f. sp. cucurbitisae</i>	Low	QUINTOZENE	Terrachlor 75 WP	No GH listing.	Pre-sowing soil treatment for all 'vegetables'. Good initial control however recolonisation occurs rapidly.				Y		Collar rot, crown rot - little quintozene used.		
		METAM SODIUM	Fumasol	No GH listing.	Good initial control however recolonisation occurs rapidly.				Fumigant		Occurs during late crop development in field crops. Crop rotation not very effective, liming gives good reduction. Reliant on resistant varieties. Little fungicides used in field crops.		
		DICHLOROPROPENE	Telone C-35	No GH listing.	Label lists 'Vegetables' Good initial control however recolonisation occurs rapidly.				Fumigant				
		PROCHLORAZ	Sportak	No registration in cucurbits or vegetables.						C		GH cucumbers - Occasionally used and effective.	
		THIOPHANATE-METHYL	Topsin M-4 A	Not registered on any cucurbits.						A		GH cucumbers - Occasionally used and effective.	
Gummy Stem Blight <i>Didymella bryoniae</i>	Moderate disease in greenhouse cucumber	CHLOROTHALONIL	Bravo 720SC	Registered in cucumber however no mention of Gummy Stem Blight on label						Y		Occasionally used. AU label - registered in all cucurbits for gummy stem blight and other diseases	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Gummy Stem Blight (cont)		COPPER HYDROXIDE	Kocide 2000 DF	No GH listing.							Y	None listed for cucurbits	Commonly used and effective - control and appearance is weather related.
		MANCOZEB + COPPER HYDROXIDE	Mancocide DF							Y	1		
		METALAXYL-M + MANCOZEB	Ridomil Gold MZ WG	Doesn't list GH or field							DY	4	
		MANCOZEB	Manzate 200 DF	Registered in cucurbits for other diseases						Y	Field 14 days, Indoor 2 days	Occasionally used and effective.	
		AZOXYSTROBIN	Amistar WG	Not registered for any cucurbits crop.						K		Occasionally used. AU label - registered all cucurbits for gummy stem blight and other diseases	
		DIMETHOMORPH	Acrobat MZ 690	No registration for cucurbits						X		AU label - registered all cucurbits for gummy stem blight and other diseases	
		TOLYFLUANID	Euparean Multi	No registration in cucurbits.						X		Occasionally used	
		PROPINEB	Antracol	No registration for cucurbits						Y		AU label - lists gummy stem blight control in watermelon and rockmelon.	
		COPPER OXYCHLORIDE	Agpro 800 WP	No registration for any cucurbits crop.						Y		AU label - registered all cucurbits for gummy stem blight and other diseases	
		METIRAM	Polyram DF	No registration for cucurbits						Y		AU label - registered all cucurbits for gummy stem blight and other diseases	
Phytophthora Rot <i>Phytophthora capsici</i>	Low - weather related problem in early crop	ETRIDIAZOLE	Terrazole 35 WP	No GH listing.	Vegetables						X		Soil Drench Treatments are not particularly effective due to re-invasion of phytophthora
		METAM SODIUM	Fumasol	No GH listing.									
		PHOSPHOROUS ACID	Foscheck	No GH listing.							Y		Registered for 'nursery stock' for phytophthora control as a plant applied treatment. Listed as a fertiliser soil drench - no disease control mentioned
		METALAXYL-M	Various Ridomil Products	Ridomil Gold MZ WG, Ridomil Gold EC and Ridomil Gold 2.5 G all lists phytophthora control for asparagus						D		Commonly used and effective.	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				GH Cucumber	Field Cucumber	Melon	Pumpkin	Squash	Zucchini				
Pythium Root Rot Pythium spp.	Low	PROPAMOCARB	Previcur	Only registered in ornamentals for Pythium						Y		Occasionally used. AU label - registered in ornamentals & turf for Pythium	
		PHOSPHOROUS ACID	Foscheck	No GH listing.							Y		Commonly used. Registered for 'nursery stock' for phytophthora control as a plant applied treatment. Listed as a fertiliser soil drench - no disease control mentioned
		METALAXYL-M	Apron	No cucurbits registration						D		Registered in brassicas & peas as seed treatment for Pythium.	

* Resistance groups combine agricultural chemicals 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 cucurbits.

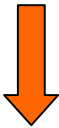
Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini				
APHIDS 	High - vectors for virus. Main aphids are: Green Peach, Melon and Potato aphids. Green Peach Aphid is 'high' problem	ALPHA-CYPERMETHRIN	Dominex Fastac	Aphids' listed for tomatoes						3A		Registered for 'Aphids' in tomatoes	
		PYRETHRINS	Garlic & Pyrethrum Concentrate	No listing for GH.	Aphids						3A	1	Major resistance issues for aphids
		<u>Beauvaria bassiana</u>	Botanigard Naturalis-O							Bio-insecticides		Not used yet in cucurbits, product in development	
Melon aphid <i>Aphis gossypii</i>		CANOLA OIL	Eco-oil	GPA						Vegetable Oil	0	Occasionally used.	
Potato aphid <i>Macrosiphum euphorbiae</i>		AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions aphid control						Botanical insecticide			
Carrot willow aphid <i>Macrosiphum euphorbiae</i>		BIFENTHRIN	Talstar 100EC				Aphids WHP 'Don't apply after flowering	Aphids Buttercup Squash WHP 'Don't apply after flowering		3A	3	Commonly used and effective. Used on all cucurbits.	
Cabbage Aphid (CA) <i>Brevicoryne brassicae</i>		DIAZINON	Diazinon 800	Reg. on tomato, cauliflower, cabbage and onion for 'aphids'						1B			
Fox Glove <i>Aulacorthum solani</i>		DIAZINON	Diazinon 50 WP	No listing for GH.	Aphids						1B	14	
Cucurbits Aphid <i>Nasonovia ribis-nigr</i>		ENDOSULFAN	Thiodan	Reg. on tomato, vegetable brassica and potato						2A		Commonly used and effective. Field cucurbits only.	
Sow thistle aphid		IMIDACLOPRID	Gaucho	Reg. on potato and squash for 'aphids'					Reg. on potato and squash for 'aphids'	4A	42	Used by some seedling producers – all cucurbits	
Green Peach Aphid (GPA) <i>Myzus persicae</i>		IMIDACLOPRID	Confidor	Registered for CA on vegetable brassicas and cucurbits+E28						4A		Commonly used and effective. Green peach aphid listed on AU label.	
Black (Peach??)Aphid <i>Brachycaudus persicae</i>		<u>Lecanicillium lecanii</u> blastospores										Not used yet in cucurbits, product in development	

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini				
Carrot black aphid <i>Macrosiphum euphorbiae</i>	APHIDS (cont)	PERMETHRINS + PIPERONYL BUTOXIDE	Greenseals Pyrethrum	No listing for GH.	Aphids						3A	3	
		PIRIMICARB	Pirimor 50		Aphids						1A	7	Commonly used and effective. Used in GH cucumbers. Reg. on tomato, cucurbits group, vegetable brassicas and cucurbits
		PYMETROZINE	Chess WG	Reg. in tomato, vegetable brassica, cucurbits and potato						9A		Commonly used and effective. All cucurbits.	
		TAU-FLUVALINATE	Mavrik	Reg. on field tomato for GPA						3A		Registered on field tomato for GPA	
		THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	Reg. for 'aphids' on tomato						3A		Registered for 'aphids' on tomato	
		PERMETHRIN + PIRIMIPHOS-METHYL	Attack		Aphids						3A+1B	3	Reg. for 'aphids' in GH tomato, cucurbits group and vegetable brassica
		DICHLORVOS	Divap	Aphids 'GH'	Aphids Vegetables						1B	3	
		FATTY ACIDS (POTASSIUM SALTS)	Nature's Way Insect Spray	No listing for GH.							Unlisted	1	
		APHID PARASITE'	<i>Aphidius colemani</i>							Bio-insecticides	0		
		APHIDOLETED	<i>Aphidoletes aphidimyza</i>							Bio-insecticides	0		
		MALATHION	Malathion 50EC	Aphids						1B	3		
		DELTAMETHRIN	Decis Forte					Aphids (WHP none listed)			3A		Reg. for 'aphids' in squash
		ROTENONE	Derris Dust								21A	1	

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


Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
APHIDS (cont)		METHOMYL	Lannate L	Reg. for GPA in tomato, cauliflower, cabbage and cucurbits						1A		.
		PHORATE	Phorate		Aphids					1B	70	Commonly used and effective.
		TERBUFOS	Counter 20G	Aphids listed for forage brassicas as seed/fertiliser treatment						1B		
		CHLORPYRIFOS	Lorsban 50EC				Winter squash Aphids		1B	10	Reg for 'aphids' in winter squash and vegetable brassicas	
		DIMETHOATE	Perfekthion S	Reg. for CA in potato, carrots and cauliflower, cabbage, Brussel sprouts and broccoli						1B		Occasionally used. Field cucurbits only.
		THIACLOPRID	Calypso	Listed for various insects on fruit (no aphids or vegetables). Not registered for the control of aphids in any crop.						4A		Used by some growers. Need to know what information there is about safety to biological control agents, as Calypso is in the same mode of action group as imidacloprid.
		ACEPHATE	Orthene	Reg. for 'aphids' in cucurbits and potato						1B		
		METHAMIDOPHOS	Monitor Tamaron	Reg. for 'aphids' in potato						1B		Occasionally used. Field cucurbits only.
CATERPILLARS 	High - Looper and Tomato	ACEPHATE	Orthene	Reg. in tomato, vegetable brassicas, cucurbits and potato						1B		Greasy cutworm - occasionally used and effective
		CHLORPYRIFOS	Lorsban 750 WG	Cutworm not listed on label						1B		Greasy cutworm - occasionally used and effective
	fruitworm the main problem. Moderate - Greasy cutworm	CARBARYL	Sevin	No listing for GH.	L, PTM,TFW + other caterpillars 'Vegetable Crops'					1A	1	not used
		DIAZINON	Diazinon 50 WP	No listing for GH.	Caterpillars					1B	14	Occasionally used in field cucurbits.
		ENDOSULFAN	Thionex	Reg. for various caterpillars in vegetable brassicas and potato						2A		Occasionally used in field cucurbits.
		METHAMIDOPHOS	Monitor Tamaron	Reg. for various caterpillars in tomato, vegetable brassica and potato						1B		
		PYRETHRUM	Garlic & Pyrethrum Concentrate	No listing for GH.	Cabbage Moth and caterpillars					3A	1	

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini				
Green lopper (GL) <i>Thysanoplusia orichalcea</i>	CATER PILLAR (cont)	TAU-FLUVALINATE	Mavrik	Reg. in cabbage and field tomato						3A			
Soybean looper (SL)		DICHLORVOS	Divap	Caterpillars 'GH'	Caterpillars - Vegetables						1B	3	
White Butterfly (WB) <i>Pieris rapae</i>		<i>Bacillus thuringiensis</i> t sub. <i>Kurstaki</i>	Bacillus thuringiensis	Caterpillars						11C	0	Commonly used and effective.	
Diamond Back Moth (DBM) <i>Plutella xylostella</i>		<i>Bacillus thuringiensis</i> sub. <i>Xen tari</i>	Bacillus thuringiensis	Reg. in vegetable brassicas and GH tomato						11C	0		
Army Caterpillar <i>Pseudaletia separata</i>		DELTAMETHRIN	Decis Forte	Reg, in field tomato, potato and vegetable brassicas						3A		Occasionally used in field cucurbits.	
Tropical Caterpillar <i>Spodoptera litura</i> (F.		ALPHA-CYPERMETHRIN	Dominex Fastac	Reg. in tomato and vegetable brassica						3A			
Copper caterpillar (Kumara) <i>Lycaena salustius</i>		BIFENTHRIN	Talstar 100EC and Talstar 80 SC	Reg, in vegetable brassicas and field tomato						3A		Occasionally used in field cucurbits.	
Cutworm <i>Agrostis spp.</i>		CYPERMETHRIN	Ripcord	Reg, in cauliflower, cabbage and tomato						3A			
Potato Tuber Moth (PTM) <i>Phthorimaea operculella</i>		PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Reg, in GH tomato, cucurbits group and vegetable brassicas						3A+1B	3		
		ESFENVALERATE	Sumi-Alpha	Reg, in tomato, cucurbits group, vegetable brassicas, potato and onion						3A			
	LAMBDA-CYHALOTHRIN	Karate	Reg, in field tomato, vegetable brassica and potato						3A		Occasionally used in field cucurbits.		
	METHOMYL	Lannate L	Reg. cauliflower, cabbage, cucurbits and tomato						1A		Occasionally used in field cucurbits.		
	SPINOSAD	Entrust Naturalyte (WP)	Reg, in field tomato and vegetable brassica						5A		Commonly used and effective. Greenhouse and field crops.		
	THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFUVALINATE	Guardall	Reg, in tomato and cabbage						3A				
	TRICHLORFON	Trifon	Reg, in tomato and vegetable brassica						1B				

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


Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini				
CATERPILLAR (cont)		EMAMECTIN	Proclaim							6A		Registered in fruit for leafroller. Needs to be registered as good IPM. AU label - in brassicas for lepidoptera.	
		TRICHLORFON + CYPERMETHRIN	Partna	Reg. in cauliflower, cabbage and tomato						1B+3A			
		MALATHION	Malathion 50EC	No listing for GH.	DBM,TFW, WB						1B	3	
		ROTENONE	Derris Dust	No listing for GH.	DBM,WB						21A	1	
		<u>Beauvaria bassiana</u>	Botanigard Naturalis-O							Bio-insecticides			
		FIPRONIL	Ascend	Reg. in vegetable brassicas						2C		Occasionally used in field cucurbits.	
		PARATHION METHYL	Folidol	Reg. in vegetables						1B	14		
		IDOXACARB	Steward 150SC	Reg. in 'head' cucurbits, cauliflower, cabbage and Brussel sprouts						22A		Occasionally used in field cucurbits.	
THRIPS 	High - major pest	ALPHA-CYPERMETHRIN	Dominex Fastac	Reg. in tomato and onions						3A		AU label – plague thrips in tomatoes.	
		ABAMECTIN	Avid	Reg. in fruit, strawberries and GH tomato						6A		No NZ thrips registrations. Occasionally used with oil. Good IPM compatibility. No registration for thrips. AU permit in tomato, cucumber & eggplant for WFT and ornamentals for melon thrips (T. palmi).	
		CHLORPYRIFOS	Lorsban 750 WG	Reg. in kumara for 'thrips'						1B			
		DELTAMETHRIN	Decis Forte	Reg. in kumara for 'thrips'						3A			
		Onion Thrips <i>Thrips tabaci</i>	ENDOSULFAN	Thionex EC	Reg. in kumara and tomato for 'thrips'						2A		Commonly used and effective. Poor IPM compatibility.
		Western Flower Thrips <i>Frankliniella occidentalis</i>	FIPRONIL	Ascend	No mention of thrips on NZ label						2C		Commonly used and effective. Poor IPM compatibility. AU label – thrips in bananas & cotton.
		Intonsa Flower Thrips <i>Frankliniella intonsa</i>	IMIDACLOPRID	Confidor	Reg. for thrips on onion						4A		AU label –thrips in eggplant and ornamentals.

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
Cucumerous thrips (WFT)	THRIPS (cont)	IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	Reg. for 'thrips' on onion						4A+3A		
		LAMBDA-CYHALOTHRIN	Karate	Reg. for 'onion thrips' on onions						3A		
		AZADIRACHTIN	NeemAzal-T/S	Not registered on all crops- thrips control						Botanical insecticide	0	
		METHAMIDOPHOS	Monitor Tamaron	Reg. for thrips on onion						1B		
		TAU-FLUVALINATE	Mavrik	Reg. for thrips on onion						3A		
		CARBARYL	Sevin	No thrips control in any veg. crop however controls thrips in fruit crops						1A		No thrips control in any veg. crop however controls thrips in fruit crops
		<i>Amblyseius cucumeris</i>	Mite-A, Thripex		Reg. on GH tomato, GH capsicum and GH cucumber				Bio-insecticides	0		
		<i>Hypoaspis aculeifer</i>	Hypomite	Thrips pupae						Bio-insecticides	0	
		DIAZINON	Diazinon 50 WP	No listing for GH.	Reg. for 'thrips' on tomato, vegetable brassicas and onions				1B	14	Commonly used and effective. Poor IPM compatibility. Field cucurbits only.	
		<i>Lecanicillium lecanii blastospores</i>							Bio-insecticides			
		LUFENURON	Match	No registrations in vegetables or thrips.						IGR		Registered in pipfruit for lepidoptera pests only. Occasionally used.
		DICHLORVOS	Divan	Reg. for 'thrips' on GH tomato and GH capsicum						1B		Commonly used and effective. Poor IPM compatibility.
		THIACLOPRID	Calypso	Thrips listed on avocados, peaches and nectarines but not any vegetable						4A		Thrips listed on avocados, peaches and nectarines
		SPINOSAD	Entrust Naturalyte (WP)							5A		Reg, in field tomato and vegetable brassica for other pests. Commonly used and effective. Good IPM compatibility. AU label – thrips in many vegetable crops including cucurbits.
MALATHION	Malathion 50EC	Thrips listed on various fruit crops however no vegetables						1B				

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
		PYRETHRUM	Garlic & Pyrethrum Concentrate	No listing for GH.	Thrips				3A	1		
		DIMETHOATE	Perfekthion S	Reg. for thrips in orchards.				1B		Occasionally used. Field cucurbits only. AU label - reg. in many vegetables including cucurbits for thrips.		

* 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 cucurbits.


Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
Grass grub Beetle <i>Oncopera spp.</i>	Moderate - can be a problem	PHORATE	Phorate	Grass Grub not listed on Phorate label for any crop						1B		Grass Grub beetle 'Confidor used as a seed dressing. SPs on the foliage'
		IMIDACLOPRID	Gaucho	Reg. for 'grass grub beetle in squash				Reg. for 'grass grub beetle in squash		4A	42	Check Sp's . Listed on cucurbits spreadsheet
		DIAZINON	DIAZINON 20g	Reg. for established pastures						1B		
		ALPHA-CYPERMETHRIN	Alpha scud	Reg. for 'Tasmanian Grass Grubs' but not on brassicas.						3A		
		DELTAMETHRIN	Decis Forte	No listing for 'grass grub' on any crop.						3A		
		TAU-FLUVALINATE	Mavrik	No listing for 'grass grub' on any crop.						3A		
		ESFENVALERATE	Sumi-Alpha							3A		
		BIFENTHRIN	Talstar 100 EC	No listing for 'grass grub' on any crop.						3A		
		TERBUFOS	Counter 20G	Controls 'grass grub' in new pastures/cereals						1B		
MITES 	Moderate - Occasional problem	DICOFOL	Kelthane 35	No listing for GH.	Mites				2B	7	Tomato Russet mite checked on all labels. Only on Abamectin label for glasshouse tomatoes	
		FATTY ACIDS (K SALTS)	Yeates Mite Killer	No listing for GH.	ERM, TSM				Not listed	1	No Tomato Russet Mite on the Fatty Acid Label	
Tomato Russet Mite (TRM) <i>Aceria lycopersici (Wolffenstein)</i>		FENBUTATIN OXIDE	Torque	Registered in fruit only. AU label 'Torque' registered for European red mite in various fruit crops but not vegetables.						12A		Occasionally used and effective. Predator mites Persimilis most common.
Two-Spotted Mite <i>Tetranychus urticae</i>		CANOLA OIL	Eco-oil	TSM							0	Commonly used and effective. Predator mites Persimilis most common.
		CLOFENTEZINE	Apollo 50SC	Label lists TSM and ERM for various crops but not vegetable crops. AU label Apollo 50SC lists European mite control in various fruit crops but not vegetables						10A		Occasionally used and effective. Predator mites Persimilis most common.
		DICHLORVOS	Divap	Mites						1B	3	

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
MITES (cont)		AZOCYCLOTIN	Peropal	No Reg. in Vegetable Crops. Controls TSM and ERM in various fruit crops						No AU Listing		Mites for cucurbits 'Acephate commonly used and effective'
		ABAMECTIN	Avid	TRM, TSM listed for GH Tomato ERM listed for pipfruit						6A		Commonly used and effective. Predator mites Persimilis most common.
		ACEPHATE	Orthene	Reg. in tomato, vegetable brassicas, cucurbits and potato						1B		Occasionally used.
		TAU-FLUVALINATE	Mavrik Flo	Reg. for Mites in Ornamentals								
		MILBEMECTIN	Mit e mec	Reg for TSM, ERM in apples								
		FENPYROXIMATE	Fenamite	Reg. for TSM, ERM in pipfruit								
		PROPARGITE	Omite 30W	No Reg. in Vegetable Crops. TSM and ERM control in various crops						14A		
Springtails <i>Collebola spp.</i>	Moderate - seedlings problem only	CHLORPYRIFOS	Lorsban 750 WG	Springtails listed on forage brassica labels						1B		Lorsban commonly used and effective
		FURATHIOCARB	Promax 400 CS	Springtails listed on forage brassica labels as a seed treatment						No AU Listing		
		IMIDACLOPRID	Gaicho						4A	42	Listed for squash and forage brassicas	
		DIAZINON	Diazinon 800	Reg. for 'springtails' in vegetable brassica						3A		
		TERBUFOS	Counter 20G	Sprintails listed for brassica vegetables as a seed/fertiliser treatment						1B		
		PHORATE	Phorate	Reg. for 'springtails' in forage brassicas						1B		
Wireworm <i>Heteroderus spp.</i>	Low - occasional problem	PHORATE	Phorate				Wireworm		1B	70	Commonly used and effective in all field grown cucurbits. Reg. for 'cucurbits' squash and potato	
		CHLORPYRIFOS	Suscon Green (G) or Chlorpyrifos	Wireworm not found on label for any crop								
		DIAZINON	Various	Wireworm not found on label for any crop								
		SYNTHETIC PYRETHOIDS	Various	Wireworm not found on label for any crop								
		ACEPHATE	Orthene	No listing for 'wireworm' for any crop								Wireworm not listed on Orthene label

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
Potato psyllid <i>Psyllidae spp.</i>	Nil - new pest, but only found on potato and capsicums at this stage.	ABAMECTIN	Avid	Psyllids not listed for any crop						6A		New pest, found in one potato and caps crop only.
		SPINOSAD	Spinosad Naturalite	Psyllids not listed for any crop						5A		No products found for 'potato psyllid' control in any vegetable crops
		METHOMYL	Lannate L	Psyllids not listed for any crop						1A		Need registrations , soft options outside op's and sp's
		ENDOSULFAN	Thiodan	Psyllids not listed for any crop						2A		
		IMIDACLOPRID	Confidor	Confidor RTU label in AU lists psyllid (lerps) control in non-bearing citrus						4A		Confidor RTU label in AU lists psyllid (lerps) control in non-bearing citrus
		PYMETROZINE	Chess WG	Psyllids not listed for any crop						9A		
		BUPROFEZIN	Applaud Ovation	Psyllids not listed for any crop						17A		
		SYNTHETIC PYRETHROIDS		Checked the most common SP labels. No psyllid mentioned						3A		Checked the most common SP labels. No psyllid mentioned
		DIMETHOATE	Dimethoate	AU labels list 'Psyllids(lerps) control in non fruit and non veg. trees						1B		AU label lists psyllid control in eucalypts
		ORGANO PHOSPHATES		Checked the most common OP labels. No psyllid mentioned						1B		
		ESFENVALERATE	Sumi-Alpha	No mention of Psyllids on label for any crop						3A		
Cabbage Leaf Miner <i>Liriomyza brassicae</i>	Nil	SYNTHETIC PYRETHROIDS		Checked the most common SP labels. No 'leafminer' mentioned						3A		Leafminer fly?? (<i>Scaptomyza flava</i>)
		DIMETHOATE	Dimethoate	AU label lists 'leafminers' for vegetables						1B		
		ENDOSULFAN	Thiodan	AU label lists 'leafminers' for tobacco and beet leafminer in beetroot						2A		
Sciarid Flies <i>Bradysia spp.</i>	Moderate pest	IMIDACLOPRID	Gaicho	Sciarid fly control not mentioned for any crop						4A		
		<i>Hypoaspis aculeifer</i>	Entomite Hypomite	GH'	'Outdoor'					Bio-insecticides	0	
		<i>Bacillus thuringiensis israelensis</i>	VictoBac 12AS	No vegetable registration						Bio-insecticide		Occasionally used. Only registered for mosquito control. AU permit for fungus gnats in GH crops.
		DICHLORVOS	Divap	Reg. for 'scariad fly' in GH tomato, GH capsicum						1B		
		IMIDACLOPRID	Confidor	Registered on vegetable brassicas & onions (thrips)						4A		Occasionally used.

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
Sciarid Flies (cont)		<i>Steinernema feltiae</i>	Gnatnem	Registered in vegetables						biological	0	Occasionally used.
		OXAMYL	Vydate	No cucurbits registration.								Occasionally used and effective as a drench at crop start. No mention of Sciarid flies on Oxamyl (Vydate) label.
		DIAZINON	Diazinon 800	Reg. on tomato, cauliflower, cabbage and onion for 'aphids'						1B		Occasionally used. No diazinon label lists Sciarid fly for control in any crop.
		SYNTHETIC PYRETHROIDS	Various	Checked the most common SP labels. No mention						3A		Checked the most common SP labels. No mention of Sciarid flies. Commonly used and effective on adults
Mealy Bugs <i>Pseudococcus spp.</i>	Nil	IMIDACLOPRID	Gaucho	Mealy bug not listed on label in NZ						4A		
		CARBARYL	Sevin	Mealy bug control in pipfruit						1A		
		AZADIRACTIN	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	Mealy bug listed for peaches, grapes, persimmons, pipfruit						17A		
		THIACLOPRID	Calypso	Mealy bug control reg. for apples however no vegetable crop						4A		
		PROTHIOFOS	Tokuthion	Controls mealy bug in grapes and pipfruit						1B		
		CRYPTOBUG (Biological)	<i>Cryptolaemus montrouzieri</i>							Bio-insecticide	0	
Green Vegetable Bug <i>Nezara viridula</i>	Moderate	CARBARYL	Sevin	Green Veg. Bug not listed for any crop in NZ						1A		
		ENDOSULFAN	Thiodan	Reg. for GVB control in tomato						2A		
		IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	Lists Green Vegetable Bug for sweet corn						4A+3A		
		METHAMIDOPHOS	Monitor Tamaron	Listed on maize/sweet corn for Green veg bug						1B		Listed on maize/sweet corn for Green veg bug
		IMIDACLOPRID	Confidor	Green Vegetable Bug not listed on Confidor label in NZ or AU						4A		Green Vegetable Bug not listed on Confidor label in NZ or AU. Occasionally used.
		TRICHLORFON	Trifon	Reg. for tomato						1B		

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)	
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini				
WEEVILS	Low - occasional problem	IMIDACLOPRID	Gaucho	Black vine weevil not listed on label however various weevils listed						4A			
		FURATHIOCARB	Promax 400 CS	Various weevils are controlled on a range of crops as a seed treatment						No AU Listing			
		TERBUFOS	Counter 20G	Listed for weevil control in forage brassicas as a seed/fertiliser treatment						1B			
Black Vine Weevil Larvae <i>Otiorhynchus sulcatus</i>		CHLORPYRIFOS	Suscon Green	Only ornamentals and flowering plants						1B			
White fringed weevil <i>Naupactus leucoloma</i>		<i>Heterorhabditis bacteriophora</i>	Otinem	Ornamentals only'						bio-insecticide			
Plant Weevils <i>Curculionidae spp.</i>		FIPRONIL	Ascend	Weevils not listed on label for any crop						2C			
Stem weevil <i>Listronotus bonariensis</i>		LAMBDA-CYHALOTHRIN	Karate	Fuller rose weevil listed for citrus only						3A			
		METHAMIDOPHOS	Monitor Tamaron	No weevils listed on label						1B			
		PHORATE	Phorate	Weevils list for forage brassica						1B		Weevils list for forage brassica	
		DIAZINON	DIAZINON	No weevil listed on label						1B			
Leafroller <i>Tortricidae spp.</i>	Nil	Bacillus thuringiensis sub. Aizawai	Dipel Xentari	Bt for leafroller control listed for a number of crops						11C			
Slugs & snails <i>Gastropoda spp.</i>	Low - occasional problem	IRON PHOSPHATE	Neudorff Slug and Snail Bait	No listing for GH.	Don't apply to edible plant parts						No listing	0	
		IRON SODIUM EDTA	Multiguard	No listing for GH.	Don't apply to edible plant parts						No listing	0	
		METHIOCARB	Mesurol	No listing for GH.	NO WHP where product comes into contact with edible plant portions when a WHP of 21 days apply						1A	0 or 21	
		Metaldehyde	Slugout	No listing for GH.	Do not apply to edible plant parts.						Molluscicide	0	
		THIODICARB	Larbait	Vegetables - slugs						1A	21		

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


Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
Rats <i>Ratus spp.</i>	Nil	HYDROCYANIC ACID	Cyanosil	Registered product in NZ						8B		
		METHYL BROMIDE	Ag Fume M.B.	Registered product in NZ						8A		
		ALUMINIUM PHOSPHIDE	Genfume AP	Registered product in NZ						8B		
		COUMATETRALYL	Racumin	Registered product in NZ								
		BROMADIOLONE	Rid Rat Super	Registered product in NZ								
		BRODIFACOUM	Talon	Registered product in NZ								
		DIPHACINONE	Pest Gone Rodent Bait	Registered product in NZ								
		FLOCOUMAFEN	Storm Secure	Registered product in NZ								
		Corn Cob -powdered'	No rats	Registered product in NZ								
WHITEFLIES 	Moderate - Need soft options to catch the early life cycle stages.	THIACLOPRID	Calypso	Whitefly not listed on Calypso label						4A		Commonly used and effective. No Whitefly listed on AU label or NZ label
		BUPROFEZIN	Applaud Ovation	GWF (GH)		GWF WHP			GWF (GH)	17A	3	Commonly used and effective. Reg. on GH tomato, GH capsicum, GH cucumber, melon and zucchini
		ENDOSULFAN	Thiodan	Reg, for whitefly on tomato						2A		
		CANOLA OIL	Eco-oil	GH Whitefly						Vegetable Oil	0	Commonly used and effective.
Greenhouse whitefly(GW) <i>Trialeurodes vaporariorum</i>												
Tobacco Whitefly (TW)(Silverleaf) <i>Bemisia tabaci (biotype B)</i>		AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions whitefly control						Botanical insecticide		Not registered on any vegetable and only on non-fruit bearing trees and vines.
		OXAMYL	Vydate	No cucurbits registration.								Occasionally used and effective as a drench at crop start. Oxamyl does not list whitefly

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

Insect name (occurrence)	Priority	Active ingredient	Common Trade Name	Registrations						Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Cucumber GH	Cucumber Field	Melon	Pumpkin	Squash	Zucchini			
WHITEFLIES (cont)		NEEM OIL		No product could be identified								Occasionally used and effective.
		IMIDACLOPRID	Gaucho	No Whitefly control for any crop						4A		
		<i>Lecanicillium lecanii</i> blastospores										
		<i>Encarsia formosa</i>	En-force, En-Strip	GH'	Reg. on GH tomato, GH capsicum and GH cucumber				Bio-insecticides	0		
		DICHLORVOS	Divap	Reg. for 'whitefly on GH tomato and GH capsicum						1B		
		PYMETROZINE	Chess WG	Reg. for 'whitefly' on GH and field tomato						9A		Occasionally used but some resistance issues
		METHOMYL	Lannate L	Whitefly (No WHP)	Reg. for 'whitefly' on GH tomato, GH capsicum and GH cucumber				1A			
		PERMETHRUM	Garlic & Pyrethrum Concentrate	No listing for GH.	GW				3A	1		
		PIRIMIPHOS-METHYL	Actellic	Reg. for 'underglass' tomato and 'underglass' cucurbits group						1B	3	
		PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Reg. for GH tomato		Reg. for GH tomato				3A+1B	3	
	FATTY ACIDS (POTASSIUM SALTS)	Nature's Way Insect Spray	No listing for GH.					Unlisted	1	Hitman' AU Label lists whitefly. No listing of Whitefly on NZ Label		

* Resistance groups combine agricultural chemicals 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 cucurbits.

Active ingredient	Common Trade Name	Registrations (field)					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
		Cucumber	Melon	Pumpkin	Squash	Zucchini			
ALACHLOR	Alanex Lasso							NA	common used and effective, even under plastic
CLOMAZONE	Magister						F	NA	common used and effective
DIMETHENAMID	Frontier							NA	occasionally used
FLUAZIFOP-P-BUTYL	Fusilade WG						A	35	common used and effective
CLETHODIM	Arrow						A	35	
HALOXYFOP	Gallant NF						A	35	occasionally used
METOLACHLOR	Finale						K	NA	common used and effective, used in squash
OXYFLUORFEN	Goal 40 WP						G	NA	Used as a pre-plant knockdown with Roundup.
QUIZALOFOP-P-ETHYL	Targa						A	35	common used and effective
SETHOXYDIM	Poast						A	35	common used and effective
S-METOLACHLOR	Dual Gold						K	NA	common used and effective, used in squash
SULFENTRAZONE	Authority							NA	
TRIFLURALIN	Trifluralin						D	NA	common used and effective, even under plastic
GLYPHOSATE	Roundup						M	NA	Always used pre-em and post em inter-row with shields
GLYPHOSATE-TRIMESIUM	Touchdown						M	NA	Used pre plant
DIQUAT	Reglone						L	NA	
PARAQUAT	Paraquat						L	NA	Pre-emergent and inter-row weed control
PINE OIL	Organic Interceptor							NA	Pre-emergent weed control

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

	Actives under review in Aust
	Registered
	Used off-label