BRASSICAS

Strategic Agrichemical Review Process 2007

Horticulture New Zealand

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 brassica industry across New Zealand. The information in this report will assist the brassica industry with its agrichemical selection and usage into the future.

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Disclaimer:

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Recommendations

In Auckland, November 2000, a Strategic Agrichemical Review Process was conducted in brassicas with the assistance of leading growers, consultants, retailers, government agencies and selected Horticulture New Zealand staff.

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

Diseases and fungicides

The high priority diseases are:

Black Rot or Bacterial Spot	Various bacteria including *Xanthomonas campestris*
Clubroot	*Plasmodiophora brassicae*
Downy mildew	*Peronospora parasitica*
Ring spot or Mycosphaerella Leafspot	*Mycosphaerella brassici-cola*

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

Product (active)	**Target disease**	**Action**
Terrachlor (quintozene)	Clubroot (*Plasmodiophora brassicae)*	New use
Captan (captan)	Downy mildew (*Peronospora parasitica*)	New use
Acrobat (dimethomorph)	Downy mildew (*Peronospora parasitica*)	New use
Amistar (azoxystrobin)	Downy mildew (*Peronospora parasitica*)	New use
Foscheck (phosphorous acid)	Downy mildew (*Peronospora parasitica*)	New use
Manzate (mancozeb)	Ring spot (*Mycosphaerella brassici-cola*)	Adding to existing registrations
Flint (trifloxystrobin)	Ring spot (*Mycosphaerella brassici-cola*)	New use

Steps forward

1. No new options could be found for Black rot or Bacterial Spot control in brassicas.
2. As quintozene is registered in Aust, confirmatory efficacy and crop safety trials should be conducted in NZ for the control of Clubroot.
3. Efficacy trials are required in the major brassica growing areas to determine the most efficacious fungicides for the control of Downy mildew using captan, dimethomorph, azoxystrobin and phosphorous acid in combination with currently registered products; and for the control of Ring spot using mancozeb and trifloxystrobin in combination with currently registered products.
4. Once efficacy and the use pattern (and the withholding period) are determined, residue trials may be required in the major brassica 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.

5. Provide the brassica industry with sound technical information for the control of Clubroot, Downy mildew and Ring spot listing fungicides, use patterns and withholding periods.
6. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ agrichemical regulations.

One of the major diseases in NZ brassica crops – Downy mildew, is a fungi that has 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 brassica industry.

Insects and insecticides

The high priority insects are:

Aphids (especially Green Peach Aphid, Black aphid, Cabbage aphid)	*Myzus persicae, Brachycaudus persicae, Brevicoryne brassicae*
Caterpillars (especially Greasy cutworm, Diamondback moth, Soybean looper, Tomato fruitworm, White butterfly	*Agrotis ipsilon, Plutella xylostella, Thysanoplusia orichalcea, Helicoverpa armigera, Pieris rapae*
Slugs & snails	*Gastropoda spp.*

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

Product (active)	**Target insect**	**Action**
Gaucho (imidacloprid)	Aphids	New use
Talstar (bifenthrin)	Aphids	New use
Steward (indoxacarb)	Lepidoptera	Adding to existing registrations
Proclaim (emamectin)	Lepidoptera	New use

Steps forward

1. Efficacy trials are required in the major brassica growing areas to determine the most efficacious insecticides for the control of aphids using imidacloprid seed treatment and bifenthrin; and Lepidoptera using indoxacarb and emamectin, in combination with currently registered products.
2. No new control options were found for snail and slug control in brassicas.
3. Once efficacy and the use pattern (and the withholding period) are determined, residues trials may be required in the major brassica 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.
4. Provide the brassica industry with sound technical information for the control of aphids and Lepidoptera caterpillars listing insecticides, use patterns and withholding periods.
5. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ agrichemical regulations.

Two of the major insect pests in NZ cucurbit crops – aphids and Lepidoptera, are 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 brassica industry.

Weeds and herbicides

The main weed gaps identified by brassica growers are:

- Dock (*Rumex spp*.)
- Groundsel (*Senecio vulgaris*)
- Cleaver (*Galium aparine*)
- Mayweed (Chamomile) (*Anthemis cotula*)
- Wild turnip (*Rapistrum rugosum*)
- Oxalis (*Oxalis spp*).
- Willow weed (*Polygonum persicaria*)

In each of these cases, the weeds can be controlled to some degree with existing registered herbicides. Otherwise the only control available is pre-plant weed control with glyphosate, oxyfluorfen or paraquat. These are existing registered uses. There is also a number of pre-emergent and post-emergent herbicides available.

New herbicides that can be pursued for these uses are:

Product (active)	**Target insect**	**Action**
Clopyralid (clopyralid)	Weeds – post-emergent	New use
Dacthal (chlorthal-dimethyl)	Weeds – pre-emergent	New use
Stomp (pendimethalin)	Weeds – pre-emergent	New use

Steps forward

1. Trials are required in the major brassica growing areas to demonstrate the techniques required for effective pre-plant weed control of problem weeds with currently registered herbicides.
2. Efficacy and crop safety trials are required in the major brassica growing areas before pursuing the use of clopyralid, chlorthal-dimethyl and pendimethalin.
3. Once the use pattern (including the withholding period and crop safety) are determined, residues trials may be required in the major brassica growing areas for these herbicides so that they comply with the default MRL (0.1 mg/kg). Residue data for some herbicides may be available from Australia or elsewhere. Some confirmatory trials in NZ may be necessary.
4. Provide the brassica industry with sound technical information for the control of weeds listing the herbicides, use patterns and withholding periods.
5. Registration can be discussed with the manufacturer, otherwise a use pattern developed to comply with the NZ agrichemical regulations.

The New Zealand brassica 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 brassica growing areas are in (HortResearch[1]):

- Auckland
- Canterbury
- Manawata / Wanganui

There are (HortResearch[1]):

- 260 brassica growers (80 broccoli, 80 cabbage, 100 cauliflower)
- 3,504 hectares planted (1,717 broccoli, 808 cabbage, 979 cauliflower)
- 82,000 T produced (18,000 broccoli, 40,000 cabbage, 24,000 cauliflower)
- $80.3 million from domestic sales
- $1.0 million from fresh export sales (2006)

Growers of all horticultural crops frequently suffer from a lack of legal access to crop protection products (agrichemicals). The problem is that whilst their crops are valuable, they are too small individually for agchem manufacturers to bear the high cost of registering agrichemicals for their use. It is also a problem in larger crops, such as brassicas, 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 brassica 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.
- Jeopardising of export trading arrangements due to unacceptable agrichemical use or residue non-compliance.

[1] HortResearch FreshFacts 2006

- Rejection of produce from export markets due to residue non-compliance.
- Fines and penalties

Agrichemicals have always been an important tool in the production of brassicas. 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 brassica 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 harvest.

Strategic Agrichemical Review Process

As a consequence of the issues facing the brassica industry regarding limited agrichemical access, AgAware Consulting Pty Ltd in association with Horticulture New Zealand Ltd undertook a review of the agrichemical requirements in brassicas 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 brassicas
- 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 brassica 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 brassica 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 brassica 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 brassicas but attempts to prioritise the major problems.

Methods

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

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

Results

For the brassica vegetables discussed in this SARP report, only the four traditional varieties were reviewed:

Broccoli ……..	*Brassica oleracea var. italica*
Brussels Sprout ……	*Brassica oleracea var. gemmifera*
Cabbage ……..	*Brassica oleracea*
Cauliflower ……..	*Brassica oleracea var. botrytis*

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

Specific differences will be discussed.

The complete list of SARP worksheets is presented.

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

Discussions

Diseases of brassicas

The major diseases of brassicas recorded are:

Common name	**Scientific name**
HIGH PRIORITY	
Black Rot or Bacterial Spot ……	Various bacteria including *Xanthomonas campestris*
Clubroot …….	*Plasmodiophora brassicae*
Downy mildew ……..……..	*Peronospora parasitica*
Ring spot or Mycosphaerella Leafspot …..	*Mycosphaerella brassici-cola*
MODERATE PRIORITY	
Leaf spot ……..…	*Pyrenopeziza brassicae*
LOW PRIORITY	
Early Blight …….	*Alternaria solani*
Pythium Root Rot ……..….	*Pythium spp.*
Rhizoctonia Root Rot ...…….….	*Rhizoctonia solani*
Sclerotinia rot ……..….	*Sclerotinia sclerotiorum*
White blister ……	*Albugo candida*

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

High priority disease

Black Rot or Bacterial Spot (Various bacteria incl. *Xanthomonas campestris*)

There are no products registered for Black Rot or Bacterial Spot control in brassicas.

Fungicides that are used off-label in brassicas for the control of Black Rot or Bacterial Spot are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
COPPER OXYCHLORIDE	Various	Registered for vegetable brassica					Y		Occasionally used and effective.
COPPER HYDROXIDE	Various	Registered for vegetable brassica					Y		Occasionally used and effective.
SULPHUR	Various	Registered for vegetable					Y		Used by growers.
MANCOZEB	Manzate	Registered for vegetable brassicas for Downy mildew					Y		Used by growers.

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

	Used off-label

These products are all occasionally used and considered effective.

- Copper based fungicides are the only products with known activity against bacteria. But there is limited control of the bacteria once it is established. Copper needs to be used to prevent the disease.
- Sulphur is used by growers and said to work. There are no registered uses for sulphur controlling bacteria. Therefore efficacy is questionable.
- Mancozeb was also listed as being used by growers. There are no registered uses for mancozeb controlling bacteria. . Therefore efficacy is questionable.

No other agrichemical options are available for the control of Black Rot or Bacterial Spot (Various bacteria incl. *Xanthomonas campestris*) in brassicas.

Management strategies for Black Rot or Bacterial Spot are:

- Use seed that has been treated in hot water to control seed-borne infection.
- Prevent overcrowding of seedlings.
- Keep seedling production areas free of susceptible weeds.
- Remove diseased plants immediately.
- Rotate crops.
- Control weeds and insects.
- Apply agrichemicals (copper) as required, especially in seedlings, used in a preventative manner.

Clubroot (*Plasmodiophora brassicae*)

Fungicides registered for Clubroot (*Plasmodiophora brassicae*) control in brassicas or vegetables are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
FLUAZINAM	Shirlan						Y	NA	Major product used.
FLUSULFAMIDE	Nebijin							NA	Rotationally used.
CHLOROTHALONIL + THIOPHANATE-METHYL	Taratek						Y+A	7	Not used.
THIOPHANATE-METHYL	Topsin						A	7	Not used.

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

	Actives under review in NZ
	Actives under review in Aust
	Registered

Both Shirlan and Nebijin are commonly used as a soil treatment, pre-plant in brassicas. There is little risk of resistance developing in the future with the continued use of these fungicides.

From the reports received, the current fungicides used for Clubroot (*Plasmodiophora brassicae*) control in brassicas are working adequately. But it was identified that alternatives are required, due to the inflexibility of the available products (pre-plant only).

In New Zealand and Australia, Basamid (dazomet) and Metan sodium (metan) are registered for Clubroot control. They are applied to the soil prior to any seeding or transplanting of the crop. There are no reports of these products being used.

Fungicides that are used off-label in brassicas for the control of Clubroot are:

Active ingredient	Common Trade Name	Registration					Resistance group*	Comments
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas		
QUINTOZENE	Terraclor	Not registered for this disease. Registered in vegetable seedlings					Y	Sometimes used.
CHLOROTHALONIL	Bravo	Not registered for this disease.					Y	Used in rotation for every other crop. Stock grazing issues.

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

	Actives under review in NZ
	Used off-label

These products are all occasionally used and considered effective.

- Terrachlor - is an old systemic fungicide with limited uses. In NZ it is only registered for use in vegetable seedlings, where it is sometimes used.
- Bravo - is an effective protectant with a wide disease spectrum, but there are no registrations for Clubroot. Therefore efficacy is questionable.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
QUINTOZENE	Terraclor	Y	Registered in Aust in brassicas for Club root as in-soil or soil drench treatment.

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

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

- Terrachlor (quintozene)
  - Australian registration;
  - MRL in: Australia, EU, Singapore & Japan (0.02 mg/kg - vegetables); Codex & Japan (0.05 mg/kg - broccoli); Codex & Japan (0.1 mg/kg - cabbage); Indonesia, Korea & Malaysia (0.02 mg/kg - cabbage)

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

FUNGICIDE ALTERNATIVES IN BRASSICAS FOR PLASMODIOPHORA

In reviewing the possible alternatives:

- Terrachlor (quintozene) - is a protectant/curative fungicide. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. As it is already registered in Australia as an in-soil or soil drench treatment, data sharing with Chemtura should be possible. **The product should be pursued.**

Downy mildew (*Peronospora parasitica*)

Fungicides registered for Downy mildew (*Peronospora parasitica*) control in brassicas or vegetables are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
CHLOROTHALONIL	Bravo						Y	7	Occasionally used and effective. Stock grazing issues.
COPPER HYDROXIDE	Kocide						Y	NA	Commonly used - effective
COPPER OXIDE	Nordox						Y	1	Not used
COPPER OXYCHLORIDE	Agpro						Y	0	Commonly used - effective
MANCOZEB	Manzate						Y	NA	Commonly used - effective
METALAXYL-M + MANCOZEB	Ridomil Gold MZ						D	NA	Occasionally used and effective

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

	Actives under review in NZ
	Registered

All of these products are commonly/occasionally used as foliar treatments in brassicas. There is little risk of resistance developing in the future with the continued use of the copper based fungicides, chlorothalonil and mancozeb as they are multi-site, protectant fungicides. But the overuse of Ridomil (metalaxyl) can lead to an increased risk of resistance developing as has been identified in New Zealand and Australia.

Feedback indicates the current fungicides used for Downy mildew (*Peronospora parasitica*) control in brassicas are working adequately. In spite of this it was identified that alternatives are required, particularly systemic/curative fungicides.

Fungicides that are used off-label in brassicas for the control of Downy mildew are:

Active ingredient	Common Trade Name	Resistance group*	Comments
CAPTAN	Captan	Y	Occasionally used and effective. Foliar and soil drenched
DIMETHOMORPH	Acrobat	X	Occasionally used and effective.
AZOXYSTROBIN	Amistar	K	Occasionally used and effective.
PHOSPHOROUS ACID	FOSCHECK	Y	Occasionally used and effective.

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

	Used off-label

From the reports received, the current off-label fungicides used for Downy mildew (*Peronospora parasitica*) control in brassicas are working adequately.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
METIRAM	Polyram	Y	NZ – registered for Downy mildew in grapes. Aust - registered for Downy mildew in brassicas.
PROPINEB	ANTRACOL	Y	NZ – registered for Downy mildew in onions. Aust - registered for Downy mildew in brassicas.

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

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

- Captan (captan)
  - MRL in: EU, Switzerland (0.1 mg/kg - vegetables); Japan (5 mg/kg - brassicas); NZ (10 mg/kg - vegetables); Thailand (15 mg/kg - vegetables); USA (2.0 mg/kg – broccoli, cabbage, cauliflower); Korea (2.0 mg/kg - cabbage)
- Acrobat (dimethomorph)
  - MRL in: EU (0.05 mg/kg - brassicas); Japan (2 mg/kg – broccoli, cabbage, cauliflower)
- Amistar (azoxystrobin)
  - MRL in: EU (0.5 mg/kg – broccoli & cauliflower; 0.3 mg/kg – cabbage); Japan (5 mg/kg – broccoli & cauliflower; 0.5 mg/kg – cabbage); USA (3 mg/kg - brassicas)
- Foscheck (phosphouous acid)
  - MRL in: Italy (2.0 mg/kg – broccoli, cauliflower); NZ – exempt
- Polyram (metiram)
  - MRL in: Aust (2.0 mg/kg – brassicas); EU, Switzerland (1.0 mg/kg - brassicas); Japan (0.2 mg/kg – brassicas, cabbage); NZ (7.0 mg/kg - vegetables); Canada (7 mg/kg – broccoli, cabbage, cauliflower); Taiwan (2.5 mg/kg - brassicas); Codex (5.0 mg/kg – cabbage)
- Antracol (propineb)
  - MRL in: Aust (2.0 mg/kg – brassicas); EU, Switzerland (1.0 mg/kg - brassicas); Japan (0.2 mg/kg – brassicas); NZ (7.0 mg/kg - vegetables); Taiwan (2.5 mg/kg - brassicas); Codex, Japan & Malaysia (5.0 mg/kg – cabbage)

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

FUNGICIDE ALTERNATIVES IN BRASSICAS FOR PERONOSPORA

In reviewing the possible alternatives:

- Captan - an old protectant fungicide with a wide disease control spectrum. In NZ it is only registered for use in nursery seedlings, as a soil drench, where it is sometimes used in brassicas. Also used foliar occasionally. 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 NZ and many overseas countries; **the product should be pursued** after efficacy is confirmed.
- Acrobat (dimethomorph) – is a protectant/systemic fungicide with excellent activity on Downy mildew during early plant growth. Resistance management is an issue; therefore it should always be used with a protectant fungicide such as mancozeb. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. 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.

- Amistar (azoxystrobin) – is a protectant/curative fungicide with a wide spectrum of activity. Resistance management is an issue. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. As there are many overseas MRL, **the product should be pursued**, provided efficacy is confirmed. This will provide a necessary new systemic fungicide.
- Foscheck (phosphorous acid) – a systemic fungicide with good active on Oomycetes. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. Overseas MRL are limited, but this may be as phosphorous acid residues are exempt in some countries in vegetables as they are in NZ. **The product should be pursued if efficacy can be confirmed.**
- Polyram (metiram) – a protectant fungicide. Does not offer any significant advantages over chlorothalonil and mancozeb. It should not be pursued.
- Antracol (propineb) – a protectant fungicide. Does not offer any significant advantages over chlorothalonil and mancozeb. It should not be pursued.

Ring spot or Mycosphaerella Leafspot (Mycosphaerella brassici-cola)

Fungicides registered for Ring spot or Mycosphaerella Leafspot (*Mycosphaerella brassici-cola*) controls in brassicas or vegetables are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
CHLOROTHALONIL	Bravo						Y	7	Occasionally used and effective. Stock grazing issues.
COPPER OXYCHLORIDE	Agpro						Y	0	Used by growers.
CYPROCONAZOLE	Alto						C	14	Occasionally used and effective.
DIFENOCONAZOLE	Score						C	14	Used by growers.
CHLOROTHALONIL + THIOPHANATE-METHYL	Taratek						Y+A	7	Not used

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

	Actives under review in NZ
	Actives under review in Aust
	Registered

Most of these products are used as foliar treatments in brassicas. There is little risk of resistance developing in the future with the continued use of copper and chlorothalonil as they are multi-site, protectant fungicides. But the overuse of the triazoles (cyproconazole and difenoconazole) can lead to an increased risk of resistance developing as has been identified in Australia.

From the reports received, the current fungicides used for Ring spot or Mycosphaerella Leafspot (*Mycosphaerella brassici-cola*) control in brassicas are working adequately. However alternatives are required, particularly systemic/curative fungicides that are not triazoles.

Fungicides that are used off-label in brassicas for the control of Ring spot or are:

Active ingredient	Common Trade Name	Resistance group*	Comments
MANCOZEB	Manzate	Y	Occasionally used and effective.
CARBENDAZIM	Carbendazim	A	Occasionally used and effective.
PROPINEB	ANTRACOL	Y	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

From the reports received, the current off-label fungicides used for Ring spot control in brassicas are working adequately.

Fungicides that are not registered in brassicas but control Ring spot or Mycosphaerella Leafspot in other situations, and could possibly be alternatives include:

Active ingredient	Common Trade Name	Resistance group*	Comments
COPPER HYDROXIDE	Kocide	Y	Registered in vegetable brassicas for Downy mildew. Should have the same activity as copper oxychloride.
EPOXICONAZOLE	Opus	C	NZ - registered for Mycosphaerella control in cereals. AU - registered for Mycosphaerella control in bananas.
PROPICONAZOLE	Tilt	C	NZ - registered for Mycosphaerella control in cereals. AU - registered for Mycosphaerella control in bananas and cereals.
METIRAM	Polyram	Y	NZ - registered for Mycosphaerella control in grapes AU - registered for Ring spot control in brassicas.
TEBUCONAZOLE	Folicur	C	NZ - registered for Mycosphaerella control in cereals. AU - registered for Mycosphaerella control in bananas and cereals.
TRIFLOXYSTROBIN	Flint	K	NZ – no registration for Mycosphaerella control. AU - registered for Mycosphaerella control in bananas.

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

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

- Manzate (mancozeb)
  - Registered in Australia
  - MRL in: Aust & Singapore (2.0/kg – brassicas); EU & Switzerland (1.0 mg/kg - brassicas); NZ (7.0 mg/kg - vegetables); Japan (0.2 mg/kg – broccoli & cauliflower, 5.0 mg/kg - cabbage); Canada (7.0 mg/kg – broccoli, cabbage, cauliflower); South Africa (3.0 mg/kg - brassicas); Taiwan (2.5 mg/kg – brassicas); Codex & Malaysia (5.0 mg.kg – cabbage); Malaysia (5.0 mg/kg – cauliflower)
- Carbendazim (carbendazim)
  - MRL in: Aust & Japan (3.0/kg – vegetables); EU & Switzerland (0.1 mg/kg - vegetables); Taiwan (4.0 mg/kg – vegetables); Korea (1.0 mg/kg – cabbage); Malaysia (2.0 mg/kg – cabbage); Switzerland (3.0 mg/kg – cabbage & cauliflower)
- Antracol (propineb)
  - MRL in: Aust (2.0 mg/kg – brassicas); EU, Switzerland (1.0 mg/kg - brassicas); Japan (0.2 mg/kg – brassicas); NZ (7.0 mg/kg - vegetables);

Taiwan (2.5 mg/kg - brassicas); Codex, Japan & Malaysia (5.0 mg/kg – cabbage)

- Kocide (copper hydroxide)
  - MRL in: Aust, Japan, Malaysia, NZ, Taiwan – exempt; EU (20 mg/kg – vegetables); Switzerland (15 mg/kg - vegetables); Canada (50 mg/kg – vegetables); Finland (10 mg/kg - vegetables); France (5.0 mg/kg - broccoli); Singapore (30 mg/kg – vegetables); South Africa (20 mg/kg – brassicas)
- Opus (epoxiconazole)
  - MRL in: EU (0.05 mg/kg – vegetables); EU & Belgium (0.2 mg/kg – cabbage)
- Tilt (propiconazole)
  - MRL in: EU, Japan & Switzerland (0.05 mg/kg – vegetables)
- Polyram (metiram)
  - MRL in: Aust (2.0 mg/kg – brassicas); EU, Switzerland (1.0 mg/kg - brassicas); Japan (0.2 mg/kg – brassicas, cabbage); NZ (7.0 mg/kg - vegetables); Canada (7 mg/kg – broccoli, cabbage, cauliflower); Taiwan (2.5 mg/kg - brassicas); Codex (5.0 mg/kg – cabbage)
- Folicur (tebuconazole)
  - MRL in: EU (1.0 mg/kg – broccoli, cauliflower); Austria, France & Germany (0.05 mg/kg – vegetables); Israel (0.2 mg/kg – brassicas); Japan (0.5 mg/kg – broccoli, cauliflower); Belgium (0.5 mg/kg – cabbage)
- Flint (trifloxystrobin)
  - MRL in: EU (0.02 mg/kg – vegetables); Switzerland (0.5 mg/kg – brassicas)

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

FUNGICIDE ALTERNATIVES IN BRASSICAS FOR MYCOSPHAERELLA

In reviewing the possible alternatives:

- Manzate (mancozeb) - an old protectant fungicide with a wide disease control spectrum. In NZ it is already registered in brassicas for other diseases. It is not expected to offer any significant advantages over chlorothalonil. But as there are MRL in NZ and many overseas countries and the product is registered for this use in Aust, **mancozeb should be pursued.**
- Carbendazim (carbendazim) – is a protectant/systemic fungicide with a wide spectrum of activity. As it is under review in NZ and Aust, it should not be pursued.
- Antracol (propineb) - a protectant fungicide with a wide disease control spectrum. It is not expected to offer any significant advantages chlorothalonil and mancozeb. It should not be pursued.
- Kocide (copper hydroxide) - a protectant fungicide with a wide disease control spectrum. It is not expected to offer any significant advantages over copper oxychloride. It should not be pursued.
- Opus (epoxiconazole) – a protective/systemic fungicide. As triazole fungicides are already registered (cyproconazole and difenoconazole), it is not registered in any vegetables in NZ or Aust and has limited overseas MRL. It should not be pursued.
- Tilt (propiconazole) – a protective/systemic fungicide. As triazole fungicides are already registered (cyproconazole and difenoconazole), it is not registered

in any vegetables in NZ or Aust and has limited overseas MRL. It should not be pursued.

- Polyram (metiram) – a protectant fungicide. It is not expected to offer any significant advantages to chlorothalonil and mancozeb. It should not be pursued.
- Folicur (tebuconazole) – a protective/systemic fungicide. As triazole fungicides are already registered (cyproconazole and difenoconazole), it is not registered in any vegetables in NZ or Aust and has limited overseas MRL. It should not be pursued.
- Flint (trifloxystrobin) – is a protectant/curative fungicide with a wide spectrum of activity. Resistance management is an issue. Efficacy needs to be confirmed for *Mycosphaerella brassici-cola* control in brassicas before proceeding. Once efficacy is confirmed and given the limited overseas MRL, a use pattern needs to be developed that provides disease control and residue compliance. Therefore **the product should be pursued**. This will provide a necessary new systemic fungicide.

Other diseases

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

Early Blight (*Alternaria solani*)

Leaf Spot (Pyrenopeziza brassicae)

Pythium root rot (*Pythium spp*)

Rhizoctonia root rot (*Rhizoctonia solani*)

Sclerotinia sp. (*Sclerotinia sclerotium*)

White blister (Albugo candida)

New fungicide that can be pursued

Product (active)	**Target disease**	**Action**
Terrachlor (quintozene)	Clubroot (*Plasmodiophora brassicae)*	New use
Captan (captan)	Downy mildew (*Peronospora parasitica*)	New use
Acrobat (dimethomorph)	Downy mildew (*Peronospora parasitica*)	New use
Amistar (azoxystrobin)	Downy mildew (*Peronospora parasitica*)	New use
Foscheck (phosphorous acid)	Downy mildew (*Peronospora parasitica*)	New use
Manzate (mancozeb)	Ring spot (*Mycosphaerella brassici-cola*)	Adding to existing registrations
Flint (trifloxystrobin)	Ring spot (*Mycosphaerella brassici-cola*)	New use

Insects of brassicas

The insects of brassicas recorded are:

Common name	Scientific name
HIGH PRIORITY	
Aphids (especially Green Peach Aphid, Black aphid, Cabbage aphid) ……	*Myzus persicae, Brachycaudus persicae, Brevicoryne brassicae*
Caterpillars (especially Greasy cutworm, Diamondback moth, Soybean looper, Tomato fruitworm, White butterfly ..…...	*Agrotis ipsilon, Plutella xylostella, Thysanoplusia orichalcea, Helicoverpa armigera, Pieris rapae*
Slugs & snails ……	*Gastropoda spp.*
MEDIUM PRIORITY	
Thrips (especially Onion thrips) …….	Thrips tabaci
Black Vine Weevil, White-fringed weevil, Stem weevil ……	Otiorhynchus sulcatus, Naupactus leucoloma, Curculionidae spp.
Sciarid Flies ……..	Bradysia spp.
Green Vegetable Bug ……	Nezara viridula
LOW PRIORITY	
Grass grub Beetle ……..	*Oncopera spp.*
Leafroller ……..	*Epiphyas spp*
Nyssius Wheat Bug ……...	*Nysius huttoni*
Springtails ……..	*Collebola spp.*
Wireworm …….	*Heteroderus spp.*
Rats ……..	*Ratus spp.*
Black beetle ……..	*Heteronychus spp.*
Symphillids ……..	*Symphyla spp.*
Cabbage Leaf Miner ……	*Psyllidae spp.*
NO PRIORITY	
Greenhouse whitefly, Tobacco Whitefly ..	*Trialeurodes vaporariorum, Bemisia tabaci* (biotype B)
Potato psyllid ……	*Psyllidae spp.*
Mealy Bugs ……..	*Pseudococcus spp.*

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

High priority insects

Aphids - Green Peach Aphid (*Myzus persicae*); Black aphid (*Brachycaudus persicae*); Cabbage aphid (*Brevicoryne brassicae*)

Although there are several aphid species that affect brassica 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 brassica varieties affected
- Resistance issues between species
- Insecticides that control all aphid species

Insecticides registered for aphid control in brassicas or vegetables are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
PYRETHRINS	Garlic & Pyreth Conc	Aphids					3A	1	
CANOLA OIL	Eco-oil	Green Peach Aphid					Bio insecticide	11	
AZADIRACHTIN	NeemAzal	Registered in all crops for many pests.					Botanical insecticide		
DIAZINON	Diazinon		Aphids				1B		
DIAZINON	Diazinon	Aphids					1B	14	Used by growers.
ENDOSULFAN	Thiodan	Aphids					2A	14	Occasionally used - effective
IMIDACLOPRID	Confidor	Cabbage Aphid					4A	70	Commonly used - effective
PERMETHRINS + PPO	Greenseals Pyrethrum	Aphids					3A	0	
PIRIMICARB	Pirimor	Aphids					1A	3	Commonly used - good IPM fit, effective.
PYMETROZINE	Chess	Aphids					9A	7	Commonly used - good IPM fit, effective.
PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Aphids					3A+1B	3	
DICHLORVOS	Divap	Aphids					1B	3	
FATTY ACIDS (K SALTS)	Nature's Way						Unlisted	1	
APHID PARASITE	*Aphidius colemani*						Biological		
APHIDOLETED	*Aphidoletes aphidimyza*						Biological		
MALDISON	Malathion	Aphids					1B		
ROTENONE	Derris Dust						21A	1	
METHOMYL	Lannate L		Green Peach Aphid				1A		Occasionally used, poor IPM fit.
PHORATE	Phorate	Aphids					1B	56	Not used for aphids.
DIMETHOATE	Perfekthion	Cabbage Aphid					1B	14	Occasionally used, poor IPM fit.
CHLORPYRIFOS	Lorsban	Reg for 'aphids' in winter squash and vegetable brassicas					1B		Used by growers

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

	Actives under review in NZ
	Actives under review in Aust
	Registered

All the products listed are commonly/occasionally used as foliar insecticides in brassicas. The emphasis for growers is the impact of the insecticide on beneficial insects in their IPM programs. Growers appear to have a good understanding of which products are IPM compatible. There is some risk of resistance developing in the future with some aphid species (especially GPA) with the continued use of some insecticides. Resistance to pirimicarb in Australia has been recorded in GPA.

From the reports received, the current insecticides used for aphid control in brassicas 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 brassicas for the control of aphids are:

Active ingredient	Common Trade Name	Resistance group*	Comments
IMIDACLOPRID	Gaucho	4A	Commonly used –effective. Seed treatment
PIRIMIPHOS-METHYL	Actellic	1B	Used by growers.
METHAMIDOPHOS	Monitor Tamaron	1B	Used by growers.

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

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

Growers report the current off-label insecticides used for aphid control in brassicas are working adequately.

Insecticides that are not registered in brassicas 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	Aphids' listed for tomatoes
Beauvaria bassiana	Botanigard Naturalis-O	Biological	Not used yet in brassicas, product in development
BIFENTHRIN	Talstar 100EC	3A	Reg. on field tomatoes, pumpkins, squash for 'aphids'
Lecanicillium lecanii blastospores		Biologica	Not used
TAU-FLUVALINATE	Mavrik	3A	Reg. on field tomato for GPA
THIACLOPRID	Calypso	4A	Thrips listed on avocados, peaches and nectarines but not any vegetable
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	3A	Reg. for 'aphids' on tomato
DELTAMETHRIN	Decis Forte	3A	Reg. for 'aphids' in squash
TERBUFOS	Counter	1B	Aphids listed for forage brassicas as seed/fertiliser treatment
ACEPHATE	Orthene	1B	Reg. for 'aphids' in lettuce 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 (imidacloprid)
  - Confidor registered in-crop, therefore Gaucho as a seed treatment will comply with the MRL
- Actellic (pirimiphos-methyl)
  - MRL in: EU & Japan (1.0 mg/kg – broccoli, vegetables, cauliflower); NZ (2.0 mg/kg – brassicas); Taiwan (0.5 mg/kg - brassicas); Indonesia, Singapore (2.0 mg/kg – cabbage, cauliflower); Switzerland (1.0 mg/kg – broccoli, 0.05 mg/kg – vegetables)
- Monitor (methamidophos)
  - MRL in: Aust, Canada, Israel, Japan, NZ, Singapore, South Africa, Thailand & USA (1.0 mg/kg – brassicas); China (0.05 mg/kg – vegetables); EU & Taiwan (0.5 mg/kg - brassicas); Switzerland (0.1 mg/kg – vegetables, 0.5 mg/kg – cabbage); Codex (0.5 mg/kg – cabbage, cauliflower); Korea (1.0 mg/kg – cabbage); Thailand (1.0 mg/kg – cabbage, cauliflower); Indonesia (1.0 mg/kg – cauliflower)
- Talstar (bifenthrin)
  - MRL in: Aust & Taiwan (1.0 mg/kg – brassicas); EU (0.2 mg/kg – broccoli & cauliflower, 1.0 mg/kg - cabbage); Japan (0.1 mg/kg – broccoli, 2.0 mg/kg – cabbage, 0.05 mg/kg - cauliflower); Switzerland (0.1 mg/kg – vegetables); Korea & NZ (0.05 mg/kg – vegetables, brassicas); USA (0.6 mg/kg – broccoli & cauliflower, 4.0 mg/kg - cabbage); Taiwan (1.0 mg/kg - brassicas)
- Calypso (thiacloprid)
  - MRL in: EU (0.05 mg/kg –vegetables); Israel (0.02 mg/kg – brassicas)

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

INSECTICIDES ALTERNATIVES IN BRASSICAS FOR APHIDS

In reviewing the possible alternatives:

- Gaucho (imidacloprid) – is a systemic seed treatment with activity on various pests. Efficacy and crop safety (seedling) data needs to be generated in the major brassica growing areas. Residue should not be necessary. As it is already registered in forage brassicas and Confidor is registered as a foliar treatment, **Gaucho should be pursued**. But a resistance management program should be developed for the use of Gaucho and Confidor.
- Actellic (pirimiphos-methyl) – is an old systemic, broad spectrum insecticide. The stand alone product (Actellic) should not be pursued as it has no vegetable registrations or labelled efficacy on aphids.
- Monitor (methamidophos) - is an old systemic, broad spectrum insecticide. Although very effective and has many overseas MRL, given the product is under review in NZ and Aust, it should not be pursued.
- Talstar (bifenthrin) - a contact/systemic synthetic pyrethroids insecticide. Registered in other vegetables for aphids and other insects. Not IPM compatible and the risk of resistance developing with overuse is high. Many other SP have registrations for aphids in other crops, but bifenthrin has some vegetable registrations. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. There are many overseas MRL in brassicas. **This product should be pursued.**

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

Caterpillars - Greasy cutworm (*Agrotis ipsilon*); Diamondback moth (*Plutella xylostella*); Soybean looper (*Thysanoplusia orichalcea*); Tomato fruitworm (*Helicoverpa armigera*), White butterfly (*Pieris rapae*)

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

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

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
ACEPHATE	Orthene		Diamondback moth, White butterfly				1B		Significant resistance. Still used by growers. Used in all brassica crops.
CARBARYL	Sevin	Looper, Potato Tuber Moth, Tomato fruitworm + other caterpillars' Registered in vegetables					1A	1	not used
DIAZINON	Diazinon	Diamondback moth + Caterpillars					1B	14	DBM – occasionally used
ENDOSULFAN	Thiodan	Diamondback moth, White butterfly					2A	14	Occasionally used - effective
METHAMIDOPHOS	Monitor Tamaron	Diamondback moth, Looper, White butterfly					1B	7	Had major resistance, now being used.
PYRETHRUM	Garlic & Pyre. Conc	Cabbage Moth and caterpillars					3A	1	limited use
TAU-FLUVALINATE	Mavrik			DBM WB			3A	3	not used
DICHLORVOS	Divap	Caterpillars Vegetables					1B	3	not used
Bacillus thuringiensis t sub. Kurstaki	Dipel	Caterpillars				DBM, WB, SL	11C	0	very commonly used
Bacillus thuringiensis sub.Xen tari	XenTari	Caterpillars					11C	0	very commonly used
DELTAMETHRIN	Decis	Diamondback moth, White butterfly					3A	3	Greasy Cutworm control - commonly used and effective.
ALPHA-CYPERMETHRIN	Dominex Fastac	Diamondback moth, White butterfly, Tomato fruitworm, Greasy Cutworm					3A	3	Used - with good effect.
BIFENTHRIN	Talstar	Diamondback moth, White butterfly					3A	3	Greasy Cutworm control - commonly used and effective.
CYPERMETHRIN	Ripcord		DBM,WB, TFW				3A	3	Used - with good effect. Used in all brassicas.
PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Diamondback moth, White butterfly					3A+1B	3	not used
ESFENVALERATE	Sumi-Alpha	Diamondback moth, White butterfly, Tomato fruitworm					3A	3	not used
LAMBDA-CYHALOTHRIN	Karate	Diamondback moth, White butterfly, Tomato fruitworm					3A	3	Greasy Cutworm control - commonly used and effective.

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall			DBM WB			3A	7	not used
METHOMYL	Lannate L		Looper				1A	7	Used by growers. Used in all brassica crops.
SPINOSAD	Entrust Naturalyte	Diamondback moth, White butterfly					5A	3	Commonly used as part of rotation
SPINOSAD	Spinosad Naturalyte		DBM, WH				5A	3	Commonly used as part of rotation
TRICHLORFON	Trifon	Cutworm, Diamondback moth, White butterfly					1B	14	not used
TRICHLORFON + CYPERMETHRIN	Partna		DBM, WB, TFW				1B+3A	14	not used
MALDISON	Malathion 50EC	Diamondback moth, Tomato fruitworm, White butterfly					1B	3	not used
ROTENONE	Derris Dust	Diamondback moth, White butterfly					21A	1	not used
FIPRONIL	Ascend	Diamondback moth, White butterfly					2C	7	Regularly used as part of rotation - effective.
PARATHION METHYL	Folidol	Chewing and sucking pests							not used
IDOXACARB	Steward 150SC		Diamondback moth, White butterfly				22A		Regularly used as part of rotation - good IPM fit, excellent control.

* 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/occasionally used as foliar insecticides for a range of Lepidoptera (caterpillar) pests in brassicas. The emphasis of growers is the level of control and impact of the insecticide on beneficial insects in their IPM programs. There appears to be a shift by growers back to synthetic pyrethroids and organophosphates. Growers claim SP and OP to be effective again, after significant resistance issues many years ago. It was stated that SP should only be used in the 'late window' for Lepidoptera control. This shift to old insecticides may be to reduce costs. Unfortunately all the SP and OP now used are quite disruptive of IPM programs.

From the reports received, the current insecticides used for Lepidoptera (caterpillar) control in brassicas are working adequately. To maintain a high level of Lepidoptera (caterpillar) control, growers must alternate the insecticides used between the different resistance groups, not between products from the same resistance group.

The emphasis for Lepidoptera control needs to be away from the old SP and OP to more IPM compatible insecticides.

Insecticides used off-label in brassicas for the control of Lepidoptera (caterpillar) are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	Comments
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
ACEPHATE	Orthene		Diamondback moth, White butterfly				1B		Significant resistance issues. Still used by growers.

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	Comments
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
CYPERMETHRIN	Ripcord		DBM, WB, TFW				3A	3	Used - with good effect. Used in all brassicas.
METHOMYL	Lannate L		Looper				1A	7	Used in all brassicas.
PIRIMIPHOS METHYL	Actellic						1A		Occasionally used and effective.
INDOXACARB	Steward		Diamondback moth, White butterfly				22A		Regularly used - excellent. Used in all brassicas.

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

	Actives under review in Aust
	Registered
	Used off-label

From the reports received, the current off-label insecticides used for Lepidoptera (caterpillar) control in brassicas are working adequately. All of these products are currently registered in selected crops from the brassica group. Growers are using these insecticides in all brassica crops.

Other than indoxacarb, all the other agrichemicals are very old insecticides, with poor IPM compatibility, even though they are effective.

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

Active ingredient	Common Trade Name	Resistance group*	Comments
CHLORPYRIFOS	Lorsban 50 EC	1B	Reg. for Corn Earworm, Army caterpillar & cutworm in maize/sweet corn: caterpillars & aphids in squash.
Beauvaria bassiana	Botanigard, Naturalis-O	Bio-insecticides	Not used yet in brassicas, product in development
EMAMECTIN	Proclaim	6A	Registered in fruit for leafroller. Needs to be registered as good IPM. AU label - in brassicas for lepidoptera.
CHLORANTRANIPROLE	New product		New lepidoptera insecticide from Dupont. Excellent activity and IPM. To be registered in 2008. Crops unknown.

* 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:

- Lannate (methomyl)
  - MRL in: EU, NZ, South Africa, (0.2 mg/kg - brassicas); Taiwan (2.0 mg/kg – broccoli, 5.0 mg/kg - cabbage); Switzerland (1.0 mg/kg – brassicas); USA (3.0 mg/kg – broccoli, 5.0 mg/kg - cabbage, 2.0 mg/kg - cauliflower); Aust (1.0 mg/kg – cabbage); Canada, Codex, Indonesia, Singapore, Thailand (5.0 mg/kg – cabbage & cauliflower); China (2.0 mg/kg – cabbage & cauliflower); Israel & Japan (2.0 mg/kg – broccoli, 5.0 mg/kg - cabbage, cauliflower)
- Steward (indoxacarb)
  - MRL in: Aust (2.0 mg/kg – brassicas); EU (0.3 mg/kg – broccoli, cabbage, cauliflower); Austria, France, Germany, Italy, Japan, Netherlands (0.2 mg/kg – broccoli, 0.1 mg/kg – cabbage, 0.3 mg/kg –

cauliflower,); Korea (1.0 mg/kg – broccoli); Japan (0.2 mg/kg – broccoli, 1.0 mg/kg – cabbage, 3.0 mg/kg - cauliflower), NZ (0.5 mg/kg – brassicas); Switzerland (0.5 mg/kg – broccoli & cauliflower, 0.3 mg/kg - cabbage); South Africa (1.0 mg/kg –cabbage); US (5.0 mg/kg – brassicas); Israel (0.02 mg/kg – cauliflower)

- Lorsban (chlorpyrifos)
  - MRL in: Aust & Taiwan (0.5 mg/kg – brassicas); Codex (2.0 mg/kg – broccoli, 1.0 mg/kg – cabbage, 0.5 mg/kg - cauliflower); EU (0.05 mg/kg – broccoli, 1.0 mg/kg - cabbage); Switzerland (0.05 mg/kg – broccoli, 1.0 mg/kg - cabbage); Japan (1.0 mg/kg – broccoli, 0.05 mg/kg – cabbage, cauliflower); USA (1.0 mg/kg – broccoli, cabbage, cauliflower); Korea (0.01 mg/kg – vegetables, 0.5 mg/kg – cabbage); South Africa (0.1 mg/kg – brassicas); China (1.0 mg/kg – cabbage, cauliflower); Israel, Malaysia, Singapore (0.05 mg/kg – cabbage, cauliflower)
- Proclaim (emamectin)
  - MRL in: Aust (0.02 mg/kg – brassicas); Japan (0.1 mg/kg – broccoli, cabbage, 0.5 mg/kg – cauiflower,), Korea (0.1 mg/kg – broccoli), Taiwan & USA (0.05 mg/kg – brassicas); Israel (0.01 mg/kg – cabbage, cauliflower); Malaysia (01 mg/kg – cabbage)

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

INSECTICIDES ALTERNATIVES IN BRASSICAS FOR LEPIDOPTERA

In reviewing the possible alternatives:

- Lannate (methomyl) - is an old systemic, broad spectrum insecticide. It is very effective and has many overseas MRL, but does impact on beneficial insects. As the product is under review in Aust, it should not be pursued. But it is very effective in controlling a range of pests both in NZ and Aust so should not be completely forgotten.
- Steward (indoxacarb) - a contact/systemic insecticide with good efficacy and minimal impact on IPM beneficial insects. As it is already registered in cauliflower, cabbage and Brussels sprouts, the registration should be extended to all brassicas. **The product should be pursued**.
- Lorsban (chlorpyrifos) - is an old systemic, broad spectrum insecticide. It is very effective as a foliar and soil treatment and has many overseas MRL. The product is under review in Aust. But if the brassica industry has an issue with soil dwelling Lepidoptera pests (eg. cutworm), then **it should be pursued** and added to the current registrations.
- 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 brassica growing areas. Residue data may also be necessary. As there are MRL in many overseas countries, **the product should be pursued.**

The selection of Proclaim (emamectin) will add greatly to the suite of insecticides available to brassica growers for the control of Lepidoptera (caterpillar) pests. This will also relieve some of the resistance pressure on current commonly used IPM compatible products such as Entrust (spinosad) and Steward (indoxacarb).

Slugs & snails (Gastropoda spp.)

Insecticides registered for slugs and snails control in brassicas or vegetables are:

Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
IRON PHOSPHATE	Neudorff Bait	Registered in all situations					Molluscicide		Occasionally used in crop.
EDTA	Multiguard	Registered in all situations					Molluscicide		Occasionally used in crop.
METHIOCARB	Mesurol	Registered in all situations					1A	0 or 21	Mesurol is main product used
METALDEHYDE	Slugout	Registered in all situations					Molluscicide		Occasionally used in crop.
THIODICARB	Larbit	Registered in all situations					1A	21	Occasionally used in crop.

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

	Registered

These products have been recorded as being used and:

- Very effective in controlling snails and slugs within the crop during development
- With the baits, care is taken not to contact the plants themselves.

INSECTICIDE ALTERNATIVES IN BRASSICAS FOR GASTROPODA

- No new molluscicide could be found for the control of snails and slugs in brassicas or other crops.

Other insects

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

- Thrips - Onion Thrips (*Thrips tabaci*), Western Flower Thrips (*Frankliniella occidentalis*), Intonsa Flower Thrip
- Weevils - Black Vine Weevil (*Otiorhynchus sulcatus*), White fringed weevil (*Naupactus leucoloma*), Plant Weevils (*Curculionidae spp*.), Stem weevil (*Curculionidae spp*.)
- Grass grub Beetle (*Oncopera spp*.)
- Leafroller (*Epiphyas spp*.)
- Nyssius Wheat Bug (*Nysius huttoni*)
- Springtails (*Collebola spp*.)
- Wireworm (*Heteroderus spp*.)
- Rats (*Ratus spp*.)
- Black beetle (*Heteronychus spp*.)
- Cabbage Leaf Miner (*Psyllidae spp*.)

- Sciarid Flies (*Bradysia spp*.)
- Green Vegetable Bug (*Nezara viridula*)

New insecticides that can be pursued

Product (active)	**Target insect**	**Action**
Gaucho (imidacloprid)	Aphids	New use
Talstar (bifenthrin)	Aphids	New use
Lannate (methomyl)	Lepidoptera	Adding to existing registrations
Steward (indoxacarb)	Lepidoptera	Adding to existing registrations
Proclaim (emamectin)	Lepidoptera	New use

Herbicide use in brassicas

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

Herbicides registered for use in brassicas are:

Active ingredient	Common Trade Name	Registrations				Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY
		Broccoli	Brussel Sprouts	Caulif lower	Cabbage			
ALACHLOR	Alanex Lasso						NA	Commonly used and effective product - post-plant.
FLUAZIFOP-P-BUTYL	Fusilade WG	Vegetables				A	35	Occasionally used and effective on grass weeds post-emergent.
CLETHODIM	Arrow	Vegetables				A	35	Occasionally used and effective on grass weeds post-emergent.
OXYFLUORFEN	Goal 40 WP					G	NA	Commonly used either pre with Roundup or early post transplant
PROPACHLOR	Ramrod Flowable					K	NA	Not used in NZ.
SETHOXYDIM	Poast					A	35	Growers don't use.
TRIFLURALIN	Trifluralin	Transplanted crops				D	NA	Occasionally used in NZ.
GLYPHOSATE	Roundup					M	NA	Used pre-plant for perennial weed control – very effective.
GLYPHOSATE-TRIMESIUM	Touchdown					M	NA	Occasionally used pre-plant.
DIQUAT	Reglone	Vegetables				L	NA	Very commonly used and effective product.
PARAQUAT	Paraquat	Vegetables				L	NA	Very commonly used and effective product.
PINE OIL	Organic Interceptor							Not used

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

	Actives under review in Aust
	Registered

Alternative herbicides used and available for the control of specific weeds in brassicas are:

Active ingredient	Common Trade Name	Resistance group*	Comments
CLOPYRALID	Clorpyralid	I	Used by growers.
CHLORTHAL DIMETHYL	Dacthal 75W	D	AU label – registered in brassicas for many weeds.
DIMETHENAMID	Frontier		Used by growers.
HALOXYFOP	Gallant NF	A	Not used in NZ. AU label – registered in brassicas for many weeds.
PENDIMETHALIN	Stomp	D	Not used in NZ. AU label – registered in brassicas for many weeds.
QUIZALOFOP-P-ETHYL	Targa	A	Not used in NZ. AU label – registered in brassicas for grass weeds post-emergent.
S-METOLACHLOR	Dual Gold	K	AU label – registered in brassicas for many weeds.

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

	Used off-label

The main weed gaps identified by brassica growers are:

- Dock (*Rumex spp*.) - only pre-plant weed control possible - glyphosate and oxyfluorfen.
- Groundsel (*Senecio vulgaris*) – only pre-plant weed control possible - glyphosate, oxyfluorfen or paraquat.
- Cleaver (*Galium aparine*) - only pre-plant weed control possible - glyphosate, oxyfluorfen or paraquat.
- Mayweed (Chamomile) (*Anthemis cotula*) - only pre-plant weed control possible - glyphosate, oxyfluorfen or paraquat.
- Wild turnip (*Rapistrum rugosum*) – pre-plant weed control possible - glyphosate, oxyfluorfen or paraquat. No selective post-emergent herbicides could be identified. Some control possible with oxyfluorfen post emergent. Needs to control seedling.
- Oxalis (*Oxalis spp*). - only pre-plant weed control is possible with glyphosate and oxyfluorfen.
- Willow weed (*Polygonum persicaria*) – pre-plant weed control possible - glyphosate, oxyfluorfen or paraquat. Trifluralin is active on some Polgonum species (*Polgonum aviculare*) - may have good activity on Willow weed. No selective post-emergent herbicides could be identified. Some control should be possible with oxyfluorfen post emergent. Needs to be controlled as a seedling.

In each of these cases, the weeds can be controlled with existing registered herbicides. Otherwise the only control available is pre-plant weed control with glyphosate, oxyfluorfen or paraquat. These are existing registered uses.

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:

- Clopyralid (clopyralid)
  - MRL in: Austria & EU (0.5 mg/kg – vegetables); Belgium (0.3 mg/kg – brassicas); Canada (1.0 mg/kg – broccoli, cabbage, cauliflower); Germany (0.05 mg/kg – vegetables); Israel (0.01 mg/kg – broccoli, cabbage, cauliflower); Italy (0.2 mg/kg – brassicas); Japan (2.0 mg/kg – brassicas); Netherlands (0.05 mg/kg – vegetables); USA (2.0 mg/kg – brassicas)
- Dacthal (chlorthal-dimethyl)
  - MRL in: Aust & USA (5.0 mg/kg - brassicas); Canada (1.0 mg/kg – broccoli, cabbage, cauliflower); EU (0.5 mg/kg – broccoli, cabbage, cauliflower); Israel (1.0 mg/kg - cabbage, cauliflower); France (0.05 mg/kg – broccoli); Italy (0.1 mg/kg – broccoli, brassicas); Japan (4.0 mg/kg – brassicas); Netherlands (0.01 mg/kg – vegetables); USA (5.0 mg/kg – brassicas)
- Frontier (dimethenamid)
  - MRL in: EU (0.01 mg/kg – vegetables); Japan & Taiwan (0.1 mg/kg – cabbage)
- Stomp (pendimethalin)
  - MRL in: Aust, EU & Japan (0.05 mg/kg – brassicas); Korea (0.1 mg/kg – brassicas); Switzerland (0.15 mg/kg – vegetables); Taiwan (0.1 mg/kg – brassicas); Japan & Korea (0.2 mg/kg – cabbage, brassicas)

HERBICIDES ALTERNATIVES IN BRASSICAS FOR WEEDS

In reviewing the possible alternatives:

- Clopyralid (clopyralid) – selective broadleaf post-emergent herbicide. Registered in forage brassicas. Clopyralid can control many ‘hard-to-kill’

weeds and this could be an advantage to growers. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary, depending on the use pattern. Given the many overseas MRL and weeds controlled, **this product should be pursued.**

- Dacthal (chlorthal-dimethyl) – a selective broadleaf and grass herbicide for use at-planting. Registered in brassicas in Australia. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. Given the many overseas MRL and weeds controlled**, this product should be pursued.**
- Frontier (dimethenamid) – a selective broadleaf and grass herbicide for use at-planting. Registered in forage brassicas. There are issues in the USA with crop safety. As crop safety issue is not clarified and there are limited overseas MRL, this product should not be pursued.
- Stomp (pendimethalin) – a broad-spectrum pre-emergent herbicide. Registered in brassicas in Australia. Efficacy and crop safety data needs to be generated in the major brassica growing areas. Residue data may also be necessary. Given the many overseas MRL and weeds controlled, **this product should be pursued.**

New herbicides that can be pursued

Product (active)	**Target insect**	**Action**
Clopyralid (clopyralid)	Weeds – post-emergent	New use
Dacthal (chlorthal-dimethyl)	Weeds – pre-emergent	New use
Stomp (pendimethalin)	Weeds – pre-emergent	New use

New opportunities for new or alternative agrichemicals in brassicas

International collaboration with USA IR-4 program

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

Agrichemical	Pest / Status	Relevance to NZ
FUNGICIDES		
CYAZOFAMID (new product)	Broccoli, cabbage - CLUB ROOT – in trials	Diseases controlled identified as a high priority
PYRACLOSTROBIN (Cabrio)	Cabbage - ALTERNARIA, DOWNY MILDEW, WHITE RUST, CERCOSPORA, POWDERY MILDEW - registered	Diseases controlled identified as a high priority
BOSCALID + PYRACLOSTROBIN (New product)	Broccoli, cabbage - ALBUGO, DOWNY MILDEW, POWDERY MILDEW - registered	Diseases controlled identified as a high priority
DIMETHOMORPH (Acrobat)	Broccoli, cabbage - DOWNY MILDEW - in trials	Disease controlled identified as a high priority
FENAMIDONE (Sereno)	Broccoli, Cabbage - DOWNY MILDEW, ALTERNARIA LEAF SPOT- in trials	Diseases controlled identified as a high priority
INSECTICIDES		
NOVALURON (Rimon)	Broccoli, cabbage, cauliflower - DIAMOND BACK, CABBAGE LOOPER, LEPIDOPTEROUS PESTS - registered	Insects controlled identified as a high priority
HERBICIDES		
CARFENTRAZONE (Affinity)	Broccoli, cabbage, cauliflower - ANNUAL WEEDS- registered	Pre-emergent - Weed spectrum unknown
CLOMAZONE (New product)	Broccoli - ANNUAL WEEDS- to be submitted for registration	Pre-emergent - Weed spectrum unknown
DIMETHENAMID-P (Frontier)	Broccoli, cabbage – WEEDS - to be submitted for registration	Pre- & post-emergent - Weed spectrum unknown
FLUMIOXAZIN (New product)	Cabbage – WEEDS - to be submitted for registration	Pre-emergent - Weed spectrum unknown
PENDIMETHALIN (Stomp)	Broccoli, Brussels sprout, cabbage, cauliflower – WEEDS – in trials	Pre-emergent - Weed spectrum unknown
SULFENTRAZONE (Authority)	Broccoli, cauliflower - ANNUAL BROADLEAF WEEDS - to be submitted for registration	Pre- & post-emergent - Weed spectrum unknown

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

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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http://207.5.17.151/biobest/en/nieuws/scanivital.htm

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http://www.bioworksinc.com/index.html

Crop Life 2007
CropLife New Zealand

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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

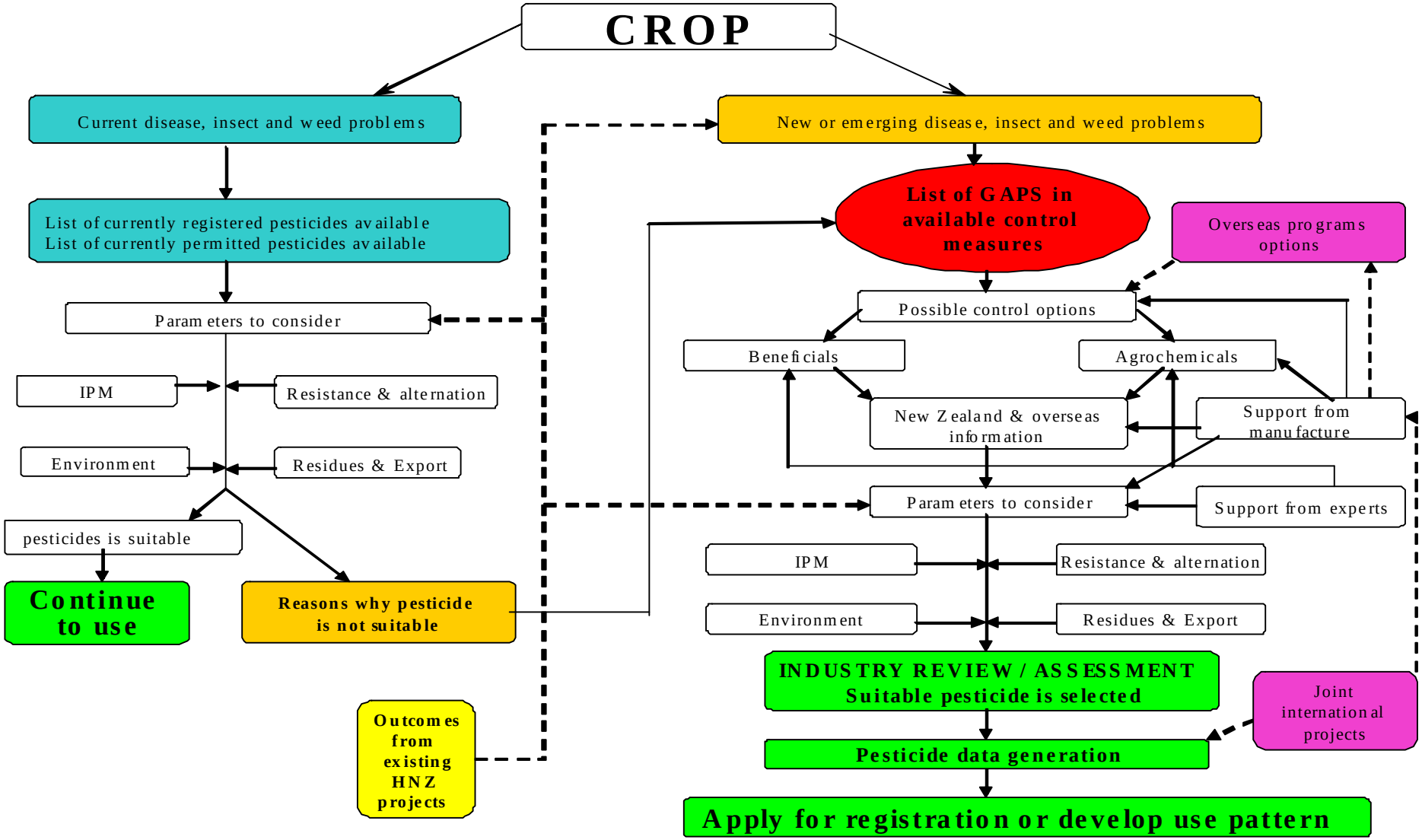

Table 1: Fungicides registered and used for the control of the MAJOR recorded diseases in brassicas.

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Black Rot or Bacterial Spot Various bacteria including *Xanthomonas campestris*	High - can be a major problem	COPPER OXYCHLORIDE	Various	Registered for vegetable brassica					Y	0	Not registered for this disease - Ring spot and Downy mildew. Occasionally used and effective.
		COPPER HYDROXIDE	Various	Registered for vegetable brassica					Y	0	Not registered for this disease - Downy mildew. Occasionally used and effective.
		COPPER OXIDE	Nordox 75WG	Registered for vegetable brassica					Y	1	
		MANCOZEB	Manzate 200 DF	Not registered for this specific disease on brassica - Downy mildew					Y		
		SULPHUR	Various	Registered for vegetable					Y	0	Not registered for this disease - Powdery mildew. Used by growers.
Clubroot *Plasmodiophora brassicae*	High - major problem	FLUAZINAM	Shirlan						Y	Do not apply after planting	Major product used. Soil treated 4 L/ha
		FLUSULFAMIDE	Nebijin							NA	Rotationally used. 18-36 L/ha soil applied. Product not listed in Aust.
		CHLOROTHALONIL + THIOPHANATE-METHYL	Taratek 5F						Y+A	7	5 litre packsize. Not used.
		THIOPHANATE-METHYL	Topsin						A	7	Not used. Cabbages - application rate 200ml/100L and 200 ml applied to each transplant hole
		QUINTOZENE	Terraclor	Not registered for this disease. Registered in vegetable seedlings					Y		Sometimes used. Registered in Aust in brassicas for Club root as in-soil or soil drench treatment.
		CHLOROTHALONIL	Bravo 720 SC	Not registered for this disease.					Y	7	Used in rotation for every other crop.

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Downy mildew *Peronospora parasitica*	High - major problem Autumn and Winter	CHLOROTHALONIL	Bravo 720 SC						Y	7	Occasionally used and effective. Stock grazing issues.
		COPPER HYDROXIDE	Kocide 2000 DF						Y	Not listed	common used - effective
		COPPER OXIDE	Nordox 75WG						Y	1	
		COPPER OXYCHLORIDE	Agpro 800 WP						Y	0	common used - effective
		MANCOZEB	Manzate 200 DF						Y	NA	common used - effective
		METALAXYL-M + MANCOZEB	Ridomil Gold MZ WG						D	NA	Occasionally used and effective. Label says 'Make the first application as soon as most seedlings have emerged and repeat every 10 days until transplanting'
		CAPTAN	Captan	No registration for any brassica crop.					Y		Occasionally used and effective. Registered for Downy Mildew control in cucurbits.
		DIMETHOMORPH	Acrobat MZ 690	No registration for brassicas however registered in grapes for Downy Mildew (Plasmopara viticola) in grapes and Downy Mildew (Peronospora destructor) in onions					X		Occasionally used and effective.
		METIRAM	Polyram DF	No reg. in brassicas however reg. for DM control in grapes					Y		NZ – registered for Downy mildew in grapes. Aust - registered for Downy mildew in brassicas.
		AZOXYSTROBIN	Amistar WG	No reg. in brassicas however controls downy mildew in other crops					K		Occasionally used and effective. Not registered on brassica. Not listed on Amistar labels in Australia. Permit in brassica leafy vegetables for Alternaria.
		PROPINEB	ANTRACOL	Not registered on brassica					Y		Not used. NZ – registered for Downy mildew in onions. Aust - registered for Downy mildew in brassicas.
		PHOSPHORUS ACID	FOSCHECK	No reg. in brassicas and no control of downy mildew in other crops.					Y		Registered for 'Nursery Stock' - Pythium and Phytophthora control. Occasionally used and effective.
		BORDEAUX MIXTURE	Cuprofix	Cuprofix not registered for brassicas.					Y		not used

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Ring spot or Mycosphaerella Leafspot *Mycosphaerella brassici-cola*	High - major disease in Winter	CHLOROTHALONIL	Bravo 720 SC						Y	7	Occasionally used and effective. Stock grazing issues.
		COPPER OXYCHLORIDE	Agpro 800 WP POO5105, Fruitfed POO5346						Y	0	Used by growers.
		CYPROCONAZOLE	Alto 100SL						C	14	Occasionally used and effective.
		DIFENOCONAZOLE	Score 250 EC						C	14	Used by growers. AU - registered for Mycosphaerella control in bananas.
		CHLOROTHALONIL + THIOPHANATE-METHYL	Taratek 5F						Y+A	7	Not used
		COPPER HYDROXIDE	Kocide 2000 DF						Y		Registered in vegetable brassicas for Downy mildew
		THIOPHANATE-METHYL	Topsin	Not registered on brassica					A		Not used by growers.
		EPOXICONAZOLE	Opus	Not registered in brassicas but controls Mycosphaerella spp. in cereals.					C		AU - registered for Mycosphaerella control in bananas in Aust.
		PROPICONAZOLE	Tilt	Not registered in brassicas but controls Mycosphaerella spp.					C		AU - registered for Mycosphaerella control in bananas and cereals in Aust.
		MANCOZEB	Manzate 200 DF	Not registered for this disease however is registered for use in brassica crops					Y		Occasionally used and effective. Has 7 D WHP so has trash grazing issues. Registered in Aust for Ring spot in brassicas.
		METIRAM	Polyram DF	No reg. in brassicas however reg. for Mycosphaerella control in grapes					Y		AU - registered for Ring spot in brassicas.
		TEBUCONAZOLE	Folicur	Not registered in brassicas but controls Mycosphaerella spp.					C		AU - registered for Mycosphaerella control in bananas and cereals
		TRIFLOXYSTROBIN	Flint	No reg. in brassicas of for Mycosphaerella control					K		AU - registered for Mycosphaerella control in bananas in Aust.
		CARBENDAZIM	Carbendazim	Not registered on brassica or vegetable brassica or by singular crop e.g. broccoli					A		Occasionally used and effective. AU - controls M. graminicola in wheat, M. fijiensis in bananas and M. pinodes in peas.
		PROPINEB	ANTRACOL	Not registered on brassica or vegetable brassica or by singular crop e.g. broccoli					Y		Occasionally used and effective. AU - lists anthracnose, early blight, downy mildew

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

* 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 brassicas.

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Leaf Spot *Pyrenopeziza brassicae*	Medium - occasional problem	COPPER OXYCHLORIDE	Various	Large pack sizes not registered on brassica or vegetable brassica or by singular crop e.g. broccoli. ONLY Kiwicare (Reg no POO2505) reg. for Leaf spot but only available in 200 g packs					Y		Regularly used - effective
		PROPICONAZOLE	Tilt	Not registered in brassicas but controls Leaf spot in cereals.					C		Registered for Pyrenopeziza control in cereals in Aust.
Early Blight *Alternaria solani*	Low - minor disease only	IPRODIONE	Rovral WP						B	NA	Seed treatment. Nursery issue (resistance issue). Only Rovral WP registered for Rhizoctonia and Alternaria. Permit (PER9669) in Aust for Alternaria leaf spot control in brassica leafy vegetables.
		AZOXYSTROBIN	Amistar WG	No reg. in brassicas however controls Alternaria in other crops					K		Permit (PER9633) in Aust for Alternaria leaf spot control in brassica leafy vegetables.
		COPPER OXYCHLORIDE	Agpro 800 WP	Not registered for bacterial spot however registered for use in broccoli					Y		all protectants work. Other possible products prochloraz (Sportak), Zineb, chlorothalonil, benalaxyl + mancozeb, imazalil, guazatine acetates,
		MANCOZEB	Manzate 200 DF	Not registered for this disease. Manzate registered for use in Broccoli.					Y		
		COPPER OXIDE	Nordox 75WG	No reg. for broccoli however reg. early blight in potatoes					Y		
		COPPER HYDROXIDE + MANCOZEB	Mancocide DF	No reg. for broccoli however reg. early blight in potatoes					Y		
		SULPHUR	Kumulus	Not registered for bacterial spot however registered in 'vegetables'.					Y		
		QUINTOZENE	Terrachlor	Not registered for this disease.					Y		
		THIRAM	Thiram	Not registered for this disease.					Y		
		ETRIDIAZOLE	Terrazole	Not registered for this disease.					X		
		FENAMIDONE + MANCOZEB	Sereno	Not reg. in broccoli. Reg. for early blight in potatoes.					X+Y		
		PROPINEB	Antracol	Not reg. for broccoli however reg. for early blight control in potatoes					Y		

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Pythium Root Rot *Pythium spp*	Low - minor disease only from nursery seedlings	ETRIDIAZOLE	Terrazole						X		Water spread and substrate used in nursery - control options inadequate. Terrazole listed for use in 'vegetables'
		METALAXYL-M	Apron						D		Apron - seed treatment, metalaxyl-M formulation registered for Pythium in brassica. Ridomil has no registration for Pythium as foliar control.
		METHAM SODIUM	Fumasol								
		PHOSPHORUS ACID	FOSCHECK						Y		Registered for 'Nursery Stock' - Pythium and Phytophthora control?
		Trichoderma harzianum	Trichopel	Sold as 'biological fertilisers' not fungicides. Other products 'T-22, T-22HB,Bio-Trek, RootShield' are sold by BioWorks in USA. Link attached					Bio-fungicide		
		PROPAMORCARB	Previcur	No registrations in any vegetable in NZ. Listed for 'ornamentals' only. No WHP listed.					Y		
		THIRAM	Thiram	Not registered for Seedbeds in vegetables however registered in ornamentals for 'damping off, seed and root rots'.					Y		
Rhizoctonia Root Rot *Rhizoctonia solani*	Low - nursery problem	QUINTOZENE	Terrachlor	-	-	-	-		Y		Need to have healthier seedlings produced. Listed for use on 'Vegetable Seedlings' Applied as a pre-sowing soil treatment. Listed to control Rhizoctonia and Fusarium.
		IPRODIONE	Rovral WP						B	NA	Seed treatment. Nursery issue (resistance issue). Only Rovral WP registered for Rhizoctonia and Alternaria only.
		AZOXYSTROBIN	Amistar WG	No reg. in brassicas					K		Registered in Aust for Rhizoctonia control in potatoes.
		THIRAM	Thiram	Not registered for Seedbeds in vegetables however registered in ornamentals for 'damping off, seed and root rots'.					Y		

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Sclerotinia sp. *Sclerotinia sclerotium*	Minor disease	FLUAZINAM	Shirlan	Not registered for Sclerotinia in brassica vegetables. Only registration is for clubroot in brassica vegetables. Registrations of Sclerotinia control in tomato and potato					Y		Occasionally used and effective.
		CHLOROTHALONIL	Bravo 720SC	Not registered for Sclerotinia in brassica vegetables. Only registered for Downy Mildew and Ringspot					Y		
		PROCYMIDONE	Sumisclex 500 SC	Not registered for brassicas. Controls Sclerotinia and on label for field cucurbits, and onion white rot					B		Occasionally used and effective.
		BOSCALID	Filan	To be registered in NZ					G		No product available in NZ, but will be registered. AU label - permits for Sclerotinia control in peas (snow and green), leafy brassica vegetables, lettuce, brassicas and beans.
		CARBENDAZIM	Carbendazim	Not registered for Sclerotinia in brassicas however registered for Sclerotinia control in beans, lettuce and field tomatoes					A		Occasionally used and effective.
		AZOXYSTROBIN	Amistar WG	Not registered for Sclerotinia control in brassicas. Reference to S. minor on Amistar 250 Australian label for field tomatoes.					K		
		THIOPHANATE-METHYL	Topsin M-4 A	Not registered for Sclerotinia control in brassicas. Reg. for Sclerotinia in beans, field tomatoes.					A		
		IPRODIONE	Rovral WP	Not registered for Sclerotinia control in brassicas. Label lists Sclerotinia control in kiwi fruit.					B		Occasionally used and effective.
White blister *Albugo candida*	Low - No control needed at this stage	SULPHUR		No registration for white blister control in brassicas.					Y		Sulphur registered for 'rust' in stonefruit. As Albugo is closely related to Pythium, Phytophthora & Downy mildew, so fungicides that control these pathogens are likely to control Albugo. AU permits for copper oxychloride, dimethomorph, azoxystrobin, chlorothalonil, mancozeb, metalaxyl + mancozeb for Albugo on brassicas. Fungicide resistance is an issue in Aust.

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

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

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

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
APHIDS ↓	Aphids - a major problem including Green Peach Aphid, Black aphid, Cabbage aphid. Resistance an issue.	ALPHA-CYPERMETHRIN	Dominex Fastac	Aphids' listed for tomatoes					3A		
		PYRETHRINS	Garlic & Pyrethrum Concentrate	Aphids					3A	1	
		Beauvaria bassiana	Botanigard ES, Naturalis-O						Bio-insecticides		Not used yet in brassicas, product in development
Melon aphid *Aphis gossypii*		CANOLA OIL	Eco-oil	Green Peach Aphid					Vegetable Oil	11	
Potato aphid *Macrosiphum euphorbiae*		AZADIRACHTIN	NeemAzal-T/S	Registered in all crops for many pests.					Botanical insecticide		
Carrot willow aphid *Cavariella aegopodii*		BIFENTHRIN	Talstar 100EC	Reg. on field tomatoes, pumpkins, squash for 'aphids'					3A		
Carrot black aphid *Cavariella aegopodii*		CARBARYL	Sevin	No listing of aphids on any crop					1A		
Cabbage Aphid (CA) *Brevicoryne brassicae*		DIAZINON	Diazinon 800		Aphids		Reg. on tomato, cauliflower, cabbage and onion for 'aphids'		1B		
Fox Glove *Aulacorthum solani*		DIAZINON	Diazinon 50 WP	Aphids					1B	14	Used by growers.
Lettuce Aphid *Nasonovia ribis-nigri*		ENDOSULFAN	Thiodan	Aphids					2A	14	occasionally used - effective
Green Peach Aphid (GPA) *Myzus persicae*		IMIDACLOPRID	Gaucho	Reg. on forage brassicas, potato and squash for 'aphids'					4A		Commonly used -effective. Seed treatment
Black (Peach)Aphid *Brachycaudus persicae*		IMIDACLOPRID	Confidor	Cabbage Aphid					4A	70	Green peach aphid listed on AU label. Imidacloprid is commonly used -effective

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
APHIDS (CONT)	APHIDS (CONT)	Lecanicillium lecanii blastospores									Not used
		PERMETHRINS + PIPERONYL BUTOXIDE	Greenseals Pyrethrum	Aphids					3A	0	
		PIRIMICARB	Pirimor 50	Aphids					1A	3	Commonly used - good IPM fit, effective. Concerns about resistance, should be rotated with pymetrozine (Chess)
		PIRIMIPHOS-METHYL	Actellic	Only available alone for grain storages & structures.					1B		Used by growers. No registrations in vegetables or for aphids.
		PYMETROZINE	Chess WG	Aphids					9A	7	Commonly used - good IPM fit, effective. Chess is the only product compatible with Aphidius
		TAU-FLUVALINATE	Mavrik	Reg. on field tomato for GPA					3A		
		THIACLOPRID	Calypso	Other pests listed on avocados, peaches and nectarines but not any vegetable. No aphids listed.					4A		
		THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	Reg. for 'aphids' on tomato					3A		
		PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Aphids					3A+1B	3	
		DICHLORVOS	Divap	Aphids					1B	3	
		FATTY ACIDS (POTASSIUM SALTS)	Nature's Way Insect Spray						Unlisted	1	
		APHID PARASITE'	*Aphidius colemani*						Bio-insecticides		
		APHIDOLETED	*Aphidoletes aphidimyza*						Bio-insecticides		
		MALDISON	Malathion 50EC	Aphids					1B		
		DELTAMETHRIN	Decis Forte	Reg. for 'aphids' in squash					3A		
		ROTENONE	Derris Dust						21A	1	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
APHIDS (CONT)	APHIDS (CONT)	METHOMYL	Lannate L		Green Peach Aphid				1A		Occasionally used, poor IPM fit. Reg. for GPA in tomato, cauliflower, cabbage and lettuce.
		PHORATE	Phorate	Aphids					1B	56	Not used for aphids.
		TERBUFOS	Counter 20G	Aphids listed for forage brassicas as a seed/fertiliser treatment					1B		
		CHLORPYRIFOS	Lorsban 50EC	Reg for 'aphids' in winter squash and vegetable brassicas					1B		Used by growers.
		DIMETHOATE	Perfekthion S	Cabbage Aphid				Reg. for CA in potato, carrots and brassicas	1B	14	Occasionally used, poor IPM fit.
		ACEPHATE	Orthene	Reg. for 'aphids' in lettuce and potato					1B		not used
		METHAMIDOPHOS	Monitor Tamaron	Reg. for 'aphids' in potato					1B		Used by growers.
CATERPILLARS ↓	Caterpillars - a major problem including Greasy cutworm, Diamond Back moth, Soybean looper, Tomato fruitworm (esp in summer), White Butterfly. Resistance an issue especially Diamond Back moth.	ACEPHATE	Orthene	Reg. in tomato, brassicas, lettuce and potato	DBM, WB		Reg. in tomato, brassicas, lettuce and potato		1B		Significant resistance issues. Still used by growers. Reg. for cauliflower and cabbage only, but used in all brassicas. Reg. in tomato, brassicas, lettuce and potato.
		CHLORPYRIFOS	Lorsban 50 EC						1B		Reg. for Corn Earworm, Army caterpillar & cutworm in maize/sweet corn: caterpillars & aphids in squash.
Heliothis (H) *Helicoverpa spp.*		CARBARYL	Sevin	L, PTM,TFW + other caterpillars 'Vegetable Crops'					1A	1	
Tomato stem borer (TSB) *Symmetrischema plaesiosoma*		DIAZINON	Diazinon 800	DBM + Caterpillars					1B	14	DBM – occasionally used. OPs causing IPM problems.
Loopers (L) *Lepidoptera spp.*		DIAZINON	Diazinon 50 WP	Caterpillars					1B	14	
Tomato Fruitworm or Corn Earworm (TFW) *Helicoverpa armigera*		ENDOSULFAN	Thiodan	DBM, WB					2A	14	Occasionally used - effective

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Greasy cutworm (GC) *Agrotis ipsilon*	CATERPILLARS (CONT)	METHAMIDOPHOS	Monitor Tamaron	DBM,L,WB					1B	7	Had major resistance, now re-used. Common used in forage brassicas. Not IPM compatible according to Graham Walker.
Green lopper (GL) *Thysanoplusia orichalcea*		PYRETHRUM	Garlic & Pyrethrum Concentrate	Cabbage Moth and caterpillars 1					3A	1	Limited use. SPs causing IPM problems.
Soybean looper (SL) Thysanoplusia orichalcea		TAU-FLUVALINATE	Mavrik	Reg. in cabbage and field tomato		DBM, WB	Reg. in cabbage and field tomato		3A	3	
White Butterfly (WB) *Pieris rapae*		DICHLORVOS	Divap	Caterpillars Vegetables					1B	3	
Diamond Back Moth (DBM) *Plutella xylostella*		*Bacillus thuringiensis t sub. Kurstaki*	Dipel	Caterpillars				DBM, WB,SL	11C	0	very commonly used
Army Caterpillar (AC) *Pseudaletia separata*		*Bacillus thuringiensis sub.Xen tari*	XenTari	Caterpillars					11C	0	very commonly used
Tropical Caterpillar (TC)		DELTAMETHRIN	Decis Forte	DBM,WB					3A	3	For Greasy Cutworm control - commonly used and effective. All SPs starting to be re-used - with good effect. Use only in late window. SPs causing IPM problems.
Copper caterpillar (CC)		ALPHA-CYPERMETHRIN	Dominex Fastac	DBM, WB, TFW,GC					3A	3	All SPs starting to be re-used - with good effect. There was a high level of resistance to SP in all regions and cross resistance known. Should only be used in late window. SPs causing IPM problems.
Cutworm (Cu) Agrotis spp.		BIFENTHRIN	Talstar 100EC and Talstar 80 SC	DBM, WB					3A	3	For Greasy Cutworm control - commonly used and effective. All SPs starting to be re-used - with good effect. There was a high level of resistance to SP in all regions and cross resistance known. Should only be used in late window. SPs causing IPM problems.

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Potato Tuber Moth (PTM) *Phthorimaea operculella*	CATERPILLARS (CONT)	CYPERMETHRIN	Ripcord	Reg, in cauliflower, cabbage and tomato	DBM,WB, TFW		Reg, in cauliflower, cabbage and tomato		3A	3	All SPs starting to be re-used - with good effect. Used in all brassicas. There was a high level of resistance to SP in all regions and cross resistance known. Should only be used in late window. SPs causing IPM problems.
		PERMETHRIN + PIRIMIPHOS-METHYL	Attack	DBM, WB					3A+1B	3	not used
		ESFENVALERATE	Sumi-Alpha	DBM,WB,TFW					3A	3	not used
		LAMBDA-CYHALOTHRIN	Karate	DBM,WB,TFW					3A	3	For Greasy Cutworm control - commonly used and effective. All SPs starting to be re-used - with good effect. There was a high level of resistance to SP in all regions and cross resistance known. Should only be used in late window. Graham Walker doesn't believe this! SPs causing IPM problems.
		METHOMYL	Lannate L	Reg. cauliflower, cabbage, lettuce and tomato	L		Reg. cauliflower, cabbage, lettuce and tomato		1A	7	Used by growers. OPs causing IPM problems. Used in all brassicas.
		SPINOSAD	Entrust Naturalite (WP)	DBM,WB					5A	3	commonly used as part of rotation - good IPM fit, effective
		SPINOSAD	Spinosad Naturalite	Reg, in field tomato, cauliflower and cabbage	DBM,WH		Reg, in field tomato, cauliflower and cabbage		5A	3	commonly used as part of rotation - good IPM fit, effective
		THIOPHANATE-METHYL + CHLOROTHALONIL + TAUFLUVALINATE	Guardall	Reg, in tomato and cabbage		DBM, WB	Reg, in tomato and cabbage		3A	7	
		TRICHLORFON	Trifon	Cutworm, DBM, WB					1B	14	not used
		TRICHLORFON + CYPERMETHRIN	Partna	Reg. in cauliflower, cabbage and tomato	DBM,WBTFW		Reg. in cauliflower, cabbage and tomato		1B+3A	14	
		MALDISON	Malathion 50EC	DBM,TFW, WB					1B	3	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
CATERPILLARS (CONT)	CATERPILLARS (CONT)	ROTENONE	Derris Dust	DBM,WB					21A	1	
		PIRIMIPHOS METHYL	Actellic						1A		No registration in vegetables. Occasionally used and effective. OPs causing IPM problems.
		Beauvaria bassiana	Botanigard ES, Naturalis-O						Bio-insecticides		Not used yet in brassicas, product in development
		FIPRONIL	Ascend	DBM, WB					2C	7	Regularly used as part of rotation - effective. Not good IPM fit because of toxicity to parasitic hymenoptera which are key natural enemies to DBM and Pieris in NZ. Also issues with cross resistance to other chemistries.
		PARATHION METHYL	Folidol	Aphids							
		EMAMECTIN	Proclaim						6A		Registered in fruit for leafroller. No record of use. Needs to be registered as good IPM. Registered in brassicas for lepidoptera in Aust.
		INDOXACARB	Steward 150SC	Reg. in 'head' lettuce, cauliflower, cabbage and Brussel sprouts	DBM,WB			Reg. in 'head' lettuce, cauliflower, cabbage and Brussel sprouts	22A		Regularly used as part of rotation - good IPM fit, effective. Used in all brassicas. Expensive and doesn't work in Ohakune - is listed as used for white butterfly.
		CHLORANTRANIPROLE		New lepidoptera insecticide from Dupont.							Excellent activity and IPM. To be registered in 2008. Crops unknown.
Slugs & snails *Gastropoda spp.*	High - major problem	IRON PHOSPHATE	Neudorff Slug and Snail Bait	Don't apply to edible plant parts					Molluscicide		Occasionally used in crop. Registered in all situations.
		EDTA	Multiguard	Don't apply to edible plant parts					Molluscicide		Occasionally used in crop. Registered in all situations.
		METHIOCARB	Mesurol						1A		Mesurol is main product used. NO WHP where product comes into contact with edible plant portions when a WHP of 21 days apply
		Metaldehyde	Slugout	Do not apply to edible plant parts.					Molluscicide		Occasionally used in crop. Registered in all situations.
		THIODICARB	Larbit	Registered in vegetables					1A	21	Occasionally used in crop. Registered in all situations

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

* 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 brassicas.

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
THRIPS	Thrips - a minor problem. Onion thrips are a major problem.	ALPHA-CYPERMETHRIN	Dominex/Fast ac	Reg. in tomato and onions					3A		
		CHLORPYRIFOS	Lorsban 750 WG	Reg. in kumara for 'thrips'					1B		
		DELTAMETHRIN	Decis Forte	Reg. in kumara for 'thrips'					3A		Resistance to SPs identified.
		ENDOSULFAN	Thionex EC	Reg. in kumara and tomato for 'thrips'					2A		Occasionally used. No resistance to endosulfan in NZ.
Onion Thrips *Thrips tabaci*		FIPRONIL	Ascend	No mention of thrips on NZ label					2C		
Western Flower Thrips *Frankliniella occidentalis*		IMIDACLOPRID	Confidor	Reg. for thrips on onion					4A		
Intonsa Flower Thrip		IMIDACLOPRID + CYFLUTHRIN	Confidor Supra	Reg. for 'thrips' on onion					4A+3A		
Cucumerous (Cucumber thrips) (WFT)		LAMBDA-CYHALOTHRIN	Karate	Reg. for 'onion thrips' on onions					3A		Resistance to SPs identified.
		AZADIRACHTIN	NeemAzal-T/S	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions thrips control					Botanical insecticide		Not registered on any vegetable and only on non-fruit bearing trees and vines.
		METHAMIDOPHOS	Monitor/Tamaron	Reg. for thrips on onion					1B		Used and very effective.
		TAU-FLUVALINATE	Mavrik	Reg. for thrips on onion					3A		Resistance to SPs identified.
		CARBARYL	Sevin (No thrip control in any veg. crop however controls thrips in fruit crops)	No thrip control in any veg. crop however controls thrips in fruit crops					1A		
		Amblyseius cucumeris	Mite-A, Thripex (Biological)	Reg. on GH tomato, GH capsicum and GH cucumber					Bio-insecticides		
		Hypoaspis aculeifer	Hypomite	Thrip pupae					Bio-insecticides	0	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
THRIPS (CONT)		DIAZINON	Diazinon 800	Thrips					1B	14	Resistance to diazinon identified.
		Lecanicillium lecanii blastospores									
		DICHLORVOS	Divap	Reg. for 'thrips' on GH tomato and GH capsicum					1B		
		THIACLOPRID	Calypso	Thrips listed on avocados, peaches and nectarines but not any vegetable					4A		Thrips listed on avocados, peaches and nectarines
		MALDISON	Malathion 50EC	Thrips listed on various fruit crops however no vegetables					1B		
		PYRETHRUM	Garlic & Pyrethrum Concentrate	Thrips					3A	1	Resistance to SPs identified.
WEEVILS 	Plant weevils - a moderate 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		
		CHLORPYRIFOS	Suscon Green	Only ornamentals and flowering plants					1B		
Black Vine Weevil Larvae *Otiorhynchus sulcatus*		*Heterorhabditis bacteriophora*	Otinem	Ornamentals only'					bio-insecticide		
White fringed weevil *Naupactus leucoloma*		FIPRONIL	Ascend	Weevils not listed on label for any crop					2C		
Plant Weevils *Curculionidae spp.*		LAMBDA-CYHALOTHRIN	Karate	Fulller rose weevil listed for citrus only					3C		
Stem weevil *Curculionidae spp.*		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		

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Grass grub Beetle *Oncopera spp.*	Low	PHORATE	Phorate	Grass Grub not listed on Phorate for any crop					1B		Grass Grub Beetle :SPs used foliar
		IMIDACLOPRID	Gaucho	Reg. for 'grass grub beetle in squash					4A		Check Sp's. Listed on cucurbit spreadsheet
		DIAZINON	DIAZINON	Reg. for established pastures					1B		
		ALPHA-CYPERMETHRIN	Alpha scud	Reg. for 'Tasmanian Grass Grubs' but not on brassicas.					3A		SP's used as a foliar. Which SP?
		DELTAMETHRIN	Decis Forte	No listing for 'grass grub' on any crop.					3A		SP's used as a foliar. Which SP?
		TAU-FLUVALINATE	Mavrik	No listing for 'grass grub' on any crop.					3A		SP's used as a foliar. Which SP?
		ESFENVALERATE	Sumi-Alpha	No listing for 'grass grub' on any crop.					3A		SP's used as a foliar. Which SP?
		BIFENTHRIN	Talstar 100 EC	No listing for 'grass grub' on any crop.					3A		SP's used as a foliar. Which SP?
		TERBUFOS	Counter 20G	Controls 'grass grub' in new pastures/cereals					1B		
		Bacillus thuringiensis	Dipel Xentari	Bt for leafroller control listed for a number of crops					11C		Nursery problem only. Bt used by growers.
Leafroller *Epiphyas spp*	Low	CHLORPYRIFOS	Lorsban 750 WG	Nyssius listed for forage brassicas					1B		Can be a problem with forage brassica seedlings. General broad spectrum if a problem in veg brassicas - Lorsban (chlorpyrifos). Not a problem in Okahune
Nyssius Wheat Bug *Nysius huttoni*	Low - forage brassica only	ENDOSULFAN	Thiodan	Nyssium listed for forage brassicas					2A	14	Used by growers as a general insect control.
		TERBUFOS	Counter 20G	Nyssius listed for forage brassicas with seed or fertiliser					1B		
		FENITROTHION	Caterkil 1000	Listed for forage brassicas					1B		
		PHORATE	Phorate	Reg. for 'nyssius' in forage brassica					1B		
		CHLORPYRIFOS	Lorsban 750 WG						1B		Used by growers as a general insect control.
Springtails *Collebola spp.*	Low - forage brassicas only	FURATHIOCARB	Promax 400 CS	Springtails listed on forage brassica labels as a seed treatment							No AU Listing
		IMIDACLOPRID	Gaucho	Listed for squash and forage brassicas					4A		
		DIAZINON	Diazinon 800	Springtails					3A	14	
		TERBUFOS	Counter 20G	Sprintails listed for brassica vegetables as a seed/fertiliser treatment					1B		
		PHORATE	Phorate	Reg. for 'springtails' in forage brassicas					1B		Used by growers

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Wireworm *Heteroderus spp.*	Minor - occasional problem	PHORATE	Phorate	Reg. for 'cucurbits' squash and potato					1B		
		ACEPHATE	Orthene	No listing for 'wireworm' for any crop							Wireworm not listed on label
Rats *Ratus spp.*	minor - occasional problem	HYDROCYANIC ACID	Cyanosil	Registered product in NZ					8B		Registered product in NZ
		METHYL BROMIDE	Ag Fume M.B.	Registered product in NZ					8A		Registered product in NZ
		ALUMINIUM PHOSPHIDE	Genfume AP	Registered product in NZ					8B		Registered product in NZ
		COUMATETRALYL	Racumin	Registered product in NZ							Registered product in NZ
		BROMADIOLONE	Rid Rat Super	Registered product in NZ							Registered product in NZ
		BRODIFACOUM	Talon	Registered product in NZ							Registered product in NZ
		DIPHACINONE	Pest Gone Rodent Bait	Registered product in NZ							Registered product in NZ
		FLOCOUMAFEN	Storm Secure	Registered product in NZ							Registered product in NZ
		Corn Cob - powdered'	No rats	Registered product in NZ							Registered product in NZ
Black beetle *Heteronychus spp.*	Minor - occasional problem	LAMBDA-CYHALOTHRIN	Karate	Only beetles listed are bronze and grass grub beetles in grapes					3A		
		METHAMIDOPHOS	Monitor Tamaron	No 'beetles' listed on labels					1B		
Symphillids *Symphyla spp.*	No problem	LAMBDA-CYHALOTHRIN	Karate						3A		
		METHAMIDOPHOS	Monitor Tamaron						1B		
		DIAZINON	Diazinon 800						1B		
WHITEFLIES 	No problem	THIACLOPRID	Calypso	Whitefly not listed on Calypso label					4A		No Whitefly listed on AU label or NZ label
		BUPROFEZIN	Applaud/Ovation	Reg. on GH tomato, GH capsicum, GH cucumber, melon and zucchini					17A		
		ENDOSULFAN	Thiodan	Reg, for whitefly on tomato					2A		
Greenhouse whitefly(GW) *Trialeurodes vaporariorum*		CANOLA OIL	Eco-oil	Greenhouse Whitefly					Vegetable Oil	0	

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
WHITEFLIES (CONT)		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.
Tobacco Whitefly (TW)(Silverleaf) *Bemisia tabaci (biotype B)*		IMIDACLOPRID	Gaucho	No Whitefly control for any crop					4A		
		Lecanicillium lecanii blastospores									
		Encarsia formosa	En-force, En-Strip	Reg. on GH tomato, GH capsicum and GH cucumber					Bio-insecticides		
		DICHLORVOS	Divap	Reg. for 'whitefly on GH tomato and GH capsicum					1B		
		PYMETROZINE	Chess WG	Reg. for 'whitefly' on GH and field tomato					9A		
		METHOMYL	Lannate L	Reg. for 'whitefly' on GH tomato, GH capsicum and GH cucumber					1A		
		PERMETHRUM	Garlic & Pyrethrum Concentrate	GW					3A	1	
		PIRIMIPHOS-METHYL	Actellic	Reg. for 'underglass' tomato and 'underglass' cucurbits group					1B		Used by growers.
		PERMETHRIN + PIRIMIPHOS-METHYL	Attack	Reg. for GH tomato					3A+1B		
		FATTY ACIDS (POTASSIUM SALTS)	Nature's Way Insect Spray						Unlisted	1	Hitman' AU Label lists whitefly. No listing of Whitefly on NZ Label
Potato psyllid *Psyllidae spp.*	Nil	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		
		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		

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Potato psyllid *Psyllidae spp* (CONT)		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
		ORGANOPHOSPHATES		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 *Psyllidae spp.*	Minor - occasional problem	SYNTHETIC PYRETHROIDS		Checked the most common SP labels. No 'leafminer' mentioned					3A		Leafminer fly?? (Scaptomyza flava). Growers have indicated that SP are effective.
		DIMETHOATE	Dimethoate	AU label lists 'leafminers' for vegetables					1B		Leafminers are a major problem in Asian Vegetables. Minor problem in head brassicas. Many products tested in lab and field and found effective. Including abamectin, Spinosad. Indoxacarb is not effective.
		ENDOSULFAN	Thiodan	AU label lists 'leafminers' for tobacco and beet leafminer in beetroot					2A		
Sciarid Flies *Bradysia spp.*	Moderate	IMIDACLOPRID	Gaucho	Sciarid fly control not mentioned for any crop					4A		
		Hypoaspis aculeifer	Entomite	Reg. for GH tomato, GH cucumber, lettuce, potato, kumara, onion and carrot					Bio-insecticides		
		Hypoaspis aculeifer	Hypomite						Bio-insecticides	0	
		Bacillus thuringiensis	VectoBac 12AS	Label lists mosquitoes and blackflies					Bio-insecticide		Label lists mosquitoes and blackflies
		DICHLORVOS	Divap	Reg. for 'scariad fly' in GH tomato, GH capsicum					1B		
		Steinermema feltae	Gnatnem						Bio-insecticide	0	
		SYNTHETIC PYRETHROIDS	Various						3A		No mention of any synthetic pyrethroid for sciarid flies. Occasionally used.
		DIAZINON	Diazinon						1B		No diazinon label lists sciarid fly for control in any crop. Occasionally used.

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

Disease name (occurrence)	Priority	Active ingredient	Common Trade Name	Registration					Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
				Broccoli	Cauli flower	Cabbage	Brussel Sprouts	Vegetable Brassicas			
Mealy Bugs *Pseudococcus spp.*	Nil	IMIDACLOPRID	Gaucho	Mealy bug not listed on label in NZ					4A		(Mealy bug not listed on label in NZ)
		CARBARYL	Sevin	Mealy bug control in pipfruit					1A		
		AZADIRACHTIN	NeemAzal-TS	Not registered on any vegetable and only on non-fruit bearing trees and vines however mentions mealy bug control					Botanical insecticide		
		BUPROFEZIN	Applaud/Ovation	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	*Cryptolaemus montrousieri*						Bio-insecticide		
Green Vegetable Bug *Nezara viridula*	Moderate pest	CARBARYL	Sevin	Green Veg. Bug not listed for any crop in NZ					1A		
		ENDOSULFAN	Thiodan Thionex	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
		TRICHLORFON	Trifon	Reg. for tomato					1B		

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

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

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

Active ingredient	Common Trade Name	Registrations				Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
		Broccoli	Brussel Sprouts	Cauliflower	Cabbage			
ALACHLOR	Alanex Lasso						NA	Pre-emergent broad spectrum herbicide. Commonly used and effective product - post-plant. But some reports of weed escapes.
CLOPYRALID	Clopyralid					I		Used by growers. Registered in forage brassicas only for thistles. AU label - registered in canola.
CHLORTHAL DIMETHYL	Dacthal 75W					D		Registered in NZ as a pre & post-emergent in onions and other crops. Controls many weeds. AU label – registered in brassicas for many weeds.
DIMETHENAMID	Frontier							Registered in NZ for pre-emergent grass and broadleaf weed control in maize, onions, sweet corn, squash, beans and forage brassicas. Used by growers.
FLUAZIFOP-P-BUTYL	Fusilade WG	Vegetables				A	35	Early post-emergence for grass weeds. Occasionally used and effective on grass weeds post-emergent.
CLETHODIM	Arrow	Vegetables				A	35	Early post-emergence for grass weeds. Occasionally used and effective on grass weeds post-emergent.
HALOXYFOP	Gallant NF					A		Not used in NZ. AU label – registered in brassicas for many weeds.
OXYFLUORFEN	Goal 40 WP					G	NA	Commonly used either pre with Roundup or early post transplant
PENDIMETHALIN	Stomp Xtra					D		Pre-emergent broad spectrum herbicide. Not used in NZ. AU label – registered in brassicas for many weeds.
PROPACHLOR	Ramrod Flowable					k	NA	Not used in NZ. AU label – registered in brassicas for many weeds.
QUIZALOFOP-P-ETHYL	Targa					A		Not used in NZ. AU label – registered in brassicas for many weeds.
SETHOXYDIM	Poast					A	35	Post-emergent grass selective herbicide. Growers don't use.
S-METOLACHLOR	Dual Gold					K		Registered in NZ as a pre & post-emergent in onions and other crops. Controls many weeds. AU label – registered in brassicas for many weeds.

Table 5 (cont): Herbicides registered and used for the control of the weeds in brassicas.

Active ingredient	Common Trade Name	Registrations				Resistance group*	WHP (days)	CURRENT PRODUCT SUITABILITY (availability, efficacy, IPM, residues, resistance, trade, WHP)
		Broccoli	Brussel Sprouts	Cauliflower	Cabbage			
TRIFLURALIN	Trifluralin	Transplanted crops				D	NA	Pre-emergent broad spectrum herbicide. Occasionally used in NZ. AU label – registered in brassicas for many weeds.
GLYPHOSATE	Roundup					M	NA	Broad spectrum knockdown herbicide. Registered in vegetables. Used pre-plant for perennial weed control – very effective.
GLYPHOSATE-TRIMESIUM	Touchdown					M	NA	Similar weed control to Roundup however may provide better control of some broadleaf weeds. Registered in vegetables. Occasionally used pre-plant.
DIQUAT	Reglone	Vegetables				L	NA	Pre-plant or inter-row for broad spectrum knockdown weed control. Registered in vegetables. Very commonly used and effective product.
PARAQUAT	Paraquat	Vegetables				L	NA	Pre-plant or inter-row for broad spectrum knockdown weed control. Registered in vegetables. Very commonly used and effective product.
PINE OIL	Organic Interceptor							Not used

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

	Actives under review in Aust
	Registered
	Used off-label