Cucumber

Strategic Agrichemical Review Process 2011-2014

HAL Projects - MT10029 & VG12081

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Horticulture Australia project no:
MT10029 – Managing pesticide access in horticulture.
VG12081 - Review of vegetable SARP reports.

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

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Horticulture Australia

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1. Media Summary

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

Alternative pesticides should ideally be selected for benefits of:

- Integrated pest management (IPM) compatibility
- Improved scope for resistance management
- Sound biological profile
- Residue and trade acceptance domestically and for export.

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

DISEASE

Diseases identified as high priorities:

Disease (common name)	**Disease (scientific name)**
Fusarium wilt	*Fusarium oxysporum*
Powdery mildew	*Sphaerotheca fuliginea*

A contrast can be seen between the paucity of chemical tools to treat one of the major disease problems, *Fusarium* wilt, and another, Powdery mildew. In the first case the only options are old chemistry used as soil fumigants. In the second there are a range of options, including products based on new active ingredients. This highlights the problem for minor crops and situations where there are often limited opportunities for research into potential tools, let alone resources for registrations and permits.

Cucumbers are a crop where growers are turning more to non-chemical solutions, partly due to lack of approved pesticides, but partly also by choice. Integrated crop and pest management strategies are considered best practice in many cases.

Nevertheless there remain considerable gaps, with a number of disease problems only served by older, permitted rather than registered chemistry, and in some cases with resistance further limiting options.

INSECTS

Insects identified as high priorities:

Insect (common name)	**Insect (scientific name)**
Aphids	*Myzus persicae*
Helicoverpa	*Helicoverpa* spp.
Whiteflies - including Silverleaf, Greenhouse.	*Bemisia tabaci, Trialeurodes vaporariorum*

There are a considerable number of insecticides registered for use in cucumbers, including the new entrants to the market: chlorantraniliprole (CORAGEN), flubendiamide (BELT) and sulfoxaflor (TRANSFORM). So for some pests, growers have reasonable options for developing a treatment schedule with good alternation of products from different chemical groups. It is expected that the use of this chemistry will be carefully managed - the industry has observed the benefits of IPM techniques, both in reducing pest problems and as a means of reducing resistance risks that come from overuse of chemicals.

There are no or limited chemicals permitted for a number of the lesser pests of cucumbers. Growers must rely on control by other chemicals already being used in the crop. This can be difficult when the management strategy is not targeted to the problem.

WEEDS

No weeds were reported as a high priority for new registrations or permits. Most weeds can be controlled with currently available herbicides but growers would welcome inclusion of cucumbers in new chemical registrations.

For field cucumber growers reported that a pre-plant herbicide, generally a knock-down, was used to prepare the paddock. Growers then usually only spot spray grass weeds with a grass selective herbicide.

In protected situations weed mats are used rather than herbicides.

2. The Australian cucumber industry

The Australian cucumber industry is a growing, innovative and resourceful horticultural industry, that is predominantly moving to protected crop production. Consumption of cucumbers has risen in recent years. It was Australia's 6th largest vegetable crop in 2011. (Ausveg 2011)

Cucumbers are grown across Australia with the main growing regions in each state being:

- Bowen / Burdekin (Qld)
- Bundaberg (Qld)
- Lockyer Valley (Qld)
- North Adelaide Plains and Riverland (SA)
- Greater Sydney Basin (Central Coast to Bargo, with epicentre in western Liverpool) (NSW)
- Mid North Coast (including Coffs Harbour, Wardell and Woolgoolga (NSW)
- Far west NSW, centred in Gol Gol (adjacent to Sunraysia district of Vic (NSW)
- Sunraysia (Vic)
- Melbourne Metro (Vic)
- Geraldton (WA)
- Metro outer areas (WA)
- Humpty Doo (NT)

In 2010/11 cucumber production was 58.5 kt, with 46% produced in SA, 40% in Qld, 10% in NSW, 3% in WA and 1% in Vic. The current domestic retail market value of fresh Australian cucumber purchased by consumers was $162M.

Although the majority of domestic consumption is from locally grown cucumbers, 9 kt were imported in 2011, with 95% of this being processed product. (Ausveg, 2012)

Due to the variety of weather and growing conditions across Australia, utilisation of protected cropping and the introduction of different varieties of cucumber, the Australian industry supplies fresh cucumber throughout the year.

An estimated 84 per cent of vegetable farms that grew cucumbers did so under cover in 2010–11. (Thompson & Zhang 2012) This is considerably greater than the protected cropping 40% reported for 2008/09.

Cucurbits in Australia are produced largely for the domestic market. In 2011 there was export of 76 t fresh and 89 t processed cucumbers (Ausveg, 2012) to New Zealand, Hong Kong, Singapore and Papua New Guinea. (Akem, 2013).

3. Introduction

3.1. Background

Growers of some horticultural crops suffer from a lack of legal access to crop protection products (pesticides). The problem may be that whilst a relatively small crop area is valuable in an agricultural sense, it is not of sufficient size for agchem manufacturers to justify the expense of registering a product use on that crop. Alternately, the disease, pest, or weed problem may be regional or spasmodic, making agchem companies unwilling to bear the initial high cost of registering suitable pesticides. As an added complication some horticultural crops may be grown in protected cropping or hydroponic situations. These can have a significant impact on pesticide performance and residue outcomes, further increasing product development requirements and registration costs.

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

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

Pesticides have always been an important tool in the production of cucumber. They control the various diseases, insects and weeds that affect the crop and can cause severe economic loss in modern high intensity growing operations. Pesticides are utilized in seedling production, pre-plant, during plant establishment, through crop development and into crop maturity to maximise crop yield, quality and customer appeal.

From a pesticide access perspective, the APVMA classifies cucumber as a minor crop. The crop fits within the APVMA crop group 011 Fruiting vegetables-cucurbits.

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

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

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

3.2. Minor use permits and registration

Cucumbers are classified as minor by the APVMA. Therefore access to minor use permits can be relatively straight forward as long as a reasonable justification is provided. Possible justification for future permit applications could be based on:

- New disease, insect or weed identified as a cropping issue
- No pesticide available
- Current pesticides no longer work – resistance
- Current pesticides limiting trade
- IPM, environmental or operator issues
- Loss of pesticides due to removal from market
- New, effective pesticide registered in another crop
- Alternate pesticide has overseas registration or minor use permit

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

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

3.3. Methods

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

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

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

3.4. Results and discussions

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

4. Pests and diseases of cucumber

4.1 Diseases of Cucumber

Common name	Scientific name
HIGH PRIORITY	
Fusarium wilt	*Fusarium oxysporum*
Powdery mildew	*Podosphaera xanthii*
MODERATE PRIORITY	
Alternaria	*Alternaria cucumerina*
Damping-off*	*Pythium* spp., *Phytophthora* spp.,
Downy Mildew	*Pseudoperonospora cubensis*
Grey mould	*Botrytis cinerea*
Gummy stem blight	*Didymella bryoniae*
LOW PRIORITY	
Angular leaf spot	*Pseudomonas syringa*
Anthracnose	*Colletotrichum orbiculare*
Bacterial spot	*Xanthomonas campestris*
Phytophthora soil fungus	*Phytophthora* spp.
Rhizoctonia ground rot	*Rhizoctonia solani*
Septoria spot	*Septoria cucurbitacearum*
Scab	*Cladosporium spp.*
Target spot	*Cercospora citrullina*
Biosecurity risk	
None listed	

*A number of pathogens can be associated with damping-off in cucumbers, either individually or as part of a disease complex. The most common are *Pythium, Phytophthora, Fusarium* and *Rhizoctonia.*

Opinion on the priority of diseases can vary across the industry. As examples:

- **Gummy stem blight** was considered as a moderate priority overall by SARP participants, but it is considered a major problem in winter in some areas;

- ***Alternaria*** has been reported to have increased in severity in recent years on some farms;

- **Bacterial spot** is considered the major problem by some growers in Qld, particularly in greenhouses. In SA and WA it is the second major problem. This can be the most important and destructive disease of cucumber in some cases. Copper is the only active registered to control *Xanthomonas* in cucurbits and there are no permits. Crop management techniques as mentioned for *Fusarium* are the main means of control for growers.

4.1.1 High priority diseases

Fusarium (*Fusarium oxysporum*)

Pre-emergence rot and damping-off can occur during propagation. Infection of older plants is more common usually leading to wilt of the entire plant. Initially, the lower leaves of the plant wilt at mid-day and recover during the evening and at night. Eventually more and more leaves wilt until the plant is totally affected.

The wilting symptom is accompanied by chlorosis and finally necrosis of interveinal areas of the leaves. Vascular discoloration of the roots and stem, which may extend to 8-10 nodes is common and can be seen by longitudinal and cross sections of the stem

Pythium root rot can also be a high priority, occurring in a disease complex with *Fusarium* wilt.

It should also be noted that as a number of pathogens can be associated with wilt, management can be improved by correct diagnosis.

- No fungicides are registered for the control of *Fusarium* wilt in cucumber, other than the soil fumigants, eg. 1,3-dichloropropene (various registered products).

- No fungicides are listed for *Fusarium* wilt control in cucumber via **permit**.

- There are some **Potential** fungicide treatments that could be developed as permits.
  - A seed dressing with thiabendazole could protect young plants
  - Post-transplant drenches of prochloraz or azoxystrobin have been tested and shown to reduce disease levels.

- Growers are **managing** the disease by crop management techniques, including:
  - Varietal choice
  - Grafting onto resistant rootstocks
  - Crop rotations
  - Good farm and crop hygiene
  - Optimal irrigation scheduling,
  - Disinfection and testing of the water supply
  - Control of fungus gnats which spread the fungus.

Powdery mildew (*Podosphaera xanthii*)

Powdery mildew is one of the easier diseases to recognize. Masses of fungal spores (conidia) are produced, giving the plant the appearance of being coated with flour or talcum powder. Areas of white to greyish growth (mycelium) can appear on young plant tissues (leaves, stem, and fruit), and can become severe enough that the entire surface is covered. As the mycelium ages, the mildew may take on a light reddish brown to grey appearance.

Symptoms of powdery mildew can range from symptomless to significant distortion of leaves, flowers, fruit, and even entire shoots. Powdery mildews can have substantial effects on yield, as they rob the host plant of nutrients, reduce the photosynthetic process, increase respiration and transpiration, impair growth, and reduce yields.

- Powdery mildew is considered a major problem in most states. It is a high priority in Qld and WA. In NSW it is a problem at harvest time during picking, as all options are not working.

- Fungicides **registered** for the control of Powdery mildew in cucumber are:
    - Azoxystrobin (various) – Group 11 protectant and curative fungicide
        - Occasionally used.
        - Reports of efficacy vary amongst growers.
        - Minimal impact on all beneficial insects.
        - Growers are concerned about the potential for resistance to develop.
    - Boscalid + kresoxim-methyl (COLLIS^) - Group 7 + 11 - systemic, protective and curative fungicide
        - Occasionally used.
        - Considered expensive.
        - Reported as very effective.
        - Minimal impact on all beneficial insects.
        - Growers expressed concern that with a heavy reliance resistance may develop.
    - Chlorothalonil (various brand name products) – Group M5 protectant fungicide
        - Occasionally used.
        - Considered effective, especially under low disease pressure.
        - Moderately harmful to some beneficial insects.
    - Copper (various) - Group M1 protectant fungicide
        - Copper is commonly used.
        - Growers report that it is only providing good efficacy in low pressure situations.
        - Moderately harmful to some beneficial insects.
    - Cyflufenamid (FLUTE^) – Group U6 fungicide.
        - First registration in 2013.
        - Care should be exercised with regard to broad registration and potential overuse across vegetable crops and associated resistance threats.
    - Fenarimol (RUBIGAN^) – Group C preventative and curative fungicide
        - Growers didn't report using this fungicide.
    - Hydrogen peroxide + peroxyacetic acid (PERATEC PLUS^) - Group M fungicide
        - Maximum 5 sprays per crop
        - 1 day withholding period is advantageous.
    - Metrafenoe (VIVANDO^) – Group U6 protectant fungicide
        - Used on younger plants (as it has a 7 day WHP).
        - Reported by growers as having good efficacy.
    - Proquinazid (TALENDO^) - Group 13 - protective fungicide
        - Field grown cucurbits only.
        - 1 day withholding period.
    - Triadimefon (various) - Group 3 - systemic, protective and curative fungicide
        - Rarely used.
        - Growers expressed concern that with a heavy reliance resistance may develop. Many growers report poor efficacy.
        - Minimal impact on all beneficial insects.
    - Triadimenol (various) - Group 3 - systemic, protective and curative fungicide
        - Occasionally used.
        - Growers expressed concern that with a heavy reliance resistance may develop. Many growers report poor efficacy.
        - Minimal impact on all beneficial insects.
- Fungicides listed for control of Powdery mildew control in cucumber via **permit**:
    - Bupirimate (NIMROD^, PER10979, expires Sep 2014) - Group 8 - systemic, protective and curative fungicide
        - Occasionally used.
        - It is very effective, especially in Queensland.
        - Growers expressed concern that with a heavy reliance that resistance may develop.
        - Minimal impact on most beneficial insects, moderate impact on predatory mites.
    - Potassium (various, PER13695, expires Sept, 2017) - Group M2 fungicide
        - Growers didn't comment on use of this chemical

- Trifloxystrobin (various, PER14050, expires June 2023) - Group 11 - systemic, protective and curative fungicide
  - Occasionally used.
  - Protected situations only
  - Conflicting reports of efficacy
  - Growers expressed concern that overuse of the chemical may lead to development of resistance.
  - Minimal impact on all beneficial insects.
  - Bayer will not be registering the use.

There are a number of registered and permitted fungicides, including several new active constituents registered in the last couple of years. There should be sufficient options for a spray program now and no further permits should be needed for powdery mildew.

4.1.2 Summary

High Priority Diseases and control options

A contrast can be seen between the paucity of chemical tools to treat one of the major disease problems, *Fusarium* wilt, and another, Powdery mildew. In the first case the only options are old chemistry used as soil fumigants. In the second there are a range of options, including products based on new active ingredients. This highlights the problem for minor crops and situations where there are often limited opportunities for research into potential tools, let alone resources for registrations and permits.

Cucumbers are a crop where growers are turning more to non-chemical solutions, partly due to lack of approved pesticides, but partly also by choice. Integrated crop and pest management strategies are considered best practice in many cases.

Nevertheless there remain considerable gaps, with a number of disease problems only served by older, permitted rather than registered chemistry, and in some cases with resistance further limiting options.

Disease	Control option
Fusarium wilt (*Fusarium oxysporum*)	**Currently registered fungicides** Only soil fumigants such as 1,3-dichloropropene + chloropicrin are registered for *Fusarium*. As a number of pathogens can be associated with wilt, management can be improved by correct diagnosis. **Currently permitted fungicides** None **Fungicide gaps** New, "safer" chemistry **Potential fungicide solutions** None nominated by growers **Non-chemical options** Crop management techniques, including: - Varietal choice - Grafting onto resistant rootstocks - Crop rotations - Good farm and crop hygiene - Optimal irrigation scheduling, - Disinfection and testing of the water supply - Control of fungus gnats which spread the fungus
Powdery mildew (*Podosphaera xanthii*)	**Registered fungicides** - Azoxystrobin (various) – Group 11 – minimal impact on beneficials, varying reports on efficacy.

Disease	Control option
	- Boscalid + kresoxim-methyl (COLLIS^) - Group 7 + 11 – efficacious, minimal impact on beneficials. - Chlorothalonil (various brand name products) – Group M5 - effective, moderately harmful to some beneficial insects. - Copper (various) - Group M1 protectant fungicide – effective under low pressure, moderately harmful to some beneficial insects. - Cyflufenamid (FLUTE^) – Group U6 – new to market, should be used strategically to reduce resistance risk. - Fenarimol (RUBIGAN^) – Group C - not reported to be used by growers - Hydrogen peroxide + peroxyacetic acid (PERATEC PLUS^) - Group M fungicide – 1 day WHP. - Metrafenoe (VIVANDO^) – Group U6 – used early in program. - Proquinazid (TALENDO^) - Group 13 – field use only, 1 day WHP - Triadimefon (various) - Group 3 – minimal impact on beneficials but poor efficacy reported. - Triadimenol (various) - Group 3 – minimal impact on beneficials but poor efficacy reported. **Permitted fungicides** - Bupirimate (NIMROD^, PER10979, expires Sep 2014) - Group 8 – good efficacy, minimal impact on most beneficial insects, moderate impact on predatory mites. - Potassium (various, PER13695, expires Sept, 2017) - Group 2 . - Trifloxystrobin (various, PER14050, expires June 2023) - Group 11 - Protected situations only, Bayer won't be registering. **Fungicide Gaps** No **Potential fungicide solutions** - **Non-chemical options** Various crop cultivation and management techniques.

Currently available fungicides

Disease Name	Active ingredient	WHP, days	Chemical group	Comments
Alternaria leaf blight	chlorothalonil	1	5	
	mancozeb + metalaxyl	7	M3+4	
	dimethomorph	7	40	Qld, NT only
	azoxystrobin (PER12998, Expires Sept 2014)	1	11	Greenhouse
Angular leaf spot (*Pseudomonas* sp.)	copper	1	1	
Anthracnose	chlorothalonil	1	5	
	copper	1	1	
	dimethomorph	7	40	Qld, NT only
	mancozeb	7	M3	
	mancozeb + metalaxyl-M (RIDOMIL^ GOLD MZ WG)	7	M3+4	
	oxadixyl+propineb	3	4+M3	
Bacterial leaf spot (*Xanthomonas* sp)	copper	1	1	
Botrytis rot	chlorothalonil	1	5	
	pyrimethanil (PER7909, Expires Sept	1	9	

Disease Name	Active ingredient	WHP, days	Chemical group	Comments
	2017)			
Damping off	metalaxyl	7	4	
Damping off (*Pythium* spp,, *Phytophthora* spp.	Metalaxyl-M	7	4	
Downy mildew	azoxystrobin	1	11	
	copper	1	1	
	copper + mancozeb	7	M1+M3	
	copper + metalaxyl-M (RIDOMIL^ GOLD PLUS)	7	4+M1	
	mancozeb	7	M3	
	mancozeb + metalaxyl	7	M3+4	
	metiram	2	M3	
	oxadixyl+propineb	3	4+M3	
	phosphorous acid	NR	33	
	propineb	3	3	
Grey mould	cyprodinil+ fludioxonil (SWITCH^)	3	9+12	
	penthiopyrad (FONTELIS^)	1(H), *(G)	7	
	cyprodinil+ fludioxonil (SWITCH^, PER11564, Expires Nov 2014)	3	9+12	
	captan (PER14326, Expires Nov 2016)	7	M4	Protected
	mancozeb (PER14046, Expires Mar 2018)	7	M3	
Gummy stem blight	azoxystrobin	1	11	
	chlorothalonil	1	5	
	copper	1	1	
	copper + mancozeb	7	M1+M3	
	dimethomorph	7	40	Qld, NT only
	mancozeb	7	M3	
	mancozeb + metalaxyl	7	M3+4	
	metiram	2	M3	
	oxadixyl+propineb	3	4+M3	
	Penthiopyrad (FONTELIS^)	1(H), *(G)	7	
Phytophthora soil fungus	metalaxyl	7	4	
Powdery mildew	azoxystrobin	1	11	
	boscalid + kresoxim-methyl	7	7+11	
	chlorothalonil	1	5	
	cyflufenamid (FLUTE^)	1	U6	
	fenarimol (RUBIGAN^)	3	3	
	hydrogen peroxide+ peroxyacetic acid (PERATEC^ PLUS)	1	M	
	metrafenone (VIVANDO^)	7	U8	
	penthiopyrad (FONTELIS^)	1(H), *(G)	7	
	proquinazid (TALENDO^)	1	13	Field only
	tea tree oil	NR	_	
	triadimefon	1	3	NSW, WA only
Powdery mildew (*continued*)	triadimenol	1	3	
	bupirimate (PER10979, Expires Sept 2014)	1	8	
	potassium bicarbonate (PER13695, Expires Sept 2017)	NR	2	

Disease Name	Active ingredient	WHP, days	Chemical group	Comments
	trifloxystrobin (PER14050, Expires Jun 2023)	3	11	Protected only
Rhizoctonia ground rot	chlorothalonil	1	5	
Septoria spot	mancozeb	7	M3	
Soil borne diseases incl *Fusarium*, Verticillium wilts, Rhizoctonia, Pythium	1,3-dichloropropene + chloropicrin	NR	8B	Pre-plant
Target leafspot	chlorothalonil	1	5	

NR = Not required
* = Dn not graze or cut for stockfood

4.2 Insects of Cucumber

Common name	Scientific name
HIGH PRIORITY	
Aphids - including Green peach aphid	*Myzus persicae*
Helioverpa	*Helicoverpa* spp.
Whiteflies - including Silverleaf, Greenhouse.	*Bemisia tabaci, Trialeurodes vaporariorum*
MODERATE PRIORITY	
Cucumber fly	*Bactrocera cucumis*
Cucumber moth	*Diaphania indica*
Fungus gnats	*Diptera*
Mites	*Acarina*
Thrips - other than WFT	*Thysanoptera*
Western flower thrips	*Frankliniella occidentalis*
LOW PRIORITY	
28-spotted potato ladybird	*Henosepilachna vigintisexpunctata*
Ants	*Formicidae*
Green vegetable bug	*Nezara viridula*
Jassids	*Cicadellidae*
Leafhoppers	*Cicadellidae*
Mealybugs	*Pseudococcidae*
Melon thrips	*Thrips palmi*
Pumpkin beetle	*Aulacophora hilaris*
Wingless grasshopper	*Phaulacridium vittatum*
Biosecurity risk	
None listed	

Decisions on priority pests can be difficult. As an example, **Fungas gnats** were considered a moderate priority in their own right but are important to control considering their duel role as root chewers during the larval stage and as vectors of *Fusarium* and *Pythium* spores. *Bacillus thuringiensis* is the only product registered to control Fungas gnats. There are no permitted products.

Western flower thrips (WFT) were considered a major issue by some growers. In Northern NSW, the warmer temperatures favour them all year round. They were also considered as major in the Adelaide plains. Abamectin, diazinon, fenamiphos, paraffinic oil, petroleum oil, spinetoram are registered for

control of WFT. However it is recognised that insecticide resistance is a problem and that crop and integrated management strategies, including farm hygiene, spray program care and monitoring.

4.2.1 High priority insects

Green peach aphid (*Myzus persicae*)

Aphids are sap-sucking insects that deposit a sugary waste that encourages the growth of a sooty mould.

Aphids can develop large colonies. They stunt young plants by sucking the sap and nutrients from leaves.

However the largest problem is contamination of produce, making it unsaleable. They also cause problems when they act as vectors for viruses.

Best management practice includes: the use of IPM compatible insecticides in combination with reliance on parasitic wasps. Beneficial species for controlling aphids - Brown lacewings, Hoverflies, Parasitic wasps and Ladybird beetles.

- Aphids are considered a major-moderate problem in many areas, although some growers have reported they are not significant in greenhouse cucumbers.
  - Can be a major vector for viral diseases - zucchini yellow mosaic virus and papaya ring-spot virus type W.
  - Aphid numbers can vary, but can be heavy.
  - Growers believe they currently have enough alternatives.

- Insecticides **registered** for the control of aphids in cucumber are:
  - Emulsifiable botanical oil (various) - contact insecticide
    - For use in cucurbits.
    - Occasionally used - only when needed.
    - Generally effective.
    - Also controls thrips and whiteflies.
    - Minimal impact on all beneficial insects.
  - Imidacloprid (various) - Group 4A contact and systemic insecticide.
    - Occasionally used - only when needed.
    - Very effective with quick knockdown.
    - Also controls thrips and whiteflies.
    - Moderately harmful to harmful to many beneficial insects.
  - Maldison (various) – Group 1B contact / systemic insecticide
    - For use in cucurbits against all aphids.
    - Mixed reports on efficacy
    - Moderately harmful to harmful to many beneficial insects.
  - Paraffinic oil / petroleum oil (various) – contact insecticide
    - For use in cucurbits against all aphids.
    - Occasionally used - only when needed.
    - Effective.
    - Also controls thrips and whiteflies.
    - Moderately harmful to some beneficial insects.
  - Pirimicarb (various) - Group 1A contact and systemic insecticide
    - Occasionally used - only when needed.
    - Registered for control of all aphids in cucurbits
    - Can be very effective but widespread resistance across Australia.
    - Minimal impact on most beneficial insects but harmful to Cucumeris which is used for thrips control

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

- Spirotetramat (MOVENTO^) – Group 23 contact and systemic insecticide
  - Use increasing due to resistance in some other products.
  - Registered for control of cotton aphid and green peach aphid in cucurbits.
  - Those that have used it say it is very effective.
  - Also controls thrips and whiteflies.
  - Moderately harmful to some beneficial insects.

- Sulfoxaflor (TRANSFORM^) – Group 4C insecticide
  - Field situations only.
  - May have adverse effects on parasitic wasps in IPM situations.
  - Registered for green peach aphid and melon (cotton) aphid in cucurbits

- No insecticides are listed for control of aphids in cucumber via **permit**.

- **Potential** insecticides for control of aphids in cucumber.
  - Cyantraniliprole (BENEVIA^) – Group 28 contact and systemic insecticide
    - Registered in cotton for control of sucking insects – silverleaf whitefly, cotton aphid (suppression only) and for chewing insects – Helicoverpa
    - Product being assessed at the APVMA. Residues studies, primarily from overseas, have been submitted for cucurbits, lettuce, peppers, tomatoes, melons, blueberries, pome and stone fruit, potatoes, beans, citrus, almonds, pecans, onion, leafy vegetables, brassica vegetables.
    - This is from the same group as Chlorantraniliprole so may have limited use for alternation.
    - The initial target Australian use pattern is not known
    - Dupont should be approached for consideration of minor crops in its development program
    - IR4 projects for various crops/thrips, beetles, leafminer, psyllids, whitefly

  - Flonicamid (new ISK/FMC product)– Group 9C
    - First registration application in assessment at APVMA. Likely first registration on cucurbits
    - Aphicide
    - IR4 project on cucumber / stink bugs, thrips, aphids
    - Overseas registrations on aphids / brassica vegetables, root vegetables, tuberous and corm vegetables, cucurbit vegetables, hops, leafy vegetables, fruiting vegetables, pome fruit and stone fruit

  - Metaflumizone (New BASF active) - Group 22B
    - Activity against Lepidoptera, Coleoptera, Hemiptera, Hymenoptera, Isoptera, and Diptera.
    - At this stage an active ingredient approval is in review at the APVMA
    - BASF could be approached for consideration of minor use crops in its development program. The Australian target use pattern is not known.

  - Pymetrozine has been suggested as a useful fit, especially with resistance to other products. There is a permit for control of silverleaf whitefly in cucurbits (PER13111)

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

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

All species of Helicoverpa have hairs protruding from each black (or white) dot.
Most obvious damage is caused by larvae that burrow directly into developing fruit causing holes in fruit to be unsaleable. Smaller larvae may cause pinprick holes which can act as entry points for disease. First stage larvae can damage flowers which decreases potential yield.

- Helicoverpa are considered a high priority problem in Qld and NT and a moderate problem in SA. Some growers have reported they are not significant in greenhouse cucumbers.
  - Parasites including Trichogramma wasps are key management tools.
  - Many soft options are available, but some are very expensive, restricting use.
  - Most insecticides used are narrow spectrum insecticides
  - Insecticide resistance has made Helicoverpa difficult to control.

- Insecticides **registered** for Helicoverpa control in cucumber:

  - *Bacillus Thuringiensis* var *Kurstaki* (Btk) (various) - Group I1C contact insecticide
    - Commonly used.
    - Very effective on small grubs, but needs regular reapplication.
    - Minimal impact on all beneficial insects.
  - Bifenthrin (various) - Group 3A contact / systemic insecticide
    - Occasionally used.
    - Not used in greenhouse crops
    - Very effective on all grubs.
    - Growers expressed concern that with a heavy reliance resistance may develop.
    - Harmful to many beneficial insects.
  - Carbaryl (various) - Group 1A contact and systemic insecticide
    - Not used.
    - Moderately harmful to harmful to many beneficial insects
  - Chlorantraniliprole (various, including CORAGEN^) - Group 28 contact and systemic insecticide
    - Occasionally used in some regions.
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects.
  - Chlorantraniliprole + Thiamethoxam (DURIVO^) - Group 4A + 28 contact and systemic insecticide
    - Controls a broad range of insect pests
    - Adds significantly to the cost of seedlings from nurseries.
    - Overuse should be avoided to reduce risk of resistance developing.
    - Moderately harmful to some beneficial insects
  - Flubendiamide (BELT^) – Group 28 contact and systemic insecticide
    - Residual activity
    - IPM fit
  - Helicoverpa NPV (various) – a biological insecticide
    - Commonly used.
    - Very effective on small grubs.
    - Minimal impact on all beneficial insects.
  - Methoxyfenozide (PRODIGY^) - Group 18 insect growth regulator
    - Field – label, protected – PER12391)
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects

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

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

- Insecticides available for the control of Helioverpa in cucumber via **permit:**
  - Methomyl (PER13395, expires Sep 2017) – Group 1B
    - Field only
    - Disruptive to beneficials but still used for ovacidal control

  - Methoxyfenozide (PRODIGY^) - Group 18 insect growth regulator (PER12391, expires Sep 2017)
    - Considered very effective but expensive.
    - Minimal impact on all beneficial insects.

- **Potential** insecticides for control of Helicoverpa:
  - Cyantraniliprole (BENEVIA^) – Group 28 contact and systemic insecticide
    - Registered in cotton for control of sucking insects – silverleaf whitefly, cotton aphid (suppression only) and for chewing insects – Helicoverpa
    - Product being assessed at the APVMA. Residues studies, primarily from overseas, have been submitted for cucurbits, lettuce, peppers, tomatoes, melons, blueberries, pome and stone fruit, potatoes, beans, citrus, almonds, pecans, onion, leafy vegetables, brassica vegetables.
    - This is from the same group as Chlorantraniliprole so may have limited use for alternation.
    - The initial target Australian use pattern is not known
    - Dupont should be approached for consideration of minor crops in its development program
    - IR4 projects for various crops/thrips, beetles, leafminer, psyllids, whitefly

  - Metaflumizone (New BASF active) - Group 22B
    - activity against important Lepidoptera, Coleoptera, Hemiptera, Hymenoptera, Isoptera, and Diptera.
    - New chemical class of insecticides, the semicarbazones, which block the voltage-dependent Na+ channel of susceptible insects.
    - At this stage an active ingredient approval is in review at the APVMA
    - BASF could be approached for consideration of minor use crops in its development program. The Australian target use pattern is not known

  - Novaluron - Group 15. Farmoz and United Phosphorous have approvals of this active
    - The status of development of an end use product is unknown.
    - The active is the subject of IR4 project work: cabbage / diamondback moth, cabbage looper, Lepidoptera; cauliflower / lepidoptera

Whiteflies: Silverleaf (*Bemisia tabaci*), Greenhouse (*Trialeurodes vaporariorum*)

Silverleaf whitefly was first detected in Australia in 1994. Adults are approximately 1 mm long and are a narrow white wedge-shaped insect. When an infested plant is disturbed the whiteflies can be seen to flutter out and rapidly resettle.

Adults feed and lay their eggs on the undersides of young leaves and a female can lay up to 160 eggs during a 60 day lifespan. The eggs turn from white to brown as they get close to hatching.

Whiteflies damage cucumbers by sucking enormous quantities of sap and covering plants with sticky honeydew. Black sooty mould grows over the honeydew.

Beneficial insects, play a very important role in the control of whitefly. Therefore any insecticide used in cucumber, needs to be compatible with these beneficial insects.

- Silverleaf whitefly is considered a major problem in NSW and Qld and moderate in SA and WA.
- Greenhouse whiteflies are a major problem and are more important than silverleaf whitefly in greenhouse cucumber production. However some growers commented that silverleaf whitefly is more difficult to kill than greenhouse whitefly.
    - Growers report that some products are suffering from resistance issues.

- Insecticides registered for the control of whitefly in cucumber:
    - Emulsifiable botanical oil (various) - contact insecticide.
        - Greenhouse whitefly only.
        - Occasionally used - only when needed.
    - Chlorpyrifos (various) – Group 1B contact and systemic insecticide
        - General whitefly claim
        - Insecticide under review by APVMA
    - Imidacloprid (various) - Group 4A contact and systemic insecticide
        - Most commonly used insecticide for whitefly.
        - Registered for greenhouse and silverleaf whitefly.
        - Some growers use multiple applications, some through drippers.
        - Growers expressed concern that with overuse and a heavy reliance that resistance may develop.
        - Very effective.
        - Moderately harmful to harmful to many beneficial insects.
    - Paraffinic oil (various) – contact insecticide
        - Occasionally used.
        - Reported as not very effective, but offers short term suppression.
        - Silverleaf whitefly but not greenhouse whitefly registration.
        - Moderately harmful to some beneficial insects.
    - Potassium salts of fatty acids (various) – contact biological insecticide
        - Permit for use in greenhouse cucumber only.
        - Greenhouse and silverleaf whitefly.
        - Occasionally used.
        - Reported as effective, but only offers short term control.
        - Minimal impact on most beneficial insects.
    - Pyrethrins+piperonyl butoxide (various) – Group 3A contact insecticide
        - Good knockdown
        - Harmful to beneficials
    - Spirotetramat (MOVENTO^) – Group 23 contact and systemic
        - Occasionally used.
        - Very effective.
        - Reported as expensive.
        - Also controls other pests.
        - Moderately harmful to some beneficial insects.
    - Sulfoxaflor (TRANSFORM^) – Group 4C insecticide
        - Field situations only.
        - Registered for control of greenhouse whitefly.
        - May have adverse effects on parasitic wasps in IPM situations.

- Insecticides listed for the control of greenhouse and silverleaf whitefly in cucumber via **permit**:
    - Bifenthrin (various, PER12947, expires Apr 2015) - Group 3A contact and systemic insecticide
        - Silverleaf whitefly only
        - Occasionally used.
        - Need to be used with activator - PBO.
        - Permit for protected cropping only. Growers reported it was not used in greenhouse crops.
        - Harmful to harmful to many beneficial insects.

- Emulsifiable botanical oil (various, PER14077, Expires Sep 2023) - contact insecticide.
  - Permit for use in greenhouse cucumber, silverleaf whitefly only.
  - Occasionally used - only when needed.
  - Reported as not very effective, but offers short term suppression.
  - Moderately harmful to harmful to many beneficial insects.
- Petroleum oil (various, PER12221, Expires Nov 2017) – contact insecticide
  - Occasionally used.
  - Reported as not very effective, but offers short term suppression.
  - Also controls other pests.
  - Moderately harmful to some beneficial insects.
- Pymetrozine (various, PER13111, expires May 2014) – Group 9B contact and systemic insecticide
  - Permit for cucurbits.
  - Occasionally used.
  - Very effective.
  - Minimal impact on most beneficial insects.

- Potential insecticides for control of whitefly in cucumbers

  There are now a number of registrations and permits. The greatest need is to manage their use to avoid resistance.

  - Chlorantraniliprole + thiamethoxam (DURIVO^) is registered for control of silverleaf whitefly in a large number of crops, but not in cucurbits. It would also be efficacious in cucurbits but may not necessary to request this additional active combination. It is also likely to be unwise from the perspective of resistance management for the product.

  - Cyantraniliprole (BENEVIA^) – Group 28 contact and systemic insecticide
    - Registered in cotton for control of sucking insects – silverleaf whitefly, cotton aphid (suppression only) and for chewing insects – Helicoverpa
    - Product being assessed at the APVMA. Residues studies, primarily from overseas, have been submitted for cucurbits, lettuce, peppers, tomatoes, melons, blueberries, pome and stone fruit, potatoes, beans, citrus, almonds, pecans, onion, leafy vegetables, brassica vegetables.
    - This is from the same group as Chlorantraniliprole so may have limited use for alternation.
    - The initial target Australian use pattern is not known
    - Dupont should be approached for consideration of minor crops in its development program
    - IR4 projects for various crops/thrips, beetles, leafminer, psyllids, whitefly
    - Similar comments to DURIVO with regard to resistance

  - Metaflumizone (New BASF active) - Group 22B
    - Activity against Lepidoptera, Coleoptera, Hemiptera, Hymenoptera, Isoptera, and Diptera.
    - At this stage an active ingredient approval is in review at the APVMA
    - BASF could be approached for consideration of minor use crops in its development program. The Australian target use pattern is not known

  - Novaluron - Group 15. Farmoz and United Phosphorous have approvals of this active. The status of development of an end use product is unknown. The active is the subject of IR4 project work: cucumber / whitefly. Efficacy and residue work would be required.

4.2.2 Summary

High Priority Insects and control options

There are a considerable number of insecticides registered for use in cucumbers, including the new entrants to the market: chlorantraniliprole (CORAGEN^), flubendiamide (BELT^) and sulfoxaflor (TRANSFORM^). So for some pests, growers have reasonable options for developing a treatment schedule with good alternation of products from different chemical groups. It is expected that the use of this chemistry will be carefully managed - the industry has observed the benefits of IPM techniques, both in reducing pest problems and as a means of reducing resistance risks that come from overuse of chemicals.

There are no or limited chemicals permitted for a number of the lesser pests of cucumbers. Growers must rely on control by other chemicals already being used in the crop. This can be difficult when the management strategy is not targeted to the problem.

Insect	Control option
Aphids including Green peach aphid (*Myzus persicae,)*	**Currently registered insecticides** - Emulsifiable botanical oil (various) - Occasionally used, good IPM fit. - Imidacloprid (various) - Group 4A - very effective but moderately harmful to harmful to many beneficial insects. - Dimethoate (various registered products) – effective but not IPM compatible - Maldison (various) – Group 1B - effective but not IPM compatible - Paraffinic oil / petroleum oil (various) – efficacious but moderately harmful to beneficials. - Pirimicarb (various) - Group 1A - can be very effective but widespread resistance across Australia. - Potassium salts of fatty acids (various) – minimal impact on beneficials. - Pyrethrins+piperonyl butoxide – Group 3 - Spirotetramat (MOVENTO^) – Group 23 – use increasing, moderately harmful to some beneficial insects. - Sulfoxaflor (TRANSFORM^) – Group 4C – new in market, field situations only. **Currently permitted insecticides** None **Insecticide Gaps** Alternates with good IPM fit. **Potential insecticide solutions** Flonicamid (new ISK/FMC product)– Group 9C – efficacy and residue data required. Pymetrozine (various) – IPM compatible, registered in other crops for aphids. **Non-chemical options** Best management practice includes the use of IPM compatible insecticides in combination with reliance on parasitic wasps.

Insect	Control option
Helicoverpa *Helicoverpa* spp.	**Currently registered insecticides** - Bacillus Thuringiensis (Bt) (various) - effective, IPM compatible. - Bifenthrin (various) - Group 3A – field only, efficacious but harsh on beneficials. - Carbaryl (various) - not used. - Chlorantraniliprole (various, including CORAGEN^) - effective, IPM compatible. - Flubendiamide (BELT^) - IPM fit. - Helicoverpa NPV (various) - effective on small grubs, IPM compatible. - Spinetoram (SUCCESS NEO^) - effective, common use, resistance issues. **Currently permitted insecticides** - Methomyl (PER13395) – Group 1B – field only - Methoxyfenozide (PRODIGY^) - Group 18 good efficacy and IPM fit. **Insecticide Gaps** Helicoverpa resistance to many chemicals. **Potential insecticide solutions** Metaflumizone (New BASF active). Novaluron - Group 15. Farmoz and United Phosphorous have approvals of this active. **Non-chemical options** IPM strategies to manage resistance. Parasites including Trichogramma wasps.
Whiteflies: Silverleaf (*Bemisia tabaci*), greenhouse (*Trialeurodes vaporariorum*)	**Currently registered insecticides** Chlorpyrifos (various) – general whitefly claim - Imidacloprid (various) - Group 4A - very effective but moderately harmful to harmful to many beneficial insects. - Paraffinic oil / petroleum oil (various) – efficacious but moderately harmful to beneficials. - Potassium salts of fatty acids (various) - Potassium salts of fatty acids (various) – minimal impact on beneficials. - Pyrethrins+piperonyl butoxide - Spirotetramat (MOVENTO^) – Group 23 – use increasing, moderately harmful to some beneficial insects. - Sulfoxaflor (TRANSFORM^) – Group 4C – new in market, field situations only. **Currently permitted insecticides** - Bifenthrin (various, PER12947, expires Apr 2015) - Group 3A - Silverleaf whitefly, protected only. - Emulsifiable botanical oil (various, PER14077, Expires Sep 2023) - greenhouse cucumber, silverleaf whitefly only. - Petroleum oil (various, PER12221, Expires Nov 2017) - offers short term suppression. - Pymetrozine (various, PER13111, expires May 2014) – Group 9B - very effective. **Insecticide Gaps** Sufficient registrations and permits now. **Potential insecticide solutions** None for short term. **Non-chemical options** IPM strategies – required to manage resistance.

Currently available insecticides

Insect Name	Active ingredient	WHP, days	Chemical group	Comments
28-spotted potato ladybird	carbaryl	NA	1A	
	maldison	3	1B	
Aphids	botanical oil	NR	oil	
	maldison	3	1B	
	paraffinic oil	1	oil	
	petroleum oil	1	oil	
	pirimicarb	2	1A	
	potassium salts of fatty acids	NR	_	
	pyrethrins+piperonyl butoxide	1	3A	
Armyworm	Bacillus thuringiensis kurstaki	NR	11	
	carbaryl	NA	1A	
Australian plague locust	carbaryl + chlorpyrifos + diazinon + maldison	SL	1A/1B	
Cabbage moth	Bacillus thuringiensis kurstaki	NR	11	
	trichlorfon	2		
Cabbage white butterfly	Bacillus thuringiensis kurstaki	NR	11	
	trichlorfon	2		
Caterpillars	diazinon	14	1B	
	pyrethrins+piperonyl butoxide	1	3A	
Cluster caterpillar	methomyl (PER13395)	3	1B	
	methoxyfenozide (PER12391)	_		
Cotton aphid	spirotetramat (MOVENTO^)	1	23	
Cucumber fly	maldison	3	1B	
Cucumber moth	bifenthrin	1	3A	
	chlorantraniliprole (CORAGEN^)	1 (H), 7 (G)	28	
	flubendiamide (BELT^)	1	28	
	methomyl (PER13395)	3	1B	
	permethrin	2	3A	
	spinetoram	3	5	
Cucurbit stemborer	carbaryl	NA	1A	
Cutworms	carbaryl	NA	1A	
	chlorpyrifos		1B	
	diazinon	14	1B	
	trichlorfon	2	1B	Qld, NT
European earwig	carbaryl	NA	1A	
European red mite	tebufenpyrad (PYRANICA^, PER13349, Expires Mar 2015, SA, WA, NT only)		21A	WA, SA, NT
Field crickets	chlorpyrifos	5	1B	Qld, WA
Fungus gnats	Bacillus thuringiensis berliner	NR	11	
	Bacillus thuringiensis israelensis (PER11472, expires May 2014)	NR	11	
Green mired	petroleum oil (PER12221, expires Nov 2017)	1	_	
Green peach aphid	imidacloprid	1	4A	
	spirotetramat (MOVENTO^)	1	23	
	sulfoxaflor (TRANSFORM^)	1	4C	Field
Green vegetable bug	carbaryl	NA	1A	
	maldison	3	1B	
	petroleum oil (PER12221, expires Nov 2017)	1	_	
Grey cluster bug	petroleum oil (PER12221, expires Nov 2017)	1	_	

Insect Name	Active ingredient	WHP, days	Chemical group	Comments
Helicoverpa	Bacillus thuringiensis kurstaki	NR	11C	
	bifenthrin	1	3A	
	carbaryl	NA	1A	
	chlorantraniliprole (CORAGEN^)	1 (H), 7 (G)	28	
	flubendiamide (BELT^)	1	28	
	helicoverpa NPV armigera	NR	_	
	methomyl (PER13395, expires Sep 2017)			
	methoxyfenozide (PER12391, expires Sep 2017))	NR(H), *(G)	18	
	spinetoram	3	5	
Jassids	maldison	3	1B	
Leafeating ladybirds	carbaryl	NA	1A	
Leafhoppers	maldison	3	1B	
	paraffinic oil	1		
	petroleum oil	1		
	pyrethrins+piperonyl butoxide	1	3A	
Lightbrown apple moth	Bacillus thuringiensis kurstaki	NR	11	
Loopers	alpha-cypermethrin (PER14433, Expires Jun 2017)	1	3A	Field
	Bacillus thuringiensis kurstaki	NR	11	
Mealybugs	chlorpyrifos	5	1B	
	potassium salts of fatty acids	NR	_	
Mediterranean fruit fly	maldison	3	1B	
Melon (cotton) aphid	sulfoxaflor (TRANSFORM^)	1	4C	Field
Mites	paraffinic oil	1	oil	
	petroleum oil	1	oil	
	potassium salts of fatty acids	NR	_	
Mites - redlegged earth mite	etoxazole (PER13304, Expires Jun 2018)	7	10B	
	maldison	3	1B	
Mites – two spotted	abamectin	3	6	
	bifenazate (PER12906, Expires Mar 2018)	7	2D	
	botanical oil	NS	oil	
	etoxazole (PER13304, Expires Jun 2018)	7	10B	
	tebufenpyrad (PYRANICA^, PER13349, Expires Mar 2015, SA, WA, NT only)		21A	WA, SA, NT
Mole crickets	chlorpyrifos	5	1B	Qld, WA
Nematodes	fenamiphos	84	1B	
Plant parasitic nematodes	1,3-dichloropropene + chloropicrin	NR	8B	
Potato moth (Leafminer)	carbaryl	NA	1A	
Pumpkin beetle	carbaryl	NA	1A	
	maldison	3	1B	
Queensland fruit fly	maldison	3	1B	
Rutherglen bug	carbaryl	NA	1A	
	maldison	3	1B	
	petroleum oil (PER12221, expires Nov 2017)	1	_	
	trichlorfon	2	1B	
Sucking insects et aphids, thrips	fenamiphos	84	1B	
Symphylans (garden centipedes)	1,3-dichloropropene + chloropicrin	NR	8B	
Tomato grub	methoxyfenozice (PER12391)	NR(H), *(G)	18	

Insect Name	Active ingredient	WHP, days	Chemical group	Comments
Thrips	potassium salts of fatty acids	NR	_	
	pyrethrins+piperonyl butoxide	1	3A	
Thrips	diazinon	14	1B	
	paraffinic oil	1	oil	
	petroleum oil	1	oil	
Thrips - Plague	alpha-cypermethrin (PER14433, Expires Jun 2017)	1	3A	Field
Thrips - Western flower thrips	abamectin	3	6	
	spinetoram	3	5	
Tomato grub	methoxyfenozide	_		Protected
Vegetable weevil	alpha-cypermethrin (PER14433, Expires Jun 2017)	1	3A	Field
	chlorpyrifos		1B	Qld, WA
Vine moth	bacillus thuringiensis kurstaki	NR	11C	
Whiteflies	chlorpyrifos	5	1B	
	potassium salts of fatty acids	NR	_	
	pyrethrins+piperonyl butoxide	1	3A	
Whitefly - Greenhouse	botanical oil	NR	oil	
	fatty acids - K salt (PER13920, Expires Mar 2018)	_	_	Glasshouse, hydroponic
	sulfoxaflor (TRANSFORM^)	1	4C	Field
Whitefly - Silverleaf	botanical oil (PER14077, Expires Sept 23)	NR	_	Greenhouse, hydroponic
	Potassium salts of fatty acids	NR	_	
	imidacloprid	1	4A	
	paraffinic oil			
	pymetrozine (PER13111, Expires May 2014)	3	9B	
	spirotetramat (MOVENTO^)	1	23	
	bifenthrin (PER12947, Expires Apr 2015)	1	3A	Protected
Whiteflies: Greenhouse whitefly, Bemisia tabaci species (Sweet potato whitefly, Silverleaf whitefly B biotype and Whitefly Q biotype)	petroleum oil (PER12221, Expires Nov 2017)	1	_	
Wingless grasshopper	carbaryl	NA	1A	
Wireworms	1,3-dichloropropene + chloropicrin	NR	8B	

(H)=Harvest
(G)= Grazing
NR= not required
*= do not graze or cut for stockfood

4.3 Weeds of cucumber

No weeds were reported as a high priority for new registrations or permits.

Herbicides **registered** and used in cucumber:

- Clomazone (various) – Group F broad spectrum post-plant herbicide
  - Only used in field grown crops.
  - Rarely used as can cause crop phyto on sandy soils.
  - Controls most weeds.
- Fluazifop-P as butyl (various) – Group A grass selective post-emergent herbicide
  - Only used in field grown crops.
  - Commonly used.
  - Considered very effective.
  - It is used to spot spray grass weeds such as couch grass.
  - Controls most grass weeds.
- Glyphosate (various) – Group M pre-plant general knockdown herbicide
  - Only used in field grown crops.
  - Commonly used.
  - Works well as a pre-crop spray.
- Quizalofop-P-ethyl (various) - Group A grass selective post-emergent herbicide
  - Only used in field grown crops.
  - Rarely used.
  - Controls most grass weeds.
- Paraquat + diquat (various) - Group L pre-plant general knockdown herbicide
  - Only used in field grown crops.
  - Occasionally used.
  - Works well as a pre-crop spray
- Sethoxydim (various) - Group A grass selective post-emergent herbicide
  - Only used in field grown crops.
  - Rarely used.
  - Controls most grass weeds.

- No herbicides are listed for control of weeds in cucumber via **permit**.

Most weeds can be controlled with currently available herbicides.

For field cucumber growers reported that a pre-plant herbicide, generally a knock-down, was used to prepare the paddock. Growers then usually only spot spray grass weeds with a grass selective herbicide.

In protected situations weed mats are used rather than herbicides.

5. References

Information

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Acronyms

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

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

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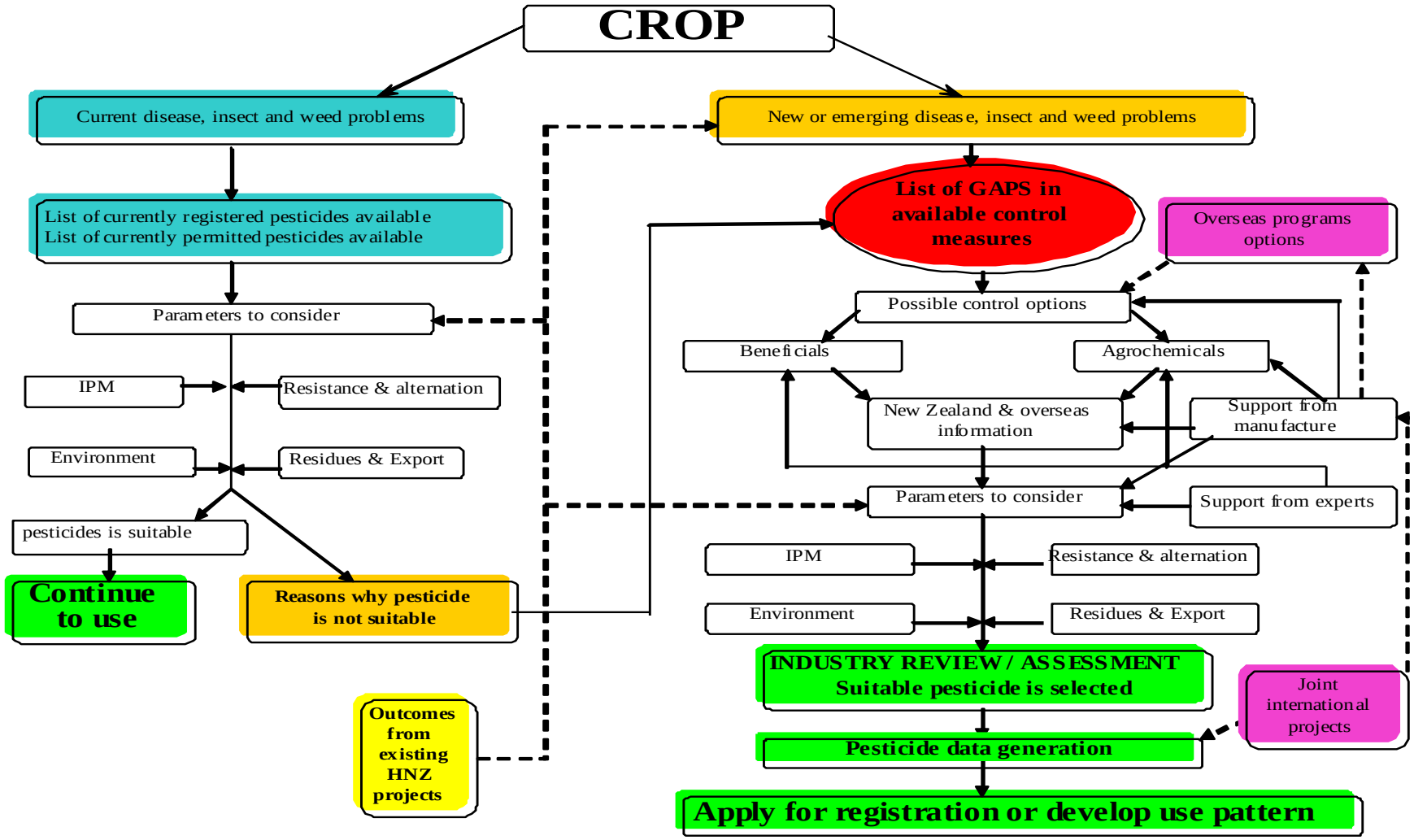
^Trademark

6. Appendices

DIAGRAM 1: The Strategic Agrichemical Review Process



Appendix 2 – currently available fungicides in cucumber.

Active ingredient	Disease Name	WHP, days	Chemical group	Comments
1,3-dichloropropene + chloropicrin	Soil borne diseases incl *Fusarium*, Verticillium wilts, Rhizoctonia, Pythium	NR	_	Pre-plant
azoxystrobin (PER12998, expires Sept 2014)	Alternaria leaf spot	1	11	Greenhouse
azoxystrobin	Downy mildew			
	Gummy stem blight			
	Powdery mildew			
boscalid + kresoxim-methyl	Powdery mildew	7	7+11	
bupirimate (PER10979, expires Sept 2014)	Powdery mildew	1	8	
captan (PER14326, expires Nov 2016)	Grey mould	7	M4	Protected
chlorothalonil	Alternaria leaf blight	1	5	
	Anthracnose			
	Botrytis rot			
	Gummy stem blight			
	Powdery mildew			
	Rhizoctonia ground rot			
	Target leafspot			
copper	Angular leaf spot (Pseudomonas sp.)		1	
	Anthracnose			
	Bacterial leaf spot (Xanthomonas sp)			
	Downy mildew			
	Gummy stem blight			
copper + mancozeb	Downy mildew	7	M1+M3	
	Gummy stem blight			
copper + metalaxyl-M (RIDOMIL GOLD PLUS)	Downy mildew		4+M1	
cyflufenamid (FLUTE)	Powdery mildew	1	U6	
cyprodinil+ fludioxonil (SWITCH)	Grey mould	3	9+12	
dimethomorph	Alternaria leaf spot	7	40	Qld, NT only
	Anthracnose			
	Gummy stem blight			
fenarimol (RUBIGAN)	Powdery mildew	3	3	
hydrogen peroxide+ peroxyacetic acid (PERATEC PLUS)	Powdery mildew	1	M	
mancozeb (PER14046, expires Mar 2018)	Grey mould	7	M3	
mancozeb	Anthracnose			
	Downy mildew			
	Gummy stem blight			
	Septoria spot			
mancozeb + metalaxyl	Alternaria leaf blight		M3+4	
	Downy mildew			
	Gummy stem blight			
mancozeb + metalaxyl-M (RIDOMIL GOLD MZ WG)	Anthracnose			
metalaxyl	Damping off		4	
	Phytophthora soil fungus			

Active ingredient	Disease Name	WHP, days	Chemical group	Comments
metalaxyl-M	Damping off (P*ythium* spp,, Phytophthora spp.	7	4	
metiram	Downy mildew	2	M3	
	Gummy stem blight			
metrafenone (VIVANDO)	Powdery mildew	7	U8	
oxadixyl+propineb	Anthracnose	3	4+M3	
	Downy mildew			
	Gummy stem blight			
penthiopyrad (FONTELIS)	Grey mould	1(H), *(G)	7	
	Gummy stem blight			
	Powdery mildew			
phosphorous acid	Downy mildew	NR	33	
potassium bicarbonate (PER13695, expires Sept 2017)	Powdery mildew	NR	2	
propineb	Downy mildew	3	3	
proquinazid (TALENDO)	Powdery mildew	1	13	Field only
pyrimethanil (PER7909, expires Sept 2017)	Botrytis rot	1	9	
tea tree oil	Powdery mildew	NR	_	
triadimefon	Powdery mildew	1	3	NSW, WA only
triadimenol	Powdery mildew	1	3	
trifloxystrobin (PER14050, expires Jun 2023)	Powdery mildew	3	11	Protected only

NR = Not required

* = Do not graze or cut for stockfood

Appendix 3 – currently available insecticides in cucumber.

Active ingredient	Insect Name	WHP, days	Chemical group	Comments
1,3-dichloropropene + chloropicrin	Plant parasitic nematodes	NR	8B	
	Symphylans (garden centipedes)			
	Wireworms			
abamectin	Two-spotted (Red spider) mite	3	6	
	Western flower thrips			
alpha-cypermethrin (PER13090, expires May 2015)	Loopers	1	3A	Field
alpha-cypermethrin	Vegetable weevil			
	Plague thrips			
Bacillus thuringiensis berliner	Fungus gnats	NR	11	
Bacillus thuringiensis israelensis (PER11472, expires May 2014)	Fungus gnats			
Bacillus thuringiensis kurstaki	Armyworm			
	Helicoverpa (Corn bollworm)			
	Helicoverpa punctigera (Native budworm)			
	Cabbage moth			
	Cabbage white butterfly			
	Loopers			
	Lightbrown apple moth			
	Vine moth			
bifenazate (PER12906, expires Mar 2018)	Two-spotted (Red spider) mite	7	2D	
bifenthrin	Cucumber moth	1	3A	
	Helicoverpa (Corn earworm)			
	Native budworm			
bifenthrin (PER12947, expires Apr 2015)	Silverleaf whitefly (Biotype B)	1	3A	Protected
botanical oil	Aphids	NR	oil	
	Greenhouse whitefly			
botanical oil (PER14077, expires Sept 23)	Silverleaf whitefly	NR	_	Greenhouse, hydroponic
botanical oil	Two-spotted mite	NS	_	
carbaryl	28-spotted potato ladybird	NA	1A	
	Armyworms			
	Cucurbit stemborer			
	Cutworms			
	European earwig			
	Green vegetable bug			
	Helicoverpa (Budworms)			
	Leafeating ladybirds			
	Potato moth (Leafminer)			
	Pumpkin beetle			
	Rutherglen bug			
	Wingless grasshopper			
carbaryl + chlorpyrifos + diazinon + maldison	Australian plague locust	SL	1A/1B	
chlorantraniliprole (CORAGEN)	Cotton bollworm (Helicoverpa armigera)	1 (H), 7 (G)	28	
	Native budworm (Helicoverpa punctigera)			
	Cucumber moth (Diaphania indica)			

Active ingredient	Insect Name	WHP, days	Chemical group	Comments
chlorpyrifos	Cutworms	5	1B	
	Field crickets			Qld, WA
	Mealybugs			
	Mole crickets			Qld, WA
	Vegetable weevil			Qld, WA
	Whiteflies			
diazinon	Caterpillars	14	1B	
	Cutworms			
	Thrips			
etoxazole (PER13304, expires Jun 2018)	Two spotted mites	7	10B	
	Red spider mite			
fenamiphos	Nematodes	84	1B	
	Sucking insects et aphids, thrips			
flubendiamide (BELT)	Helicoverpa	1	28	
	Cucumber moth			
helicoverpa NPV armigera	Helicoverpa (Corn earworm)	NR	_	
	Native budworm			
imidacloprid	Green peach aphid	1	4A	
	Silverleaf whitefly			
maldison	28-spotted potato ladybird	3	1B	
	Aphids			
	Cucumber fly			
	Green vegetable bug			
	Jassids			
	Leafhoppers			
	Mediterranean fruit fly			
	Pumpkin beetle			
	Queensland fruit fly			
	Redlegged earth mite			
	Rutherglen bug			
methomyl (PER13395)	Cucumber moth	3	1B	
	Cluster caterpillar			
	Helicoverpa			
methoxyfenozide (PER12391)	Native budworm	NR(H), *(G)	18	
	Tomato grub			
	cluster caterpillar			
paraffinic oil	Aphids	1		
	Leafhoppers			
	Mites			
	Thrips			
	Silverleaf whitefly			
petroleum oil	Aphids	1	_	
	Leafhoppers			
	Mites			
	Thrips			
petroleum oil (PER12221, expires Nov 2017)	Whiteflies: Greenhouse whitefly, Bemisia tabaci species (Sweet potato whitefly, Silverleaf whitefly B biotype and Whitefly Q biotype)			
	Green mired			
	Green vegetable bug			
	Grey cluster bug			
	Rutherglen bug			
pirimicarb	Aphids	2	1A	

Active ingredient	Insect Name	WHP, days	Chemical group	Comments
potassium salts of fatty acids	Aphids	NR	_	
	Mealybug			
	Thrips			
	Two spotted mite / spider mite			
	Whitefly			
pymetrozine (PER13111, expires May 2014)	Silverleaf whitefly	3	9B	
pyrethrins+piperonyl butoxide	Ants	1	3A	
	Aphids			
	Caterpillars			
	Leafhoppers			
	Thrips			
	Whiteflies			
spinetoram	Cucumber moth	3	5	
	Helicoverpa (Budworms)			
	Western flower thrips			
spirotetramat (MOVENTO)	Cotton aphid	1	23	
	Green peach aphid			
	Silverleaf whitefly			
sulfoxaflor (TRANSFORM)	Green peach aphid	1	4C	Field
	Melon (cotton) aphid			
	Greenhouse whitefly			
tebufenpyrad (PYRANICA, PER13349, expires Mar 2015)	European red mite	14	21A	WA, SA, NT
	Two-spotted (Red spider) mite			
trichlorfon	Cutworms	2	1B	Qld, NT
	Cabbage white butterfly			
	Cabbage moth			
	Rutherglen bug			

NR = not required

Appendix 4 – currently available herbicides in cucumber.

Active ingredient	Chemical group
aminopyralid + picloram	I
clomazone	Q
dicamba	I
diquat + paraquat	L
fluazifop	A
picloram + triclopyr	I
quizalofop	A