GROWER GUIDE

American Serpentine Leafminer, Serpentine Leafminer, and Vegetable Leafminer

FOR ONIONS

KEY POINTS

Three new species of *Liriomyza* leafminer flies are now present in Australia:
American Serpentine Leafminer (ASLM (*Liriomyza trifolii*))
Serpentine Leafminer (SLM (*Liriomyza huidobrensis*))
Vegetable Leafminer (VLM (*Liriomyza sativae*))

- They all feed on many plants and will likely affect most commercial crops (including onions).
- Damage on some commercial crops has been recorded from Qld, NSW, NT, WA and Vic.
- Experience from other countries shows us that overuse of chemical controls will backfire.
- IPM approaches are the most likely to be successful in managing these insects.

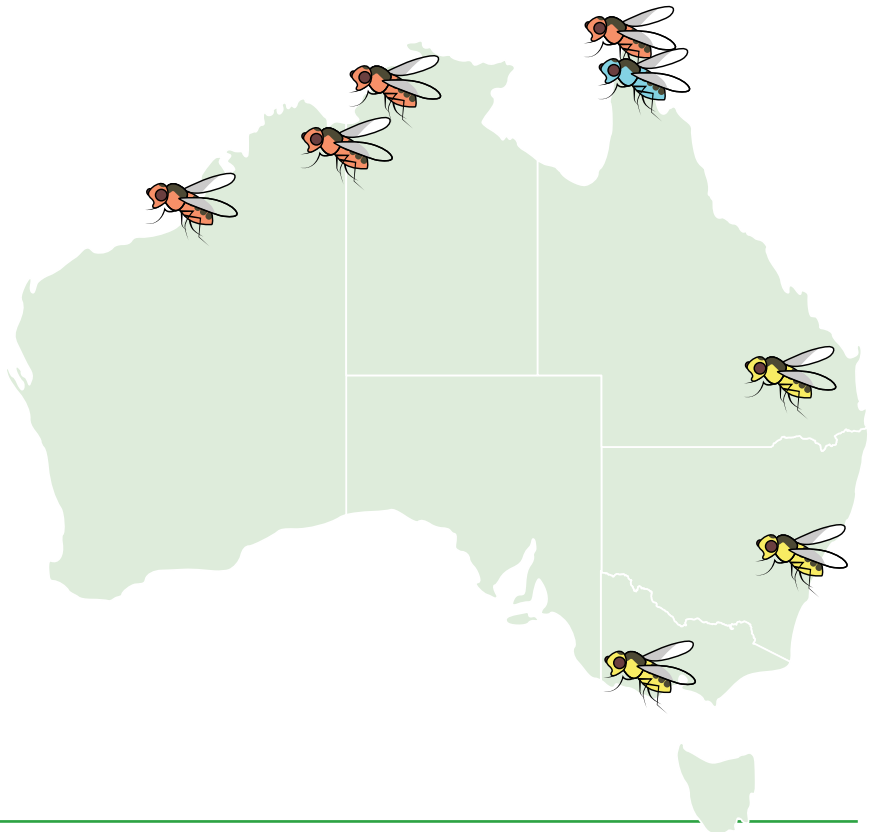
Hort Innovation

Current known distribution of the new leafminers as of 2023

Vegetable Leafminer
(first detected in Cape York, 2015)

Serpentine Leafminer
(first detected in the Sydney basin, 2020)

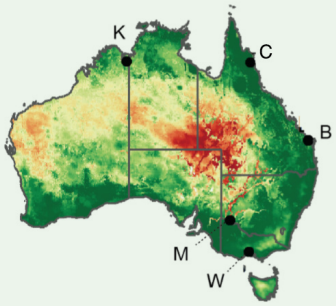
American Serpentine Leafminer
(first detected near Kununurra, 2021)



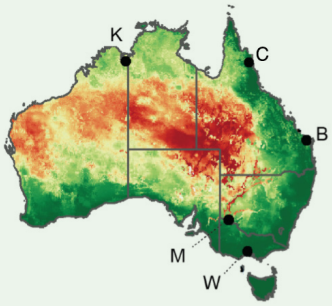
Seasonality

Each of the new leafminer species has a preferred climate suitability. Modelling has been prepared to show where and when each species is likely to be at its most active.

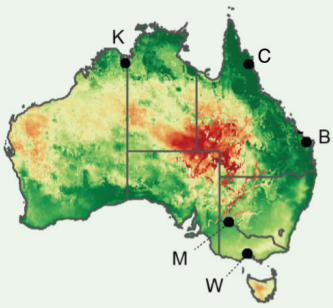
American Serpentine Leafminer



Serpentine Leafminer



Vegetable Leafminer



Number of days per year with predicted positive growth[1]

0 100 200 300

Key regions

B- Bundaberg
C- Cairns
K- Kununurra
M- Mildura
W- Werribee

1 Maino, J. et al. (2023) Austral Entomology, 62(1), 118–130.

Insect Life Cycle

Leafminers have four life cycle stages

- Typical leafminer lifecycle takes 13 to 43 days from eggs to adult emergence.
- Time taken to complete each life stage varies depending on temperature.
- Development rates become quicker as temperature increases, leading to overlapping generations.
- However, lethal temperature limits exist for each of these leafminer species:
  - ASLM 10°C and 35° C
  - SLM 5°C and 32°-35°C
  - VLM 10°C and 40°C

1 EGGS

Adult females create holes (stippling) when feeding and/or laying eggs.

2 LARVAE

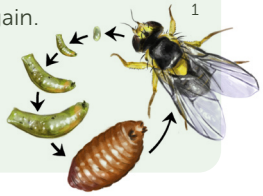
These eggs hatch after 2-5 days and the larvae tunnel through the leaves creating serpentine leaf mines predominantly on the upper surface of the leaf. This is the most damaging stage for onions.

3 PUPAE

The larvae then pupate, either on the leaf or in the soil.

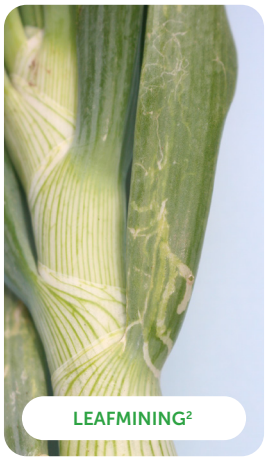
4 ADULTS

Adult flies then emerge from the pupae, mate, and lay eggs, beginning the cycle again.



Pest & Impact


STIPPLING[2]


LEAFMINING[2]


PUPAE[1]

Damage from leaf mining and feeding can cause premature leaf drop and also create points for secondary infection from fungi and bacteria.


ONION LEAVES WITH EXTENSIVE LEAFMINING AND SECONDARY INFECTION[2]

Some naturalised and recently established leafminer flies

	LOW ECONOMIC CONCERN				HIGH ECONOMIC CONCERN		
	 **Cabbage Leafminer**[1] *Liriomyza brassicae*	 **Chrysanthemum Leafminer**[2] *Chromatomyia syngenesiae*	 **Beet Leafminer**[5] *Liriomyza chenopodii*	 **Bean Fly**[6] *Ophiomyia phaseoli*	 **American Serpentine Leafminer**[4] *Liriomyza trifolii*	 **Serpentine Leafminer**[3] *Liriomyza huidobrensis*	 **Vegetable Leafminer**[1] *Liriomyza sativae*
MINE TYPE	Leaf	Leaf	Leaf	Leaf and Stem	Leaf	Leaf	Leaf
COMMON HOSTS	Brassicas, such as Broccoli, Chinese Cabbage, Kale and others	Sow thistle and other Asteraceae	Beets, Chickweed	Green beans and other Legumes	Chrysanthemums, Capsicum, Melons, Potatoes, and Beans	Celery, Pumpkin, Zucchini, Beans, and Potatoes	Melons, Beans, Tomatoes

1 Image credit: Dr Elia Pirtle, Cesar Australia
2 Image credit: John Duff (DAF Qld)
3 Image credit: Shannon Mulholland (DPI NSW)
4 Image credit: Kim Saligari (DPIRD WA)
5 Image credit: Peter Ridland, Univeristy of Melbourne
6 Image credit: Central Science Laboratory, York (GB), British Crown

Farm Biosecurity

How it spreads

Adult leafminers are generally considered poor flyers. The most likely cause of spread is as a hitchhiker on goods, aircrafts, vehicles, and the movement of plant material.

- Eggs and larvae may be spread via live plant material eg. cut flowers, leafy vegetables
- Pupae may be spread along with crop debris or soil or stuck on plant material at harvest

Consider which of these are relevant to your property!

Image credit: John Duff (DAF Qld)

Prevention of spread

Ensure you have a rigorous biosecurity plan in place that includes:

- Appropriate signage
- Boot sanitising stations
- Car cleaning stations
- Only purchasing farm inputs from reliable or certified sources
- Regular monitoring and surveillance of your crops
- Refusal of entry to anyone who refuses to comply with your biosecurity procedures

LEARN MORE

Information about how to maintain good on-farm biosecurity can be found online here

Download Guide

Monitoring Leafminers

- Conduct visual inspections of crops regularly, looking for stippling or leaf mining damage
- Use sticky traps to monitor for adult flies
- Visually inspect leaves to look for mines and larvae
- Inspect leaves and stems of plants for pupae that have stuck to the plant surface
- Use trays placed below crop canopies to monitor for pupae (this will only work for certain crops)

LEARN MORE

A concise guide to monitoring for leaf mining flies in Australia is available online here

Download Guide

Car Cleaning Stations

Sticky Traps

Field Surveillance

Integrated Pest Management

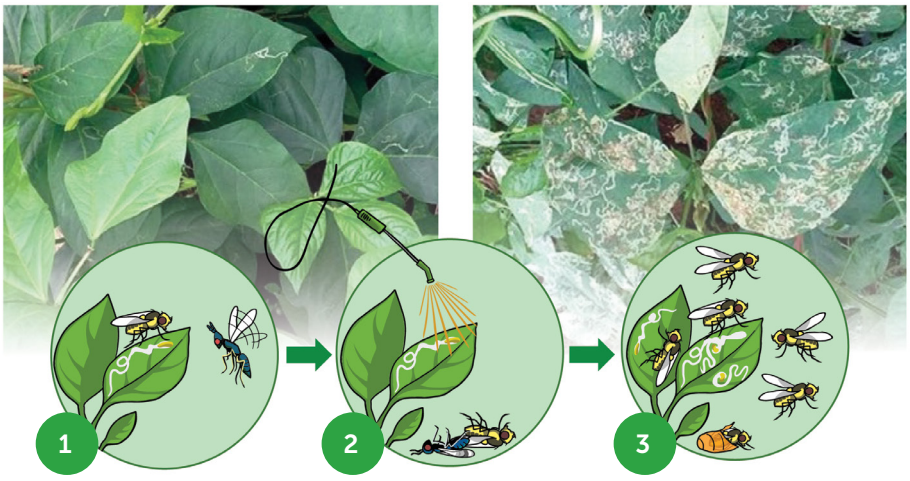
Foundations of an IPM approach

CULTURAL
Monitor pest and parasitoid activity to make informed management decisions.

CHEMICAL
Avoid a reliance on insecticides, especially broad-spectrum products. This has lead to insecticide resistance developing and a destruction of local beneficial insect populations. Consider softer option insecticides.

BENEFICIALS
Conserve beneficial natural enemies such as parasitoids. Learn the signs of parasitism of the larvae in the leaf mines. Collect pupae to determine the level of pupal parasitism. The signs of active parasitism will indicate some control of the leafminer population.

Only one of these bean plants has been treated with insecticide, but which one it is may surprise you.[1]



1 Parasitoid wasps naturally control leafminer flies.

2 Non-selective insecticides destroy parasitoid wasps but not all leafminer flies.

3 Without parasitoids, leafminer populations can grow substantially.

Leafminer outbreaks overseas

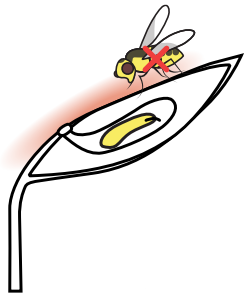
The plant on the right was treated weekly with insecticide sprays, but only accumulated heavy damage after treatment. This is a common problem overseas, where the excessive use of non-selective and broad spectrum insecticides leads to the destruction of parasitoid wasps, which are natural enemies of leafminers. Integrated pest management programs should prioritize conservation of parasitoids and consider all chemical use in a system.

Chemical management

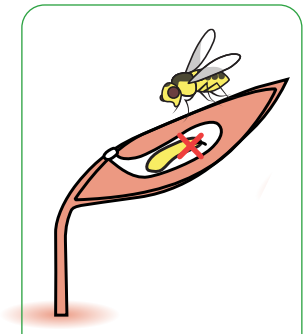
Leafminer species have developed resistance to many insecticides.
An integrated approach is necessary to prevent further resistance.
If chemical treatments are used, rotate mode of action groups and avoid broad-spectrum pesticides. Contact, systemic, and translaminar pesticides are effective on different stages. Biological control with parasitoid wasps is more effective. Avoid harming beneficial wasp populations.

Avoid leafminer outbreaks by monitoring during high risk periods and by using softer chemicals.
See table page 7.

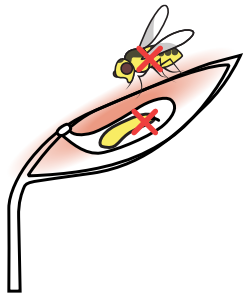
INSECTICIDE MODES [1]



CONTACT
Contact pesticides are effective against adults



SYSTEMIC
Systemic pesticides are effective against larvae



TRANSLAMINAR
Translaminar pesticides are effective against both adults and larvae

✕ Mortality of leafminer adult or larva

● Dispersal of chemical on/in plant tissue

1 Image credit: Dr Elia Pirtle, Cesar Australia

Natural control by beneficials

Parasitoid wasps

Parasitoid wasps are a natural way to control leafminers. Parasitoid wasps can reach the leafminer larvae within the leaf, laying their eggs on or in the larvae. They bring about mortality through parasitism or by direct feeding on the developing leafminer larvae. Field mortality rates can reach up to 80%.

Australia has at least 50 species of these wasps that attack native and exotic pests. Four are particularly good at targeting leafminer flies:

KEY PARASITOID WASPS THAT ATTACK LEAFMINER FLIES [1]

Opius spp.

- Larval/pupal parasitoid
- Recorded in all states
- At least three different species of this genus attack native leafminers in Australia.

Diglyphus isaea

- Larval parasitoid
- Present in southeastern Australia (but likely only recently established)
- Mass reared overseas for biological control

Hemiptarsenus varicornis

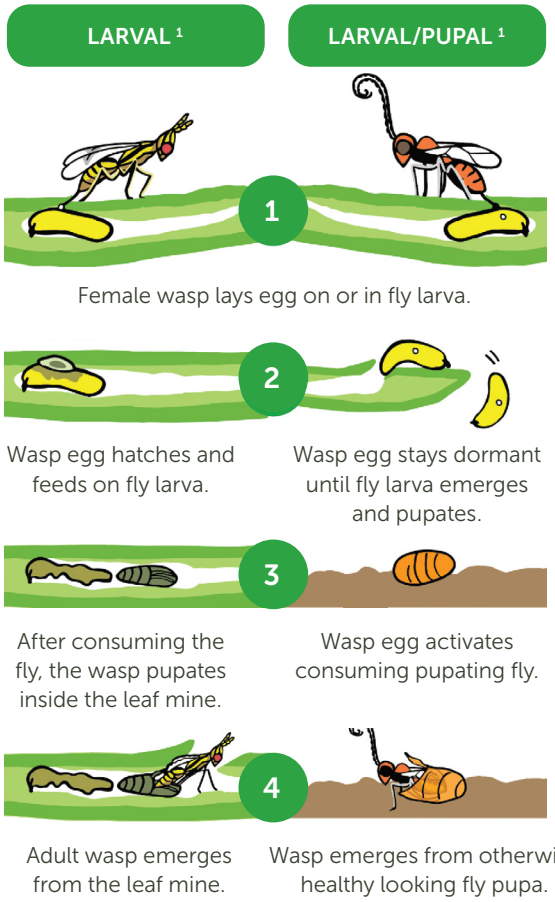
- Larval parasitoid
- Recorded in all states
- Important source of control overseas
- Early exploiter of new exotic leafminer

Zagrammosoma latilineatum

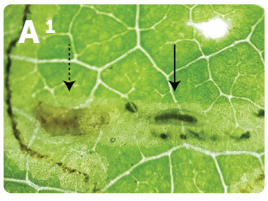
- Larval parasitoid
- Recorded in QLD, NSW, VIC, WA and NT
- Major source of leafminer control in Far North QLD
- Ecology and biology is poorly understood

Lifecycles of parasitoid wasps

Their lifecycles vary and can be classified as "larval" or "larval/pupal".



Look for signs of larval parasitism inside leaf mines with a hand lens (A and B). Pupae of leafminers parasitised with larval/pupal wasps will not show signs of parasitism until emergence of wasps from otherwise healthy looking leafminer pupae (C).



Parasitoid wasps are much smaller than a thumb tack.

1 Image and illustration credit: Dr Elia Pirtle, Cesar Australia
2 Image credit: Eddy Dunne (Total Grower Services Bundaberg)

Minor Use Permits Available for Leafminers† *(Liriomyza Species)*

✓ CURRENT PERMIT
O SUPPRESSION ONLY ^
✗ CROP MUST BE DESTROYED
FC FIELD CROPPING ONLY

Active Ingredient	Cyromazine	Chlorantraniliprole	Cyantraniliprole		Spirotetramat	Spinosad	Spinetoram		Abamectin	Emamectin Benzoate	Dimethoate	Thiamethoxam & Chlorantraniliprole
Mode of Action	17	28	28	28	23	5	5	5	6	6	1B	4B & 28
Activity	Translaminar	Systemic	Systemic	Systemic	Systemic & Translaminar	Contact & Systemic	Contact & Translaminar	Contact & Translaminar	Contact & Translaminar	Translaminar	Contact & Systemic	Systemic
Example Product	Diptex 150WP	Coragen	Benevia	Benevia	Movento 240 SC	Entrust	Success Neo	Success Neo	Vertimec	Warlock	Dimethoate 400	Durivo
Permit Number	PER81867	PER87631	PER93849	PER93850	PER88640	PER94331	PER87878	**PER94451**	PER81876	PER87563	PER89184	**PER94452**
Expiry	30/09/2026	31/03/2029	31/12/2026	31/12/2026	29/02/2026	30/04/2026	31/12/2027	**31/07/2027**	30/04/2024**	31/03/2029	31/03/2025	30/06/2026
Impact on Beneficials including parasitoids	LOW	LOW	LOW	LOW	LOW TO MOD	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	HIGH	HIGH
Brassica Veg*	✗							✓		O		
Broccoli	✓							✓		O		
Bulb Onions									O			
Bulb Vegetables			✓						O			
Cabbage (Head)	✗							✓	O	O		
Capsicums & Chillies			✓		O	✓		✓	O			
Celery				✓	O FC	✓		✓	O			
Corn			✓					✓				
Culinary Herbs						✓		✓				
Cucurbits	✓		✓			✓		✓	O			
Eggplant			✓		O	✓		✓	O			
Fruiting Veg#	✓		✓			✓		✓	O			
Snow & Sugar Snap Peas	✓				O	✓	✓		O			
Green Beans	✓				O FC	✓	✓		O			
Green Peas	✓					✓			O			
Leafy Brassicas	✗					✓		✓				
Leafy Vegetables+	✗					✓		✓	O			✓
Legume Vegetables	✓					✓			O			✓
Lettuce (Head)	✓				O *Inc. Leafy*	✓		✓				
Parsley					O	✓		✓				✓
Potatoes			✓			✓		✓				
Pulses	✓					✓			O		✓	
Rhurbard					O FC	✓		✓	O			
Root & Tuber Veg	✓					✓		✓	O			
Silverbeet & Spinach	✗	O				✓		✓	O			✓
Stalk & Stem Veg	✓					✓		✓				
Tomatoes			✓		O	✓		✓	O			

Disclaimer: This is a quick reference guide and omits certain elements included in minor use permits, such as jurisdictions and restraints. Every effort has been made to provide the most complete and up-to-date information as of publication date, however, we recommend you check the specific detals on the APVMA website in the hyperlinks provided.

† Current as of publication date.
* Excluding Broccoli
\# Excluding Cucurbits, Corn or Mushrooms
\+ Excluding Lettuce

^ Suppression denotes a level of effectiveness less than total control but still of economic benefit.
** Under review for by APVMA, due June 2024*

Trade & Movement Restrictions

There are currently movement restrictions in place to limit the spread of leafminers in Australia. Interstate trade regulations are updated regularly. Always check for the most current information with your relevant state government department.

FAR NORTHERN QUEENSLAND

Vegetable leafminer is a declared far northern QLD pest and is limited by the movement restrictions of the far northern biosecurity zones.

Learn More

WESTERN AUSTRALIA

In Western Australia movement of material that could potentially carry American Serpentine leafminer is restricted from the Shires of Broome, Derby West Kimberley, and Wyndham-East Kimberley into the rest of the state.

Learn More

Reporting Requirements

Some jurisdictions have legal requirements to report the detection of leafminers. You can report pests by calling the Exotic Plant Pest Hotline on 1800 084 881

STATE	VLM	SLM	ASLM
NSW	Reportable	Not Reportable	Reportable
NT	Reportable	Reportable	Not Reportable
SA	Reportable	Reportable	Reportable
QLD	Reportable	Not Reportable	Not Reportable
TAS	Not Reportable	Reportable	Not Reportable
VIC	Reportable	Not reportable	Reportable
WA	Reportable	Reportable	Reportable

Regardless of the legal requirements in your region, if you suspect a pest not currently known to be in your area, please take photos of the pest and call the Exotic Plant Pest Hotline on 1800 084 881

Acknowledgements

Management strategy for serpentine leafminer, *Liriomyza huidobrensis* (MT20005) is a strategic levy investment under the Hort Innovation Vegetable, Potato – Fresh and Potato – Processing, Onion and Melons Funds.

This project has been funded by Hort Innovation using the vegetable, potato, onion and melon research and development levies and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian horticulture.

Other Resources

MANAGEMENT OF LEAFMINING FLIES

A more in-depth guide to the management of leafmining flies is available here.

Download Guide

Queensland Government · Cesar Australia · AUSVEG · NSW Government Industry & Investment · The University of Melbourne · Northern Territory Government · Department of Primary Industries and Regional Development, Government of Western Australia

Hort Innovation MELON FUND — This project has been funded by Hort Innovation using the melon research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

Hort Innovation VEGETABLE FUND — This project has been funded by Hort Innovation using the vegetable research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au