

GROWER GUIDE

American Serpentine Leafminer, Serpentine Leafminer, and Vegetable Leafminer

FOR MELONS AND CUCURBITS



KEY POINTS



Three new species of *Liriomyza* leafminer flies are now present in Australia:

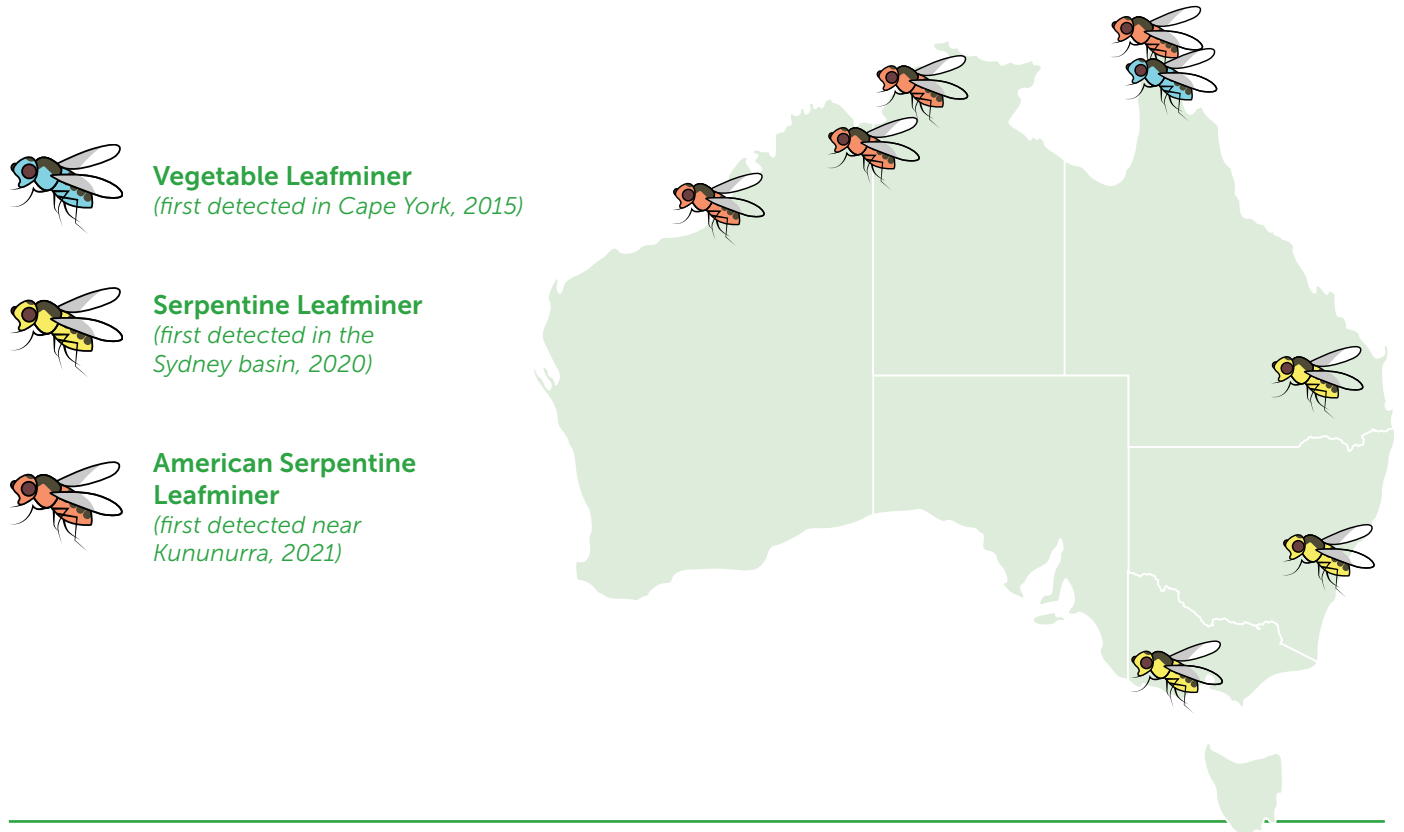
American Serpentine Leafminer (ASLM (*Liriomyza trifolii*))

Serpentine Leafminer (SLM (*Liriomyza huidobrensis*))

Vegetable Leafminer (VLM (*Liriomyza sativae*))

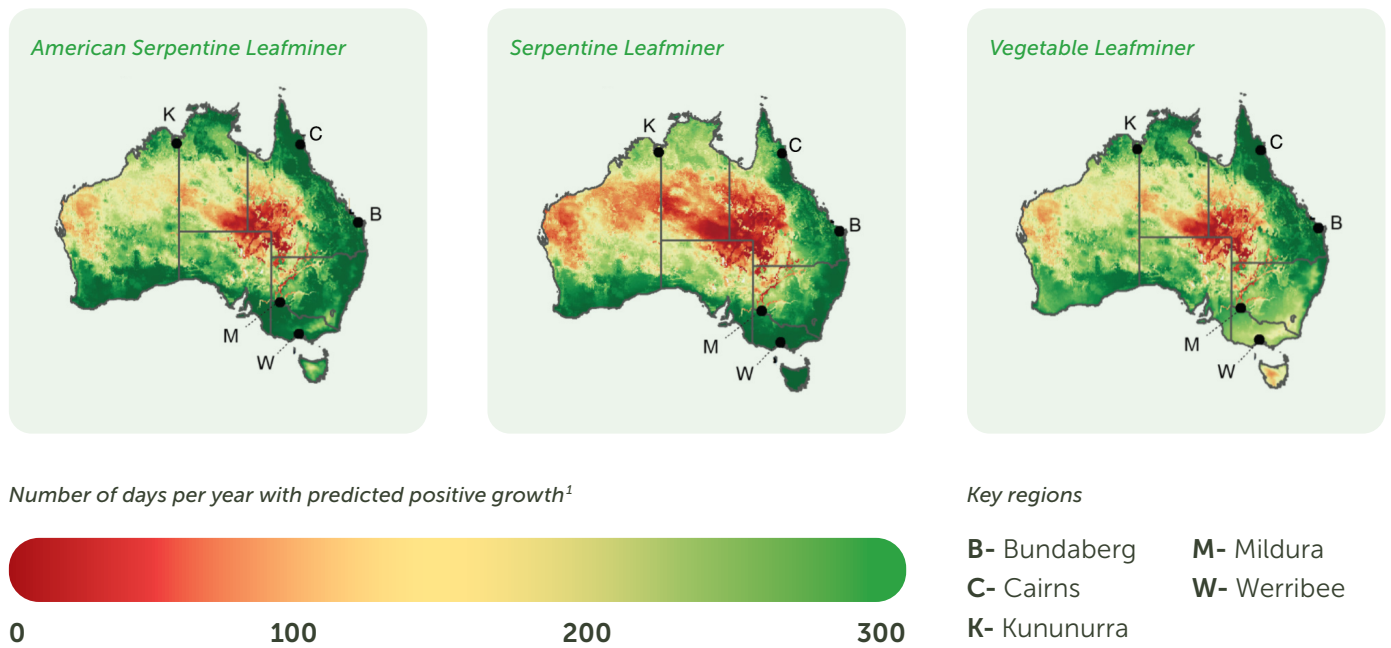
- They all feed on many plants and will likely affect most commercial crops (including melons and cucurbits).
- Damage on some commercial crops has been recorded from Qld, NSW, NT, WA and Vic.
- Experience from other countries shows us that overuse of chemical controls will backfire.
- IPM approaches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

Current known distribution of the new leafminers as of 2023



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.



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

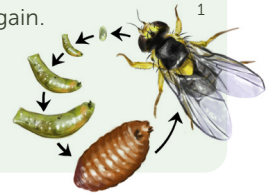
These eggs hatch after 2-5 days and the larvae tunnel through the leaves creating serpentine leaf mines predominantly on the upper surface of the leaf. This is the most damaging stage for melons and other cucurbits.

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



STIPPLING²



LEAFMINING³



PUPAE¹










Damage from leaf mining and feeding can cause premature leaf drop leading to sunburn of fruit, and also create points for secondary infection from fungi and bacteria.



MELON LEAVES WITH EXTENSIVE LEAFMINING AND SECONDARY INFECTION⁴

Some naturalised and recently established leafminer flies

| | LOW ECONOMIC CONCERN | | | | HIGH ECONOMIC CONCERN | | |
|---------------------|---|---|---|---|--|---|---|
| |  |  |  |  |  |  |  |
| | Cabbage Leafminer¹ <i>Liriomyza brassicae</i> | Chrysanthemum Leafminer² <i>Chromatomyia syngenesiae</i> | Beet Leafminer⁵ <i>Liriomyza chenopodii</i> | Bean Fly⁶ <i>Ophiomyia phaseoli</i> | American Serpentine Leafminer⁴ <i>Liriomyza trifolii</i> | Serpentine Leafminer³ <i>Liriomyza huidobrensis</i> | Vegetable Leafminer¹ <i>Liriomyza sativae</i> |
| 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, University 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

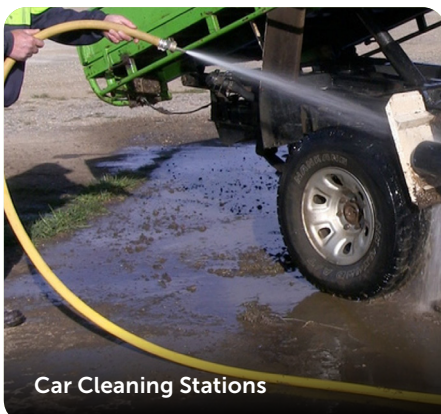
Information about how to maintain good on-farm biosecurity can be found online here

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



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

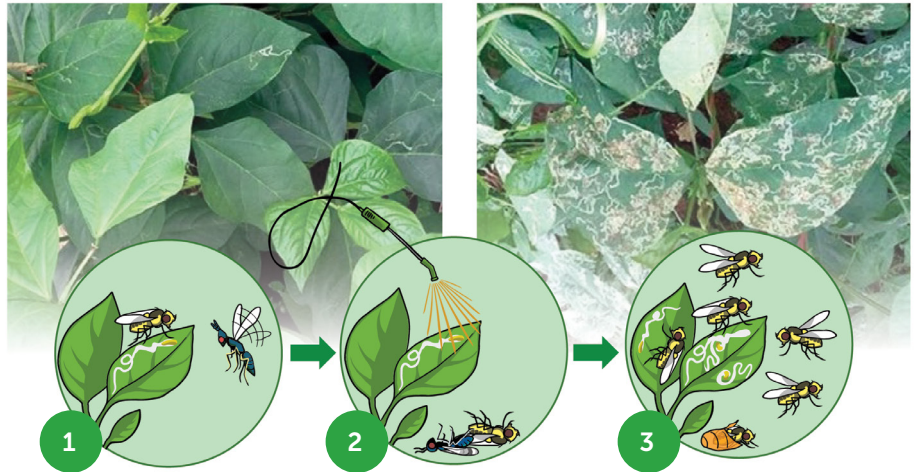
Avoid a reliance on insecticides, especially broad-spectrum products. This has led to insecticide resistance developing and a destruction of local beneficial insect populations. Consider softer option insecticides.

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 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.

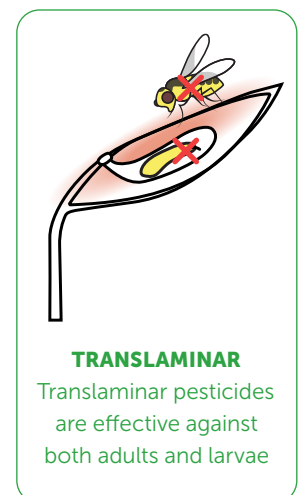
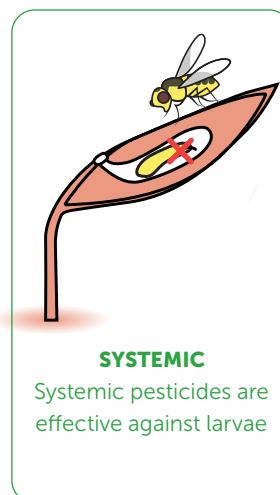
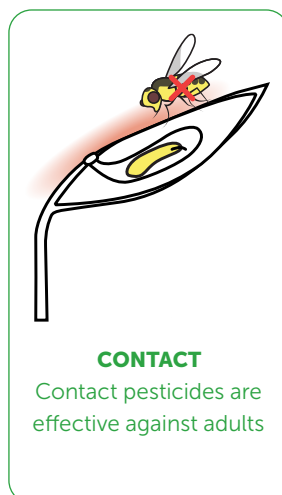
Chemical management

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



X 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 FLIES¹

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

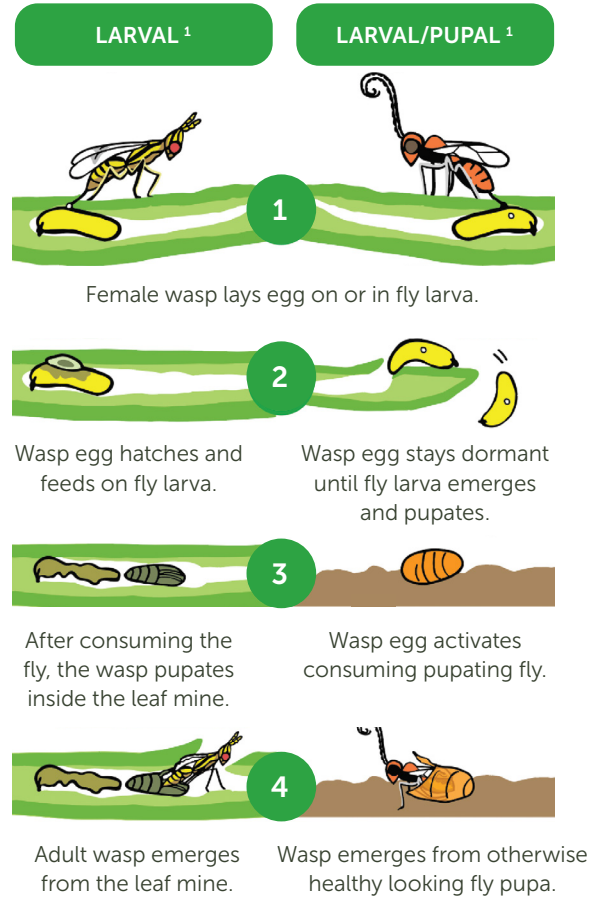
Zagrammosoma latilineatum



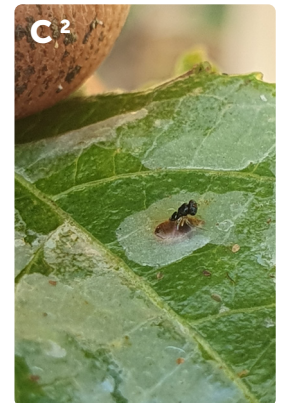
- Larval parasitoid
- Recorded in QLD, NSW, VIC, WA and NT
- Major source of leafminer control in Far North QLD
- Ecology and biology is poorly understood

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 ✗ CROP MUST BE DESTROYED
○ SUPPRESSION ONLY [^] **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 [*] | ✗ | | | | | | | ✓ | | ○ | | |
| Broccoli | ✓ | | | | | | | ✓ | | ○ | | |
| Bulb Onions | | | | | | | | | ○ | | | |
| Bulb Vegetables | | | ✓ | | | | | | ○ | | | |
| Cabbage (Head) | ✗ | | | | | | | ✓ | ○ | ○ | | |
| Capsicums & Chillies | | | ✓ | | ○ | ✓ | | ✓ | ○ | | | |
| Celery | | | | ✓ | ○ FC | ✓ | | ✓ | ○ | | | |
| Corn | | | ✓ | | | | | ✓ | | | | |
| Culinary Herbs | | | | | | ✓ | | ✓ | | | | |
| Cucurbits | ✓ | | ✓ | | | ✓ | | ✓ | ○ | | | |
| Eggplant | | | ✓ | | ○ | ✓ | | ✓ | ○ | | | |
| Fruiting Veg [#] | ✓ | | ✓ | | | ✓ | | ✓ | ○ | | | |
| Snow & Sugar Snap Peas | ✓ | | | | ○ | ✓ | ✓ | | ○ | | | |
| Green Beans | ✓ | | | | ○ FC | ✓ | ✓ | | ○ | | | |
| Green Peas | ✓ | | | | | ✓ | | | ○ | | | |
| Leafy Brassicas | ✗ | | | | | ✓ | | ✓ | | | | |
| Leafy Vegetables [*] | ✗ | | | | | ✓ | | ✓ | ○ | | | ✓ |
| Legume Vegetables | ✓ | | | | | ✓ | | | ○ | | | ✓ |
| Lettuce (Head) | ✓ | | | | ○ <i>Inc. Leafy</i> | ✓ | | ✓ | | | | |
| Parsley | | | | | ○ | ✓ | | ✓ | | | | ✓ |
| Potatoes | | | ✓ | | | ✓ | | ✓ | | | | |
| Pulses | ✓ | | | | | ✓ | | | ○ | | ✓ | |
| Rhubarb | | | | | ○ FC | ✓ | | ✓ | ○ | | | |
| Root & Tuber Veg | ✓ | | | | | ✓ | | ✓ | ○ | | | |
| Silverbeet & Spinach | ✗ | ○ | | | | ✓ | | ✓ | ○ | | | ✓ |
| Stalk & Stem Veg | ✓ | | | | | ✓ | | ✓ | | | | |
| Tomatoes | | | ✓ | | ○ | ✓ | | ✓ | ○ | | | |

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 details 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.



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.

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.