MANAGEMENT OF RECENTLY ESTABLISHED *LYRIOMYZA* LEAFMINERS

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

QUICK FACTS

- They all feed on many plants and will likely affect most commercial crops (such as potato, tomato and eggplant)
- 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 successfully manage these insects

CURRENT KNOWN DISTRIBUTION OF THE NEW LEAFMINERS

Vegetable Leafminer was first detected in 2015 at the tip of Cape York Peninsula in Queensland. No further detections have been made. SLM was first detected in western Sydney, New South Wales in October 2020 and a month later in Queensland's Fassifern Valley, followed by the Darling Downs and Lockyer Valley. SLM has since been detected in Victoria. ASLM was detected in July 2021 in the Torres Strait Islands and northern Western Australia. There have since been further detections in Kununurra (WA), Darwin and Katherine in the Northern Territory, and the Northern Peninsula Area of Cape York (Qld). There has been a single detection in Broome (WA).

RISK OF SPREAD AND ESTABLISHMENT

Major risk pathways of leafminers into and across Australia is by the importation of infested ornamental host plants and cut flowers. Leafy vegetables and seedlings can move leafminers across Australia. Natural pathways or human-assisted entry can also occur at the borders (e.g., on plant material illegally imported).

Globally, *Liriomyza* leafminer dispersal

- Vegetable leafminer (first detected in Cape York, 2015); (Cape York)
- Serpentine leafminer (first detected in the Sydney basin, 2020); (Sydney, Southeast Qld potentially Bundaberg, Werribee, Vic)
- American serpentine leafminer (first detected near Kununurra, 2021). (Kununurra, Darwin, Broome, Cape York)

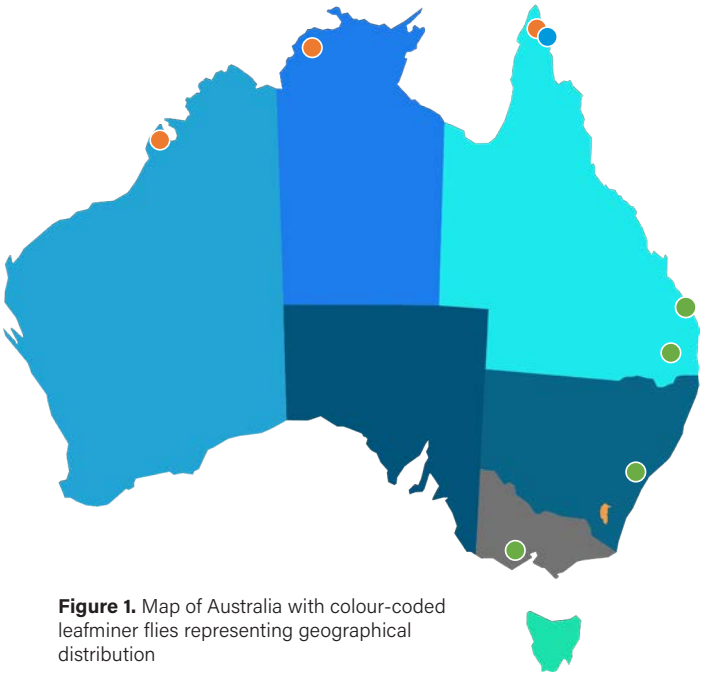


Figure 1. Map of Australia with colour-coded leafminer flies representing geographical distribution

and establishment has occurred rapidly, with populations found on most continents now. Many important vegetable production regions in Australia have the climatic conditions suited to *Liriomyza* spp. establishment.

In potatoes, feeding punctures are visible throughout the plant as it grows. Initial infestation begins in the lower third of the plant, which eventually leads to necrosis in the above-ground plant tissue and subsequent defoliation. Larval damage is worse in a fully-grown plant than in a developing plant. When the pest first became established in Indonesia, yield losses of up to 70 per cent were recorded as farmers struggled to control the pest with conventional insecticides. Potato growers in South America, particularly in Peru, Bolivia, Brazil, Chile and Argentina, have experienced substantial potato yield loss due to serpentine leafminer. In Peru, yield losses varied between potato varieties and greater yield losses were seen in earlier maturing potatoes (up to 60 per cent) than later maturing potatoes (up to 30 per cent). In Argentina, potatoes were severely damaged during tuber bulking but the severity of damage varied between provinces.

Climate models and existing pest knowledge have been used to determine the pest's establishment risk in regions across Australia. A predictive model based on temperature, moisture constraints and predicted dominant stressors (cold, heat, desiccation) was created by Cesar Australia as part of a levy-funded project, MT16004 which developed a contingency plan for each pest (see further reading at the end of this article).

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 (Figure 2).

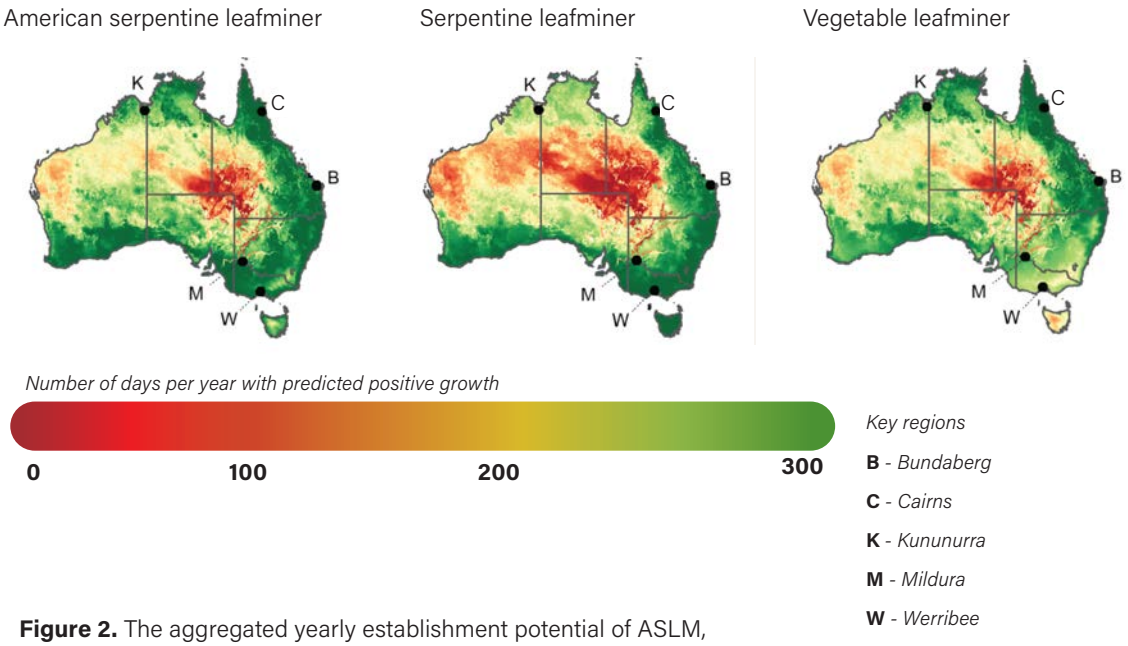


Figure 2. The aggregated yearly establishment potential of ASLM, SLM and VLM as the number of months across the year with increasing population sizes based on temperature and moisture constraints. Reference: Maino, J. et al. (2023) *Austral Entomol*, 62 (1), 118-130.

INSECT LIFE CYCLE

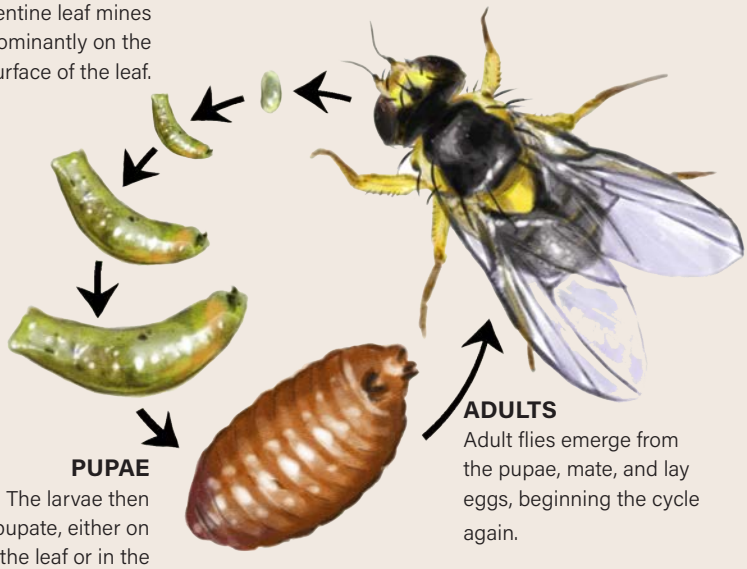
The life cycle for *Liriomyza* leafminers is generally consistent across species. Adult serpentine leafminers range from 1.3-2.3mm in length. The typical leafminer life cycle takes 13 to 43 days from eggs to adult emergence. The time taken to complete each life stage varies depending on temperature. 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

LIFE CYCLE STAGES

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.

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



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

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

Illustration by Elia Pirtle

IMPACT

Damage from leaf mining and feeding can cause premature leaf drop leading to an increased risk of secondary infection from fungi and bacteria.

'Stippling' damage (Fig. 3a), caused by adults feeding and/or laying eggs, is visible in the early stages of infestation and can lead to a high risk of plant fungal and bacterial infection. Eggs are too small to be seen by the naked eye, so a healthy-looking plant may harbour the pest without us knowing. Inside the leaf tissue, larvae begin to feed within the leaf, creating tunnels or mines that become larger as the larvae mature. These leaf mines can reduce photosynthetic activity, causing premature leaf drop. The most severe infestations usually occur late in the season and can affect large areas of the leaf (Fig. 3b). Damage from leaf mining and feeding can cause premature leaf drop leading to reduced yields, further impacted by secondary infection from fungi and bacteria (Fig. 3c). In warm areas and greenhouse production, damage may be more severe.

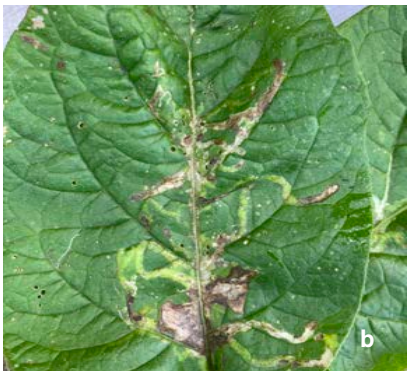


Figure 3. Damage caused by *Liriomyza* leafminers feeding on host plants: a) stippling damage caused by adult feeding and egg laying, b) mines caused by larvae feeding on potato leaf and opportunistic secondary infection, c) Severe infestation in potato crop leads to reduced photosynthetic capacity (Image credits: John Duff, Queensland DAF).

INTEGRATED PEST MANAGEMENT

Cultural: Monitor pest and parasitoid activity to inform management decisions.

To detect and monitor adults, look for stippling on leaves indicating adult leafminers. Yellow sticky cards can be placed at plant height and inspected at least twice weekly.

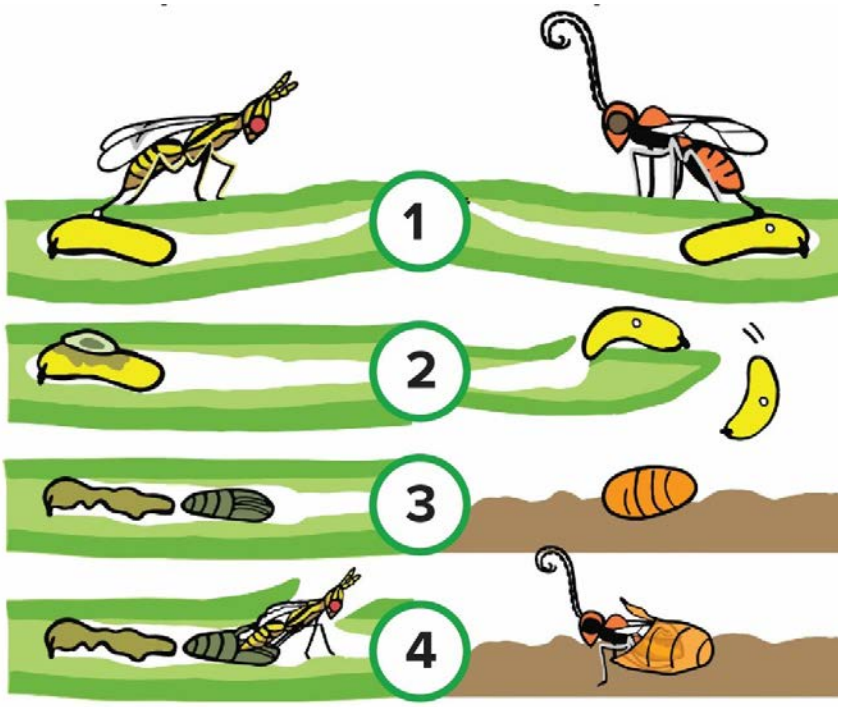
Deep soil cultivation before planting to destroy infested weeds and plant material from the previous season can reduce the severity of leafminer outbreaks. Non-host cover crops to exclude adult flies from laying eggs may also help in some cases. Alternate weedy hosts such as sowthistle, chickweed, and nightshade should be destroyed to reduce overwintering populations.

For severe, yearly infestations, consider:

- Tilling or cultivating the top 5cm of soil in early spring to disrupt the life cycle and kill overwintering pupae.
- Checking transplants for signs of leaf mines and white stippling before planting; destroy infested plants.
- Clipping and destroy infested leaves to prevent larval development.
- Using adequate irrigation to keep plants healthy and reduce stress.
- Immediately after the final harvest, removing plants and deeply ploughing crop residues to remove food sources and inhibit pupal development.

Beneficials: Conserve beneficial natural enemies such as parasitoids; learn the signs of parasitism to determine if visible leafmining damage is associated with active parasitoid wasps controlling the leafminer population.

Parasitoid wasps are a natural way to control leafminer. International management of *Liriomyza* leafminers includes using natural enemies such as parasitoid wasps that attack larvae. Research has indicated that Agromyzid parasitoids rapidly target exotic *Liriomyza* leafminers, and many are reported to affect these pests overseas. Field mortality rates can reach up to 80%. Australia has at least 50 species of these wasps that attack native and exotic leafminers. Their life cycles vary and can be classified as 'larval' or 'larval/pupal'.



LARVAL

1. Female wasp lays an egg on or in fly larva.
2. Wasp egg hatches and feeds on fly larva.
3. The wasp pupates inside the leaf mine after consuming the fly.
4. Adult wasp emerges from the leaf mine.

LARVAL/PUPAL

1. Female wasp lays an egg on or in the larva.
2. Wasp egg stays dormant until fly larva emerges and pupates.
3. Wasp egg activates, consuming pupating fly.
4. Wasp emerges from otherwise healthy looking fly pupa.

Figure 4. Life cycles of parasitoid wasps: larval life cycle versus larval (left)/pupal life cycle (right) (Illustration by Elia Pirtle)

Chemical: Avoid broad-spectrum insecticides and reduce the evolution of resistance to insecticides.

Worldwide, Serpentine leafminer and its related species have been reported to be resistant to many insecticides, including organophosphates, carbamates, synthetic pyrethroids, cyromazine, avermectin, and spinosyns. An integrated approach is needed to avoid further insecticide resistance developing. If you are using chemical treatments, rotate the mode of action groups.

Chemical management must be carefully planned, and broad-spectrum pesticides must be avoided.

Contact, systemic, and translaminar pesticides are effective at different stages (Figure 5). Because leafminers are protected within the plant, foliar insecticidal control is often difficult. Foliar protectants must be applied before egg deposition on the crop. The window of activity is a concern and may require several applications for adequate control of the emergence of leafminer.

Biological control with parasitoid wasps is more effective. Avoid harming beneficial wasp populations.

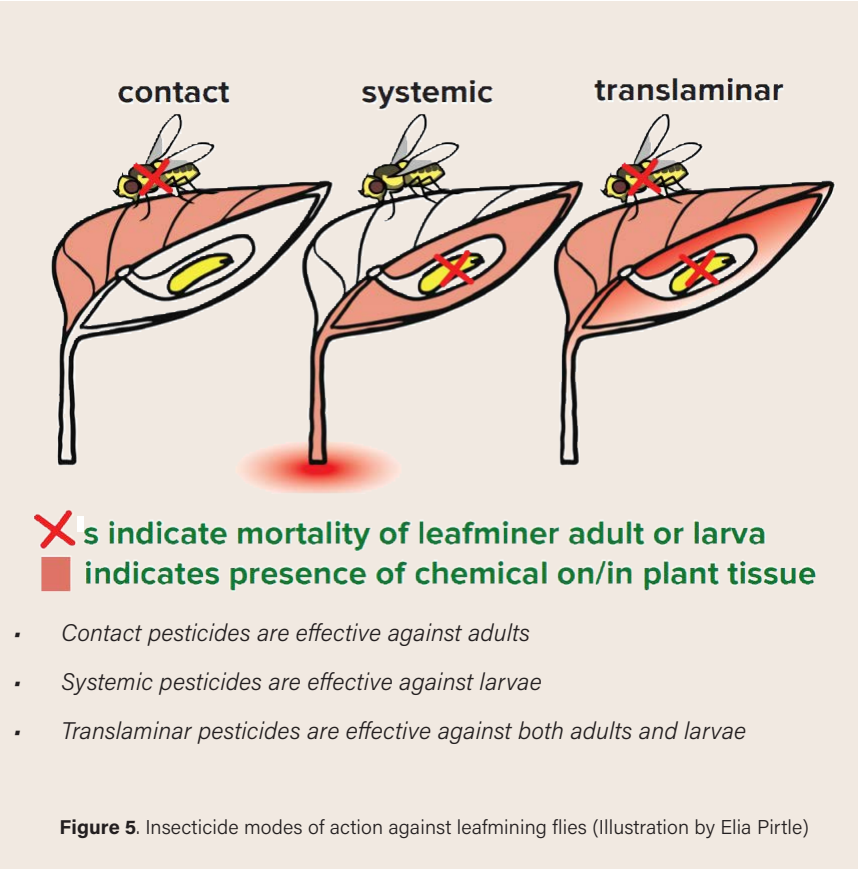


Figure 5. Insecticide modes of action against leafmining flies (Illustration by Elia Pirtle)

This article first appeared in 'Australian Grower' magazine, Summer 2023.

FURTHER READING

- Resources for management of leafmining flies in Australia
- Chemical management of leafminers from NSW DPI
- AUSVEG biosecurity alerts
- Plant Health Australia: Vegetable leafminer
- Plant Health Australia: Serpentine leafminer
- Plant Health Australia: American serpentine leafminer

FIND OUT MORE

Please get in touch with the AUSVEG Extension & Engagement Team on 03 9882 0277 or email science@ausveg.com.au.

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