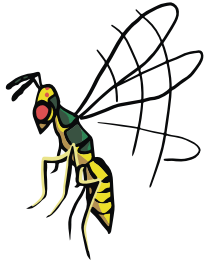


The serpentine leafminer (SLM: *Liriomyza huidobrensis*)

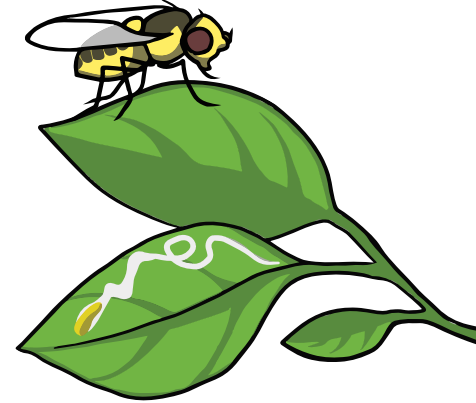


IPM principles and monitoring

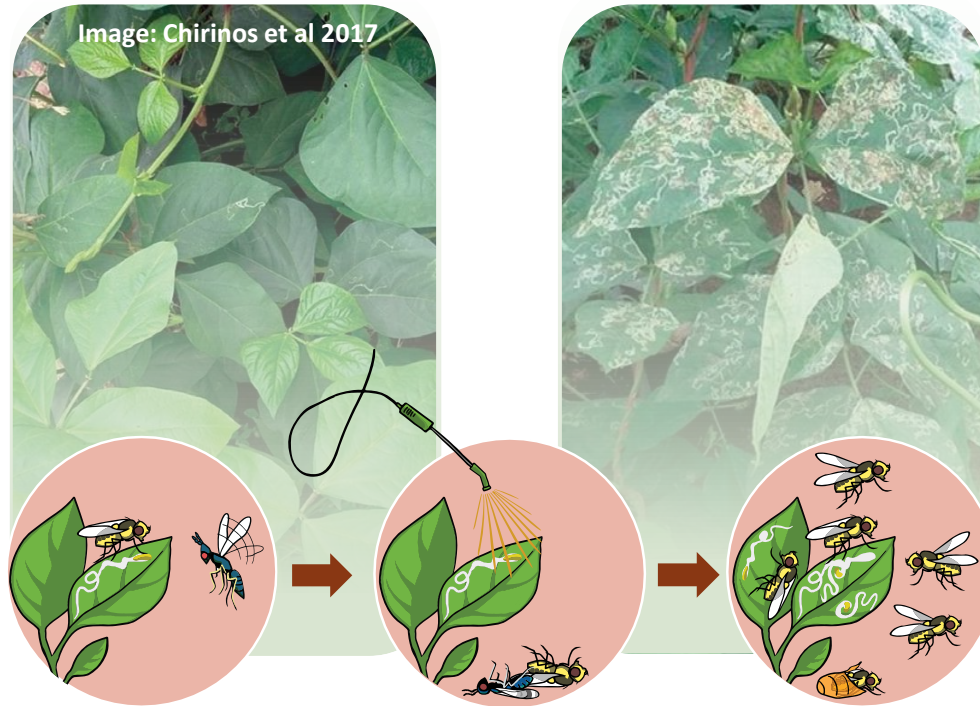
Dr. Elia Pirtle (Cesar Australia)

epirtle@cesaraustralia.com

Jan 28, 2021



Why such large losses?



Above: *Closterocerus nr trifasciatus*, photos by Dr. Ryan Perry, University of California Riverside

Management of exotic leafminers



What will IPM look like on my farm?

Foundations of IPM approaches overseas



- **Understand role of parasitoids:** know the signs of parasitism; understand the role of reservoirs of parasitoids (i.e. non pest flies).
- **Monitor pest activity:** follow economic thresholds to reduce sprays and allow parasitoid populations to build.
- **Avoid broad-spectrum insecticides:** do not target leafminer flies with inappropriate chemicals; consider effect of chemicals that target other pests

Management of exotic leafminers



Parasitoid wasps of leafminer

- Mortality results from parasitism, or by stinging and feeding by adult wasps.
- Unassisted field mortality rates can reach as high as 80%.
- Most of these wasps are very generalist (attacking many leafminer species)



These wasps are very small (~1 mm) and pose no threat to humans!

Hemiptarsenus varicornis on top of a 10 mm diameter thumb tack (tack image: Wikimedia commons; wasp images: Elia Pirtle, cesar Pty Ltd)

Management of exotic leafminers



Diglyphus isaea.
Image: Elia Pirtle,
cesar Pty Ltd



*Hemiptarsenus
varicornis.* Image: Elia
Pirtle, cesar Pty Ltd

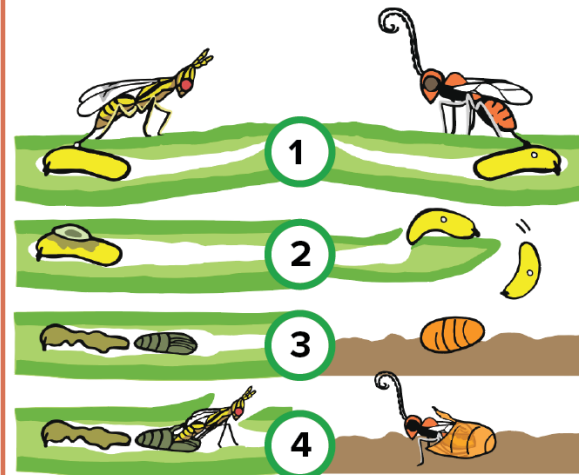


Opius spp. Image: Elia
Pirtle, cesar Pty Ltd

Lifecycles of parasitoid wasps

Idiobionts

Koinobionts



1 Female wasp stings and paralyzes the fly larva, and lays egg on or inside.

2 Wasp egg hatches and feeds on fly larva.

3 After consuming the fly, the wasp pupates inside the leaf mine.

4 Adult wasp emerges from the leaf mine.

1 Female wasp lays egg on or in fly larva without paralyzing it.

2 Wasp egg stays dormant until fly larva emerges and pupates.

3 Wasp egg activates, consuming pupating fly.

4 Wasp emerges from otherwise healthy

Management of exotic leafminers

Parasitoids in Australia

- Australia has many parasitoids which attack *Liriomyza* and other agromyzids
 - Scientific papers report at least 50 species of beneficial wasps that might attack exotic *Liriomyza* are found in Australia
 - This includes three of the most important overseas species
 - Our sampling has found they are already providing important control of vegetable leafminer in the Torres Strait

It will be important to start looking for signs of parasitism in SLM in NSW and QLD!



Management of exotic leafminers



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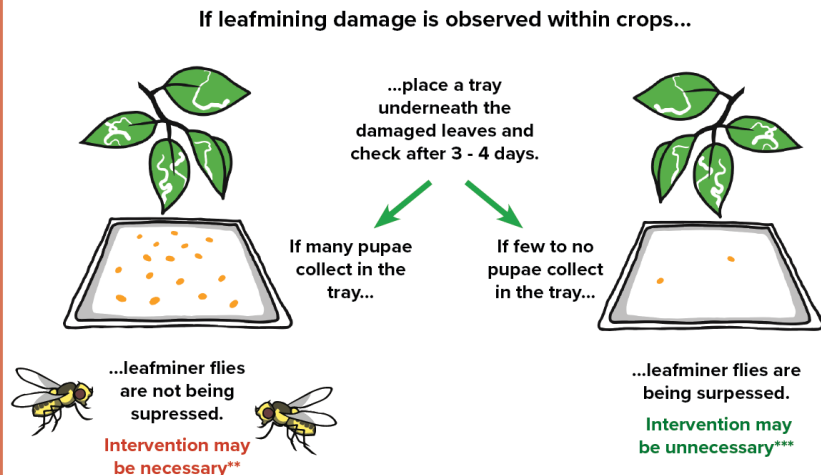
Management of exotic leafminers

Monitoring for leafminer and parasitoid activity

- Presence of leaf mines does not mean you need to intervene!
- Cheaply and easily assess leafminer activity by monitoring for pupae or adults via traps!
- Thresholds/monitoring techniques must be developed for Australia next



Using pupal trays to monitor activity of *Liriomyza* leafminers*

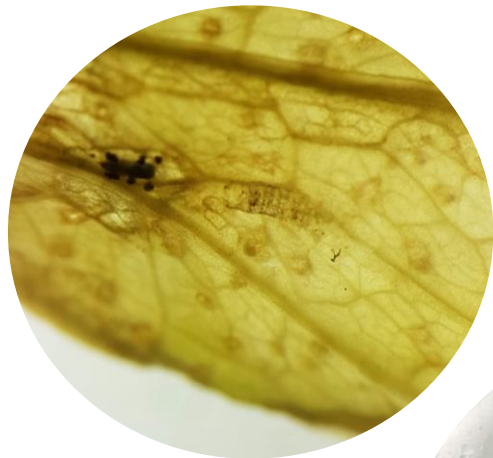


* This technique does not work for leafminer flies which pupate inside the leaf. However, exotic leafminers of high economic concern to Australia all emerge from leaves to pupate.

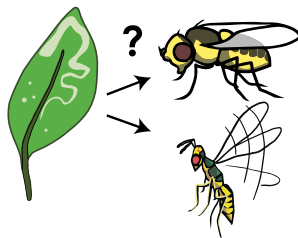
** If endoparasitoid wasps (see Figure 4) are present, the number of pupae collected in the tray may still overestimate the fly population. Pupae can be collected and stored in sealed plastic bags with a damp paper towel until emergences of flies and/or wasps occur, to determine the level of endoparasitism.

*** Thresholds for pupa counts within trays have not yet been developed within Australia for the exotic leafminers of high economic concern. If these leafminers establish, this technique would need to be validated, and thresholds developed.

Management of exotic leafminers

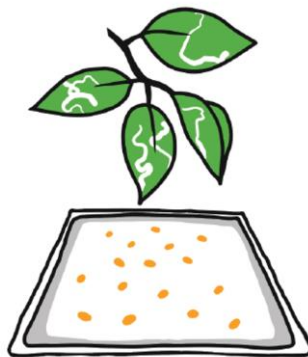


- Already seeing many signs in QLD samples!



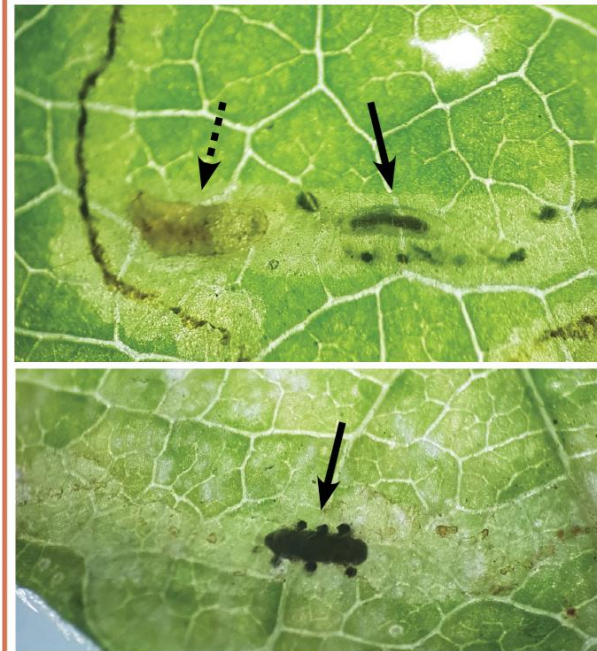
Can you see signs of parasitism?

koinobionts



idiobionts

Signs of parasitism



Signs of parasitism visible under a microscope or hand lens. Top: A wasp larva (solid arrow) inside a leafmine, near a leafminer larva carcass (dotted arrow). Bottom: A wasp pupa inside a leafmine (solid arrow). Images: Elia Pirtle, cesar Pty Ltd.



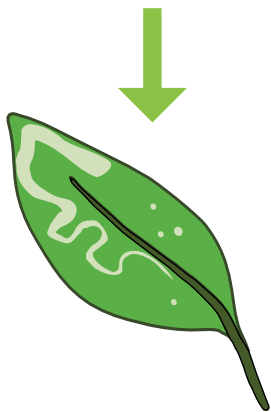
What will be the signs if SLM reaches my area?

And why should I be looking...

- Early detection can avoid accidental disruption of wasps, creating an even bigger problem
- Your reports will help us build and validate better management tools!

Surveying for exotic leafminers

What should I look for?



- Leaf mines are long lasting
- Flies are tiny, transient and short lived
- Traps are not feasible for early detection



Targeting surveillance: What, when and where?

When should I be looking?

Where should I be looking?



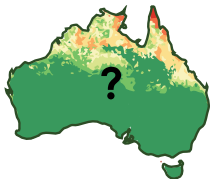
Actual size of adult

Surveying for exotic leafminers



1. Targeted surveillance

What should I
look for?



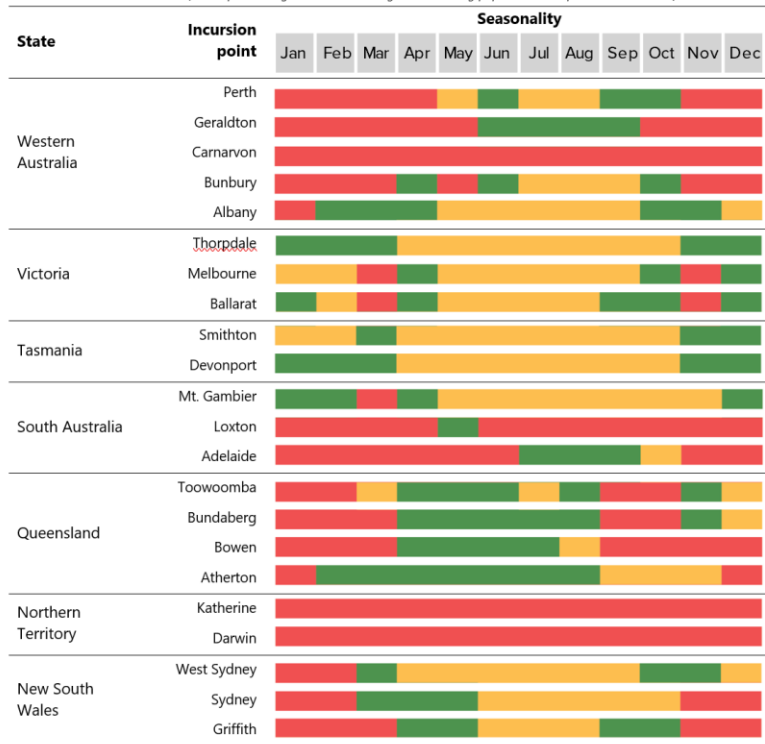
Establishment risk

- In the highest risk season, when high pest growth potential overlaps with crop growth (especially young crops)

Targeting surveillance: What, when and where?

When should I
be looking?

Table 6 Major Australian growing regions showing risk seasonality for serpentine leafminer activity across the year. Green means highest establishment risk (where the population growth potential was greater than 50% of the maximum predicted growth rate) yellow means lower establishment risk (where the population growth potential was between 1 and 50% of the maximum), and red means lowest establishment risk (where predicted growth rates are negative, meaning populations are predicted to decline).



Surveying for exotic leafminers



1. Targeted surveillance

What should I
look for?

- A high risk crop



Targeting surveillance: What, when and where?

When should I
be looking?

Where should I
be looking?

Surveying for exotic leafminers



1. Targeted surveillance

What should I
look for?

- A high risk crop
- A high risk part of the paddock
 - Based on spread pathways
 - Near to transport routes and unloading areas
 - The 'incoming wind side' of paddock edges



Targeting surveillance: What, when and where?

When should I
be looking?

Where should I
be looking?

flowers



plants



soil



machinery



tourists



Surveying for exotic leafminers



2. Survey guidelines

While surveying

- **Scan:** Scan upper surfaces of leaves as you walk, looking for signs of stippling or mining.
- **Snap:** Take a photo of any suspicious damage and record a GPS point.
- **Collect:** Take a sample of the damage
- **Call:** Immediately report to the Exotic Plant Pest Hotline on 1800 084 881.

Tips for conducting surveys



1. Scan
for damage



2. Snap
a photo



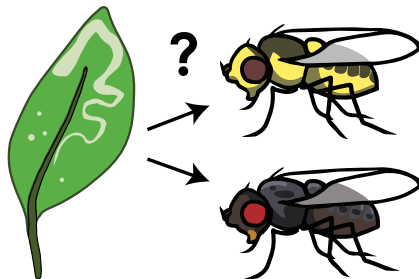
3. Collect
a sample

IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE

 **1800 084 881**

4. Call

Surveying for exotic leafminers



Can I distinguish
symptoms from
other pests?

No!

- There are many other leafminer in Australia
- So what do we do...?
 - Call anyway!
 - Keep a sample!

Allows for DNA
testing!



3. Collect
a sample



Management of exotic leafminers



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Thanks to our partners!

- Thursday Island and Bamaga NAQS
- Torres Strait Regional Authority
- Kaurareg Native Title (Aboriginal) Corporation
- Torres Shire Council
- NPA Regional Council
- Apudthama Land Trust
- Seisia Enterprises
- Greenlife Industry Australia
- Queensland Department of Agriculture and Fisheries
- Project partners and steering committee

Hort Innovation

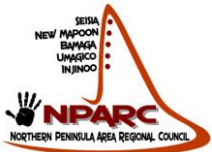
Project MT16004



Australian Government
Department of Agriculture
and Water Resources



Plant Health
AUSTRALIA



All images unless otherwise noted: Dr. Elia Pirtle