L. trifolii damage to chrysanthemum.

American serpentine leafminer: A threat to horticulture

The American serpentine leafminer *(Liriomyza trifolii)* is a small fly belonging to the family Agromyzidae. It infects plant species from 29 plant families including many vegetable, ornamental and legume crops. Currently, Australia remains free of this leafminer species but it is now well-established in nearby countries, including Indonesia. However, if the pest does establish in Australia, it could threaten our horticulture industry. AUSVEG Biosecurity Officer Madeleine Quirk reports.

The Research, Development and Extension program for control, eradication and preparedness for vegetable leafminer (MT16004) was developed in recognition of the extensive impact that vegetable leafminer (VLM; *Liriomyza sativae*) could have on the vegetable, nursery and melon industries if it were to move into production areas with no management plan in place. Project partners include Cesar, Plant Health Australia, Northern Australia Quarantine Strategy (NAQS), the University of Melbourne and AUSVEG.

The project has recently expanded to investigate two closely related leafminers, *Liriomyza trifolii* and *Liriomyza huidobrensis*. These pests have been recognised as potential threats to Australia's vegetable, nursery, melon, and potato industries, and neither species is present in Australia.

The following is an overview of *Liriomyza trifolii (L. trifolii)*, commonly known as the American serpentine leafminer, focusing on the pest's biology, distribution, effect on horticultural industries worldwide, and chemical and biological control strategies.

Pest overview

Adult *L. trifolii* can grow between 1-1.7 millimetres. The thorax and abdomen are grey/black with patchy yellow regions, while the head is completely yellow. Females will use their ovipositor (a tubular organ which can rasp through the leaf surface) to insert eggs just below the leaf surface that hatch between 2-5 days after being laid. Eggs are too small to be seen by the naked eye, so a seemingly healthy plant may be harbouring the pest without us knowing.

Inside the leaf tissue, colourless larvae grow to 3 mm, and as they move through three instar phases, the larvae become yellow-orange and exit the leaf at the third instar phase. Larvae pupate externally to the leaf, usually in the soil below the plant, from which adults emerge 7-14 days later.

The duration of *L. trifolii's* life cycle varies with temperature. At 28 degrees Celsius (°C), a single cycle can be achieved in 14-15 days. At lower temperatures, the cycle takes longer. Research has shown that adults will not feed or lay eggs at temperatures as low as 12°C.

L. trifolii larvae feeds internally on living plant tissue, particularly plant leaves, reducing photosynthetic activity and causing premature leaf drop. Unlike many other leafminers, the American serpentine leafminer is polyphagous (it has a broad host range from a number of families). It also has a high reproductive rate and has developed resistance to several classes of broad-spectrum insecticides.

Ornamental crops, legumes and vegetables are affected by the pest. Host families include Apiaceae (celery), Asteraceae (chrysanthemum, gerbera, lettuce), Brassicaceae (broccoli, cauliflower), Cucurbitaceae (cucumber, melon, pumpkin), Fabaceae (beans, lentils), and Solanaceae (potato, tomato, capsicum).

Damage from this pest reduces both marketability and crop yield, and has resulted in economic losses to growers globally. Examples include:

- Between US$18 and $21 million damage per year to Californian greenhouse ornamental growers in the early 1980s.
- $93 million in damage to the Californian chrysanthemum industry between 1981 and 1985.
- 80 per cent losses to celery growers in Florida in 1980, estimated at US$9 million.

Risk of spread and establishment in Australia

Major risk entry pathways for leafminers into Australia are by importation of infested ornamental host plants, cut

Adult American serpentine leafminer. Images courtesy of Central Science Laboratory, Harpenden, British Crown, Bugwood.org.

flowers, leafy vegetables and seedlings. Human-assisted entry can also occur, e.g. illegally on plant material.

Globally, *L. trifolii* dispersal and establishment has occurred rapidly, with populations found on most continents, including Europe, Asia, Africa, Central America, the Caribbean, North America, South America and Oceania (American Samoa, Guam, Fiji and Tonga). It has recently been identified in Indonesia. Movement of cut flowers and infested chrysanthemum cuttings have played a major role in the spread of *L. trifolii* from its original range in the Americas to other regions in the world.

While *L. trifolii* is not yet present in Australia, many horticultural production regions in Australia have climatic conditions similar to locations overseas where it has already established, and therefore could be at risk of establishment. It is a heat-tolerant species, meaning it will thrive in tropical locations, potentially tolerating temperatures near 35°C. It does not adapt as well to cool-climate regions as other leafminers, but it could maintain populations year-round in protected environments such as greenhouses.

Chemical and biological control

L. trifolii can rapidly develop resistance to various chemical groups, particularly organophosphates, carbamates, diamides and pyrethroids, which can make control difficult. Application of broad-spectrum insecticides often results in larger leafminer populations as these insecticides reduce the reservoir of natural enemies (parasitoid wasps as well as other generalist predators like spiders), which keep leafminer populations in check. Overseas, several insecticides are used for the control of *L. trifolii*, including but not limited to abamectin, azadirachtin, chlorantraniliprole, cyromyzine, indoxacarb, spinetoram and spinosad. Currently, Plant Health Australia (PHA) is seeking to obtain insecticide permits for control of *L. trifolii* and other *Liriomyza* leafminers in Australia as a preparedness measure for growers. PHA will be releasing a contingency plan in coming months, which includes further details on these applications.

Nevertheless, many species of parasitoid wasps have been recorded attacking the pest. MT16004 project partners from Cesar and the University of Melbourne are currently reviewing international literature to investigate the suite of parasitoids that attack *L. trifolii* worldwide, and they will cross-reference this list with those that already exist in Australia.

They have already identified possible parasitoid species for future control of *L. sativae* and have identified several wasp species attacking Torres Strait and Seisia populations. Some of these wasps are also found in other regions of Australia, which is promising for future management of vegetable leafminer. It is highly likely that the same, or similar, suite of parasitoids that might control *L. sativae* populations in Australia could also assist in potential control of *L. trifolii*.

Further Reading

- Capinera JL. 2017. American serpentine leafminer, *Liriomyza trifolii* (Burgess). University of Florida.

- Reitz SR, Gao Y & Lei Z. 2013. Insecticide use and the ecology of invasive Liriomyza leafminer management.

Find out more R&D

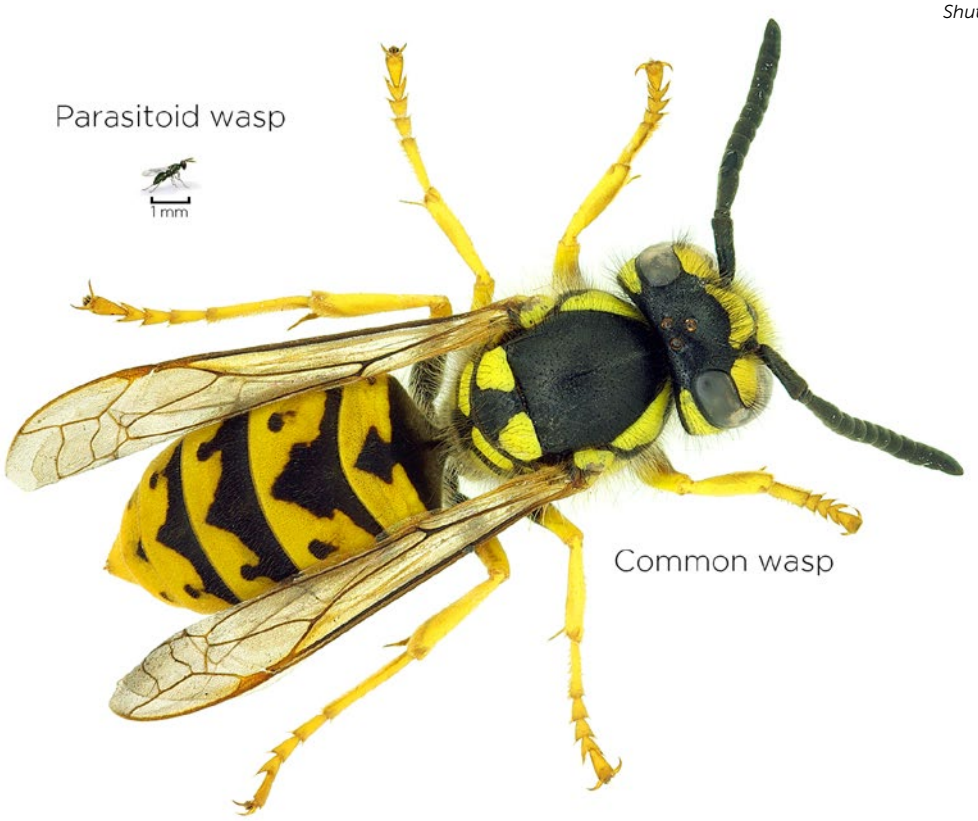
Any unusual plant pest should be reported immediately to the relevant state or territory agriculture agency through the Exotic Plant Pest Hotline (1800 084 881).

For further information, please contact AUSVEG's Extension and Engagement Team on 03 9882 0277 or email science@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable, nursery, melon and potato research and development levies and contributions from the Australian Government.

Project Number: MT16004

Hort Innovation



Parasitoid wasp *(Diglyphus isaea)* compared against common wasp *(Vespula germanica)*. *Source: Elia Pirtle (parasitoid wasp), Shutterstock (common wasp).*

How parasitoid wasps are helping to fight the leafminer battle

In 2017, a Hort Innovation Vegetable Fund project was established to recognise the damaging impact that vegetable leafminer could have on some of Australia's fresh produce industries if it were to move into production regions. AUSVEG Biosecurity Officer Madeleine Quirk explores the role of parasitoid wasps in controlling vegetable leafminer populations in far-north Queensland, the importance of parasitoid wasps overseas, and research conducted into reservoirs of parasitoid wasps within Australia's non-pest leafminers.

Vegetable leafminer *(Liriomyza sativae; VLM)*, potato leafminer *(Liriomyza huidobrensis)* and American serpentine leafminer *(Liriomyza trifolli)* are exotic flies that cause significant damage to horticultural commodities overseas, and potentially threaten Australia's vegetable, nursery, melon and potato industries.

VLM established itself in the Torres Strait in 2008 and was subsequently found on mainland Australia, in Seisia on the Cape York Peninsula, in 2015. However, VLM populations have not reached problematic levels – instead, they seem to be held in check largely by tiny biological control agents called parasitoid wasps.

What is a parasitoid wasp?

Parasitoid wasps that attack leafminer flies are less than two millimetres long. Female wasps lay their eggs on or inside fly larvae or pupae, and when the eggs hatch, the wasp larva eats the fly larva/pupa before completing its development and emerging as a new adult wasp. Some of the adult wasp species also kill large numbers of leafminer larvae by directly feeding on host larvae to acquire nutrients for the development of additional eggs in the wasp.

Dr Peter Ridland from the University of Melbourne has conducted a literature review of the wasps that parasitise leafminer flies in Australia and internationally.

"Those native and invasive leafminer species studied in Australia have a large range of parasitoid wasp species attacking them. Some of these wasps are also exotic and presumably arrived in Australia many years ago with their host leafmining flies," Dr Ridland said.

"Australia has at least 50 species of parasitoid wasps known to parasitise native leafminer flies. Many of these species are known to attack vegetable leafminer overseas, including *Hemiptarsenus varicornis* and *Diglyphus isaea*. The good news is that Australia will not need to import any new parasitoid species for the biological control of vegetable leafminer."

News from the incursion front

Cesar Research Scientist Dr Elia Pirtle has undertaken extensive field research in the Torres Strait and Cape York Peninsula, studying parasitoid wasps and their relationship with VLM.

"Some of our Australian species already show signs of very effective vegetable leafminer control on the incursion front in far-north Queensland. We have found at least six species of parasitoids attacking vegetable leafminer and, in some cases, unassisted field rates of parasitism can reach as high as 80 per cent," Dr Pirtle said.

"While there may be a lot of factors contributing to vegetable leafminer's limited mainland distribution, we predict that it is, in part, due to these wasp populations slowing down its spread."

Chemical use: a global problem

Although the tiny parasitoid wasps are keeping leafminer numbers low in far-north Queensland, they are extremely

sensitive to chemicals and can be wiped out by a single spray. When a crop is sprayed, beneficial insects such as predators and parasitoid wasps are knocked out while VLM, sheltering in the soil as pupae or as larvae in mines, continue to breed and multiply.

This is referred to as a secondary pest outbreak, meaning that it is not until its natural enemies are destroyed that the surviving leafminers become a problem for growers. That is especially true when they start to develop resistance to common insecticides, even if the insecticides are targeted at other pests in the crop.

"Overseas, excessive use of non-selective insecticides has caused devastating leafminer outbreaks for growers," Dr Ridland said.

"On the other hand, it has been demonstrated repeatedly that conservation of parasitoids is one of the foundations of a successful integrated pest management system.

"While we can't say for sure how parasitoids might affect vegetable leafminer populations in Australian production regions in the future, we are confident that this approach will underpin its successful management."

Examining relationships

Marianne Coquilleau is a Master of Philosophy Candidate at the University of Melbourne. For two years, she has been sampling mined plants and rearing specimens from six sites around Melbourne to examine the effect parasitoid communities have on several local leafminer fly species.

"The four common leafminers are *Liriomyza brassicae, Liriomyza chenopodii, Phytomyza plantaginis,* and *Phytomyza syngenesiae,*" Ms Coquilleau said.

In Victoria alone, Ms Coquilleau found that those four flies that feed mostly on weeds are attracting and maintaining a healthy community of nine genera of parasitoid wasps.

"Though this number may seem low, it's a good start for focusing on species and populations already established and suited to the Australian climate," she said.

Parasitoid wasps are not fussy when it comes to their diet and tend to overlap with each other in their favourite leafminer to eat. In fact, *L. brassicae* was found to be parasitised by every wasp species that our project team found around Victoria. This supports Dr Pirtle's findings from Seisia: there are a wide range of local biocontrol agents that could be utilised for vegetable leafminer control, and it is likely that more wasp species will develop a taste for VLM if it spreads.

"We are banking on that being the case for the local parasitoids to shift onto invasive exotic leafminer species," Ms Coquilleau said.

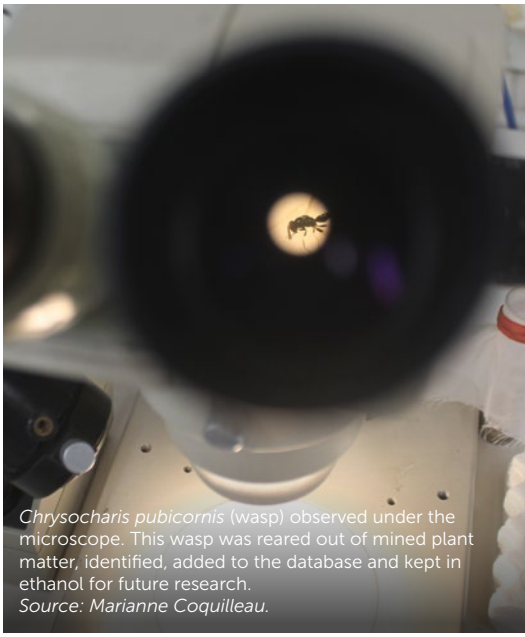
Some of the parasitoid wasps found in Victoria are distributed across the Torres Strait and Cape York Peninsula, and already appear to be attacking VLM in the north. These include *Zagrammosoma latilineatum* and *Hemiptarsenus varicornis*.

"More research needs to be done to look at parasitism levels over time, and across different wasp species combinations. These detailed studies cannot be undertaken until vegetable leafminer invades the Australian production regions, which we hope is delayed for a long time," Ms Coquilleau said.

Overall, Ms Coquilleau's research reinforces that local Australian parasitoids will be the cornerstone of future integrated pest management strategies, and we already have several species to choose from. She also hopes that it is a first step towards looking at the temporal presence of wasps of interest and their non-pest hosts, so that it can be taken into consideration when it comes to spraying schedules.

What we do know for certain is that if vegetable leafminer spreads to agricultural regions, it will become essential for growers to protect and promote their parasitoid wasp communities and integrate them into their pest management regimes.

Marianne Coquilleau examining mined plants in a temperature-controlled location. Wasps and flies enclosed inside can take several weeks to emerge. *Source: Marianne Coquilleau.*


Chrysocharis pubicornis (wasp) observed under the microscope. This wasp was reared out of mined plant matter, identified, added to the database and kept in ethanol for future research. *Source: Marianne Coquilleau.*

Find out more R&D

For more information, contact AUSVEG Biosecurity Officer Madeleine Quirk on 03 9882 0277 or madeleine.quirk@ausveg.com.au. Alternatively, you can visit the project page on the AUSVEG website at ausveg.com.au/biosecurity-agrichemical/biosecurity/mt16004.

Any unusual plant pest should be reported immediately to the relevant state or territory agriculture agency through the Exotic Plant Pest Hotline (1800 084 881).

The Research, Development and Extension program for control, eradication and preparednesss of vegetable leafminer has been funded by Hort Innovation using the vegetable, nursery, melon, and potato research and development levies and contributions from the Australian Government.

Project Number: MT16004

Hort Innovation

Subscribe for leafminer project updates

Be sure to keep up-to-date on VLM project updates and upcoming workshops by subscribing to the AUSVEG Front Line e-Bulletin. Please visit https://ausveg.com.au/biosecurity-agrichemical/biosecurity/ to subscribe.

Serpentine leafminers (*Liriomyza huidobrensis*) could pose a serious threat to the potato industry if they were to establish in Australia.

Serpentine leafminer: A threat to the potato industry

Serpentine leafminers *(Liriomyza huidobrensis)* are small flies belonging to the family Agromyzidae. They seriously affect solanaceous crops (such as potato, tomato and eggplant), as well as crops in the Asteraceae, Cucurbitaceae and Fabaceae families. Currently, Australia remains free of this species of leafminer, which is now well established in nearby countries, including Indonesia. If the pest establishes itself in Australia, it could threaten the local potato industry. AUSVEG Biosecurity Officer Madeleine Quirk reports.

The *Research, Development and Extension program for control, eradication and preparedness for vegetable leafminer* (MT16004) was developed in recognition of the extensive impact that vegetable leafminer (VLM; *Liriomyza sativae*) could have on the vegetable and nursery industries if it were to move into production areas with no management plan in place. Project partners include Cesar, Plant Health Australia, Northern Australia Quarantine Strategy (NAQS), the University of Melbourne and AUSVEG.

Project partners have since identified *Liriomyza huidobrensis*, commonly known as serpentine leafminer, as a pest that requires immediate further research and development of preparedness in case it establishes in Australia.

The following article addresses the leafminer's distribution, effect on potatoes, ability to resist chemicals, and establishment potential in Australia.

MT16004 is a strategic levy investment under the Hort Innovation Nursery and Vegetable Funds.

Leafminer identification

Adult serpentine leafminers range from 1.3-2.3mm in length, and females are slightly larger than males. Distinctive features include dark bristles on the head, brownish-yellow antennae with dark end segments, and dark side walls of each body segment.

Serpentine leafminer eggs are slightly translucent and off-white and are barely visible to the naked eye. Colourless larvae hatch from the eggs and turn pale yellow-orange. During later instars, the larvae turn solid yellow-orange. Larvae develop inside the leaf tissue and vary in size but they can reach up to 3.2mm in length. The larvae form irregular serpentine mines which tend to be restricted by veins and are generally found towards the base of the leaf. The third (final) instar larvae exit the leaf and pupate externally to the leaf, usually in the soil below the plant.

Worldwide distribution

The serpentine leafminer originated in the highlands of South America and is better adapted to cooler climates than VLM. It is now established in Africa, Asia, Central America, Europe and North America (in glasshouses in Canada, but not in the United States). Australia remains free from the serpentine leafminer, which is now well established in Indonesia (since 1995) and has been recorded in West Timor.

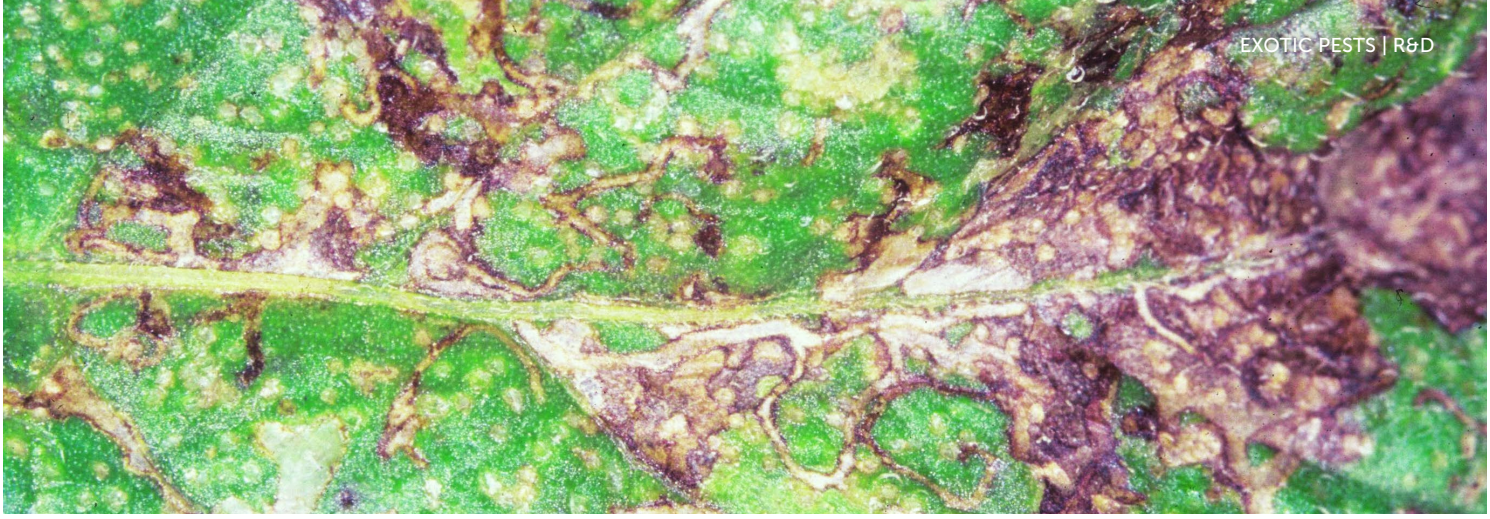
In California, *Liriomyza langei* was first described in 1951 and subsequently synonymised with *L. huidobrensis*. However, it was subsequently reinstated as a separate species in 2001. This polyphagous species can only be distinguished morphologically from *L. huidobrensis* with great difficulty, so molecular testing is required to differentiate the two species accurately.

Effect on potato industries worldwide

Worldwide, the serpentine leafminer is a serious pest of arable crops, vegetables and ornamental crops grown in glasshouses or in the field. Larvae tunnel inside the leaf tissue and create visible 'mines' on the leaf surface. Leaf mining reduces photosynthetic activity and can result in premature leaf drop. Plant damage is also caused by female flies using their ovipositor (a tubular organ which can rasp through the leaf surface to allow eggs to be laid inside the leaf tissue) to make feeding punctures as well as depositing eggs.

Serpentine leafminer damage reduces crop marketability and yield, resulting in economic losses to growers. In potatoes, feeding punctures are visible all over 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 a developing plant.

When the pest first became established in Indonesia, yield losses up to 70 per cent were recorded as farmers struggled to control the pest with conventional insecticides. A research paper compiled by Plant Health Australia (2009) highlighted Indonesia as a high-risk entry pathway for serpentine leafminer to Australia.



Liriomyza huidobrensis damage to a potato leaf. Image courtesy of Merle Shepard, Gerald R.Carner and P.A.C Ooi, Insects and their Natural Enemies Associated with Vegetables and Soybean in Southeast Asia, Bugwood.org.

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.

Chemical and biological control

Translaminar insecticides such as abamectin, cyromazine, neem, and spinosad, which penetrate the leaves and subsequently contact the larvae, are effective for control of the serpentine leafminer.

However, serpentine leafminers can rapidly develop resistance to a number of chemical groups, particularly synthetic pyrethroids and organophosphates, which can make control extremely difficult. Applications of broad-spectrum insecticides often result in larger leafminer populations as the pesticide reduces natural enemies such as parasitic wasps and spiders. This was experienced in Costa Rica, where farmers over-applied chemicals in an attempt to contain leafminer populations on snow peas, and in Indonesia, where the majority of potato farmers sprayed insecticides twice weekly but were dissatisfied with the results.

Worldwide, many species of parasitoid wasps have been recorded attacking the serpentine leafminer. MT16004 project partners are currently finding a number of endemic Australian parasitoids attacking non-pest species of leafminers, which should be effective biological control agents for VLM. It is highly likely that the same suite of parasitoids in Australia will assist in the control of the serpentine leafminer.

Risk of spread and establishment in Australia

Serpentine leafminer is most likely to enter Australia through importation of infested ornamental host plants, cut flowers, leafy vegetables and seedlings. Invasion could also occur via wind, assistance from humans or illegally on plant material. Unhatched eggs pose the most risk as they are difficult to detect in visual inspections.

Dispersal and establishment of leafminer species has occurred rapidly across the globe and the serpentine leafminer has become a destructive pest of potatoes in some, but not all potato growing areas where it is found. In China, the serpentine leafminer moved through 27 provinces over a six-year period, covering more than 394,000km². If the serpentine leafminer were to become established in Australia without control mechanisms in place, it would have a significant effect on horticultural production.

VLM was detected on multiple islands across the Torres Strait between 2008 and 2015. VLM was then detected on the most northerly point of the Australian mainland, Cape York Peninsula, in 2015.

Scientific literature suggests that this same pathway is a high-risk entry pathway for the serpentine leafminer, reaffirming the need to increase industry efforts to be aware of and to prepare for this pest.

Find out more R&D

Any unusual plant pest should be reported immediately to the relevant state or territory agriculture agency through the Exotic Plant Pest Hotline (1800 084 881).

For further information, please contact AUSVEG's Extension and Engagement Team on 03 9882 0277 or email science@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable and nursery research and development levies and contributions from the Australian Government.

Project Number: MT16004

Hort Innovation

Further reading

The invasive Liriomyza huidobrensis (Diptera: Agromyzidae): understanding its pest status and management globally – Weintraub PG et al. 2017. Journal of Insect Science 17 (1), 28 https://academic.oup.com/jinsectscience/article/17/1/28/3051723

Threat Specific Contingency Plan – Serpentine leafminer Liriomyza huidobrensis – Plant Health Australia (2009) http://www.planthealthaustralia.com.au/wp-content/uploads/2013/03/Serpentine-leaf-miner-CP-2009.pdf

Vegetable leafminer under the microscope in far north Queensland

In May 2019, Cesar and AUSVEG travelled to Torres Strait and Cape York Peninsula to undertake research and extension activities focusing on control, eradication and preparedness for the vegetable leafminer. AUSVEG Biosecurity Officer Madeleine Quirk provides an overview of the surveillance activities undertaken so far, and emphasises the role that the Northern Australia Quarantine Strategy plays in the project and in biosecurity.

Research, Development and Extension program for control, eradication and preparedness for vegetable leafminer (2017-2020) (MT16004) is a strategic levy investment under the Hort Innovation Vegetable, Nursery and Melon Funds. It brings together Cesar, Plant Health Australia, the Department of Agriculture's Northern Australia Quarantine Strategy (NAQS), the University of Melbourne and AUSVEG to undertake activities to prepare for vegetable leafminer (*Liriomyza sativae*; VLM).

Since 2008, the VLM has been moving down the Torres Strait islands and in 2015, the pest was detected on Cape York Peninsula in northern Queensland. The project was developed in recognition of the impact that VLM could have on the vegetable, nursery and melon industries were it to move into production regions.

NAQS plays a key role within the VLM project by providing extensive knowledge, technical and practical advice and data resources to Cesar, the University of Melbourne and AUSVEG, as well as logistics assistance during our visits to Torres Strait and Cape York Peninsula.

NAQS combatting biosecurity threats in Australia's north

In support of the Department of Agriculture's broader objectives, NAQS conducts monitoring and surveillance for exotic plant and animal diseases across the north of Australia from Cairns to Broome, including Torres Strait.

The biosecurity strategy's key responsibility is to provide early detection of target exotic plant pests, diseases and weeds that may affect Australia's national plant and animal health status and trade in agricultural products and environmental amenity. In doing this work, NAQS delivers a range of services and operations, including:

- Onshore scientific surveys.
- Offshore scientific surveys under direction from the department's Plant Division.
- Community awareness activities on how to report evidence of exotic target species and comply with applicable biosecurity regulations.
- Engagement activities with Indigenous Ranger groups under contract to assist surveys, collect data, and perform trapping services under direction from NAQS scientists and Community Liaison Officers.
- Contribution of expertise to national policies, industry measures and research relating to plant health surveillance.

In addition to this work, specific activities in Torres Strait include performing biosecurity functions to manage risks in accordance with applicable biosecurity regulations and deliver surveillance and response measures under the Exotic Fruit Fly in Torres Strait Response Plan.

NAQS collaborates with horticulture industries in other parts of Australia by periodically having industry representatives participate in NAQS surveys, for example citrus canker; providing data to industry groups to assist their biosecurity preparedness and planning; and contributing expertise to research projects upon request and where they align with NAQS surveillance objectives.

Research up north supporting horticulture industries further south

Through MT16004, NAQS has been instrumental in working with Cesar and the University of Melbourne to develop survey guidelines and rapid genetic diagnostics for VLM, which will assist industry in preparation for this horticultural pest.

It is important to quickly detect VLM if it spreads to a new area. Our research team is measuring survey efforts for VLM in Torres Strait so that we can provide advice to growers about management strategies.

At the Frog Gully Community Garden on Thursday Island in 2018, NAQS staff were tasked with searching for real leafminer damage on garden plants, while Cesar recorded how long before surveillance officers detected VLM damage, and what percent of damage they spotted.

Harold Matthew, one of NAQS' local biosecurity officers, was involved in the experiments in 2018 and 2019.

"The research team and I learned a lot from this project that occurred on Thursday Island," Mr Matthew said.

"It is a reminder to NAQS biosecurity officers of how to identify that particular leafminer, and how important our job is to be mindful when we carry out our daily operations."

The 2018 NAQS survey on Thursday Island validated the approach taken by Cesar last year in the Victorian vegetable production regions of Werribee and Tyabb, where growers surveyed for 'fake' VLM damage painted onto crops. Together, these trials allowed the research team to calculate the amount of time that must be spent per area to ensure a high chance of spotting low abundance leafminer damage in agricultural systems, forming part of the VLM survey guidelines that are being developed.

This year, Cesar returned to Thursday Island to test whether the guidelines developed from the 2018 trials would improve detection success. During an annual training activity, biosecurity staff from NAQS and rangers from the Torres Strait Regional Authority were divided in two groups, half surveying without instruction and half surveying according to the guideline, at the pace of approximately two metres per minute. While the data still requires analysis, preliminary results suggest survey success improved when participants followed our guidelines.

"The leafminer training received this year will assist in supporting the work we carry out in Torres Strait in our role in the frontline of biosecurity surveillance," Mr Matthew said.

"I encourage all NAQS staff to be able to identify and manage the process of doing these activities and contact the correct authorities if they find any leafminer activity."

In addition to this surveillance work, NAQS has been providing valuable support to Cesar in developing rapid diagnostic tests that will be able to determine whether suspicious damage was caused by VLM or by one of Australia's many native leafminers. Specifically, Cesar is developing a molecular test that will be capable of determining if VLM DNA is present in a seemingly empty leafmine.

Cesar ran an experiment in the Frog Gully Community Garden on Thursday Island in 2018, which looked at the persistence of DNA in 'empty' leafmines – or those mines from which a fly has already emerged, but has left behind traces of itself. The experiment required freshly vacated leafmines to be tagged and then left to age before collection. With Harold Matthew leading these leafmine collections after Cesar staff returned home, Cesar was able to determine that VLM DNA can be detected, even in empty leafmines that were one month old, with a success rate of approximately 75 per cent. This is exciting news for surveillance, as this test will make it possible to identify whether VLM is causing damage to a crop or if it is one of Australia's native leafminers.

Benefits for industry

The research undertaken in Torres Strait will significantly assist vegetable, nursery and melon growers in preparation for VLM as it will give them guidelines for surveillance and new options for diagnostics. The surveillance and DNA diagnostics work is forming the core of surveillance toolkits supporting industry, government, and gardeners, which are currently under development. They will bring together statistically-based recommendations for survey technique, guidelines for sample collection and minimum standards for data recording. These toolkits will be available to industry at the conclusion of the project in 2020, but you can view a draft of our VLM survey guide for growers at the AUSVEG webpage (ausveg.com.au/biosecurity-agrichemical/biosecurity/mt16004/). We are very keen to hear your thoughts and feedback.

This project was made possible with support from the Australian Department of Agriculture, Torres Strait Regional Authority, Kaurareg Native Title Aboriginal Corporation, Torres Shire Council, myPathways, Apudthama Land Trust, Seisia Enterprises and NPA Regional Council.

Vegetable leafminer damage to siratro leaf on Thursday Island, QLD.

Find out more R&D

Please contact AUSVEG Biosecurity Officer Madeleine Quirk on 03 9882 0277 or at madeleine.quirk@ausveg.com.au.

This project has been funded by Hort Innovation using the vegetable, nursery and melon research and development levies and contributions from the Australian Government.

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Preparing for exotic leafminers: a threat to Australian horticulture

Exotic leafminers such as vegetable leafminer (*Liriomyza sativae*), potato leafminer (*Liriomyza huidobrensis*) and American serpentine leafminer (*Liriomyza trifolii*), are significant global pests. In 2015, vegetable leafminer was detected along Australia's Cape York Peninsula. This article outlines how surveillance can help industry prepare for the potential arrival of other exotic leafminers.

Internationally, exotic leafminers have been known to cause problems early upon arrival before chemical management plans have been adjusted to conserve beneficial insects.

Knowing this, surveillance of exotic leafminers across Australia's horticulture industries is critical to ensuring that correct chemical choices can be made as soon as exotic leafminers arrive, to avoid sudden outbreaks and crop losses, and increase the chance of local containment or eradication.

A three-year cross-industry project has resulted in surveillance and management recommendations. Project partners include project lead Cesar; University of Melbourne; Plant Health Australia; the Department of Agriculture, Water and Environment's Northern Australia Quarantine Strategy; and AUSVEG.

Early detection surveillance should be undertaken in high risk crops and during high risk periods, when climate suitability for the pests are high. These crops include Fabaceae, Solanaceae, Cucurbitaceae, Apiaceae, Brassicaceae, Asteraceae, Alliums, and many ornamentals.

A web-based tool is now available for exploring risk of exotic leafminer across region and season (see Figure 1). Surveillance will be particularly important when a high-risk season overlaps with young crops, because young crops are particularly susceptible to leafminer damage.

Figure 1: Predicted seasonal risk of Liriomyza sativae across eight Australian horticulture production regions.

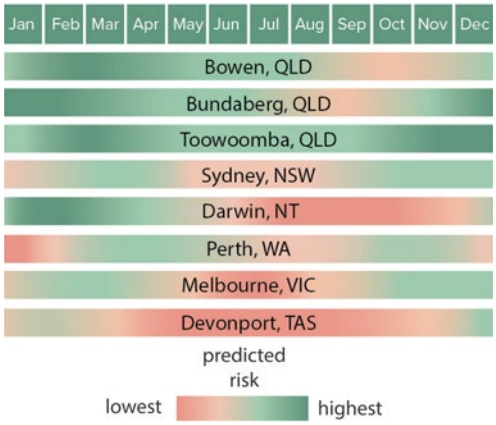
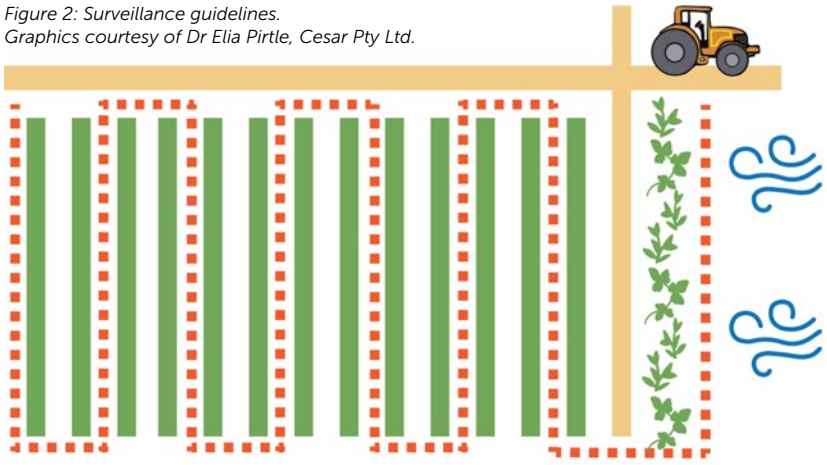


Figure 2: Surveillance guidelines. Graphics courtesy of Dr Elia Pirtle, Cesar Pty Ltd.



How do I survey my farm?

To survey your farm as part of an early detection approach, choose a block of crops – at least 30 rows of plants – that may be at high risk as a result of being an at-risk crop, near to transport routes and unloading areas, or on the incoming wind side of farm or paddock edges.

Within the block, survey by following a snaking transect line (see red dotted line in Figure 2), which includes broadleaf weeds present along the edges of the block and travels down every other row of plants. Grasses do not need to be inspected. Scan the upper surfaces of the leaves as you walk, looking for signs of stippling or mining (see Figure 3), at a slow walking pace of 10 seconds per metre to ensure high confidence in your ability to detect leafminer damage. Always record your survey results.

If you think you see suspicious damage: take a photo, collect a sample of leaves bearing the suspicious damage, and record the GPS point.

It is important to collect at least three mined leaves, but preferably as many as possible. Label the bag using a permanent marking pen with the following information: name; contact number; date; address, town, postcode; crop type.

Once the sample has been collected and stored, immediately report the suspicious damage to the Exotic Plant Pest Hotline on 1800 084 881. This will put you in touch with the Department of Primary Industries or Agriculture in your state or territory.

What if these pests become established?

The most effective natural control of leafminer is parasitoid wasps. Australia has at least 50 species of parasitoid wasps that attack native leafminer flies, and many are known to attack exotic leafminers overseas. If exotic leafminers establish in Australian production regions, they should be managed using an integrated pest management approach, which will allow parasitoid wasp populations to build up.

Regular crop monitoring will also be crucial for management. Using sticky traps is another useful way to monitor leafminer populations, because they attract adult leafminers and may give an indication of when leafminer flies are moving into the crop. Pupa trays identify whether active fly populations are present around leaf mines – these also an important and easy-to-use monitoring tool.

Furthermore, appropriate chemical choices within Australia have also been identified and several permits are now secured for future management.

Figure 3: Liriomyza sativae damage to siratro.
Image taken by Dr Elia Pirtle, Cesar Pty Ltd.

Find out more R&D

For more information, contact AUSVEG Biosecurity Officer Madeleine Quirk on 03 9882 0277 or madeleine.quirk@ausveg.com.au. Alternatively you can visit the project page on the AUSVEG website at ausveg.com.au/biosecurity-agrichemical/biosecurity/mt16004/.

Any unusual plant pest should be reported immediately to the relevant state or territory agriculture agency through the Exotic Plant Pest Hotline (1800 084 881).

The project *RD&E program for control, eradication and preparedness for vegetable leafminer* (MT16004) has been funded by Hort Innovation using the vegetable, nursery, melon, and potato research and development levies and contributions from the Australian Government.

Project Number: MT16004

Hort Innovation

Industry resources

The MT16004 project team has developed preparedness and management guides to provide support on surveillance and monitoring. Visit ausveg.com.au/mt16004 to access these guides.

There is also a series of short, informative webinars that delve deeper into leafminer risk, surveillance and management. Visit the AUSVEG YouTube Channel to view these webinars: youtube.com/ausveg.

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Peter Anderson, Qld Sales Agronomist — peter.anderson@haifa-group.com — **0459 488 850**

Jason Teng, Customer Service/Logistics — jason.teng@haifa-group.com — **0488 036 528**

(03) 9583 4691 australia@haifa-group.com **www.haifa-group.com**

ENHANCING FUTURE PREPAREDNESS FOR THE VEGETABLE LEAFMINER

This edition of *The Front Line* provides an update on the ongoing strategic levy investment project for the vegetable leafminer. The project involves many research, development and extension activities that will help the Australian vegetable and nursery industries prepare for the pest. AUSVEG Biosecurity Officer Madeleine Quirk speaks to Dr Peter Ridland, an entomologist at the University of Melbourne, to find out more.

Vegetable leafminer on cucumber. Inset: Vegetable leafminer lifecycle. Images courtesy of Elia Pirtle, Cesar.

Project MT16004 – *RD&E Program for control, eradication and preparedness for Vegetable Leafminer (2017-2020)*, a strategic levy investment under the Hort Innovation Vegetable and Nursery Funds, brings together Cesar, the University of Melbourne, Plant Health Australia, the Northern Australia Quarantine Strategy and AUSVEG to undertake a number of activities to prepare for the vegetable leafminer (VLM).

Since 2008, the VLM has been moving down the Torres Strait Islands and in 2015, the pest was detected on the Cape York Peninsula in northern Queensland. MT16004 was developed in recognition of the impact that the VLM could have on Australian vegetable and nursery production industries if it were to move into vegetable production areas.

The project has many facets, including: identifying spread pathways of the VLM to Australia; modelling the spread from Cape York Peninsula; investigating biological and chemical control; developing management guidelines and trapping methods; developing a VLM contingency plan; and communicating updates as they arise throughout the lifetime of the project.

WHAT IS THE VEGETABLE LEAFMINER?

The VLM is one of a small group of agromyzid leafminers that attack a very wide range of host crops, primarily in the Cucurbitaceae, Fabaceae and Solanaceae families. They can also move readily between non-crop and crop plants.

The feeding habits of these pests can be devastating to crops. High levels of mining reduce yield and can also lead to premature defoliation in some crops.

"The adult female fly scrapes circular feeding holes in the plant surface with her ovipositor," University of Melbourne entomologist, and consulting entomologist on the project, Dr Peter Ridland said.

"This damage can facilitate infection by some plant pathogens including bacteria, fungi and viruses," he continued.

Eggs are also laid in some of these feeding holes. Legless larvae hatch and feed internally, forming the characteristic mines in the leaf. However, larvae are generally held in check by generalist parasitoid wasps, which lay their eggs inside other insects or beside other insect larvae, including agromyzid flies.

CURRENT PROJECT FINDINGS AND FUTURE ACTIVITIES

Dr Ridland is reviewing global scientific literature on biological control options for VLM and is compiling a comprehensive overview of research previously conducted in Australia on agromyzids and their parasitoids. In his experience, the review has been important in setting the direction for research in biological control strategies for VLM.

A key finding of the research team has been the recognition that Australia already has a large number of generalist parasitoid species attacking endemic agromyzids and that it will not be necessary to import foreign species as biological control agents for VLM.

"Our challenge will be to utilise existing parasitoid wasps effectively in VLM management while recognising the constraints placed by pest management requirements for other key pests in the crops," Dr Ridland said.

"The second year of the project will see a major emphasis on collecting and rearing parasitoid wasps from a range of agromyzid hosts in the major horticultural areas in eastern Australia.

"We intend to define the distribution of the parasitoid, *Diglyphus isaea*, which to date has only been found in south-eastern Australia."

Dr Ridland and the project team are also very interested in receiving reports of leafmining activity on crop and non-crop plants from growers and consultants.

COULD RESEARCH EFFORTS BE APPLIED TO OTHER LEAFMINER SPECIES?

Dr Ridland added that the information gained from MT16004 on the Australian fauna of generalist leafminer parasitoids will also be directly applicable to two other closely related leafminer species, *L. huidobrensis* and *L. trifolii*. These species are currently found in south-eastern Asia and some nearby Pacific Islands, and both pest species are considered to be more damaging pests than VLM, largely due to the high level of insecticide resistance in the invading populations found in Asia.

INFO R&D

For more information, contact AUSVEG Biosecurity Officer Madeleine Quirk on 03 9882 0277 or madeleine.quirk@ausveg.com.au. Alternatively you can visit the project page on the AUSVEG website at ausveg.com.au/biosecurity-agrichemical/biosecurity/mt16004/.

Any unusual plant pest should be reported immediately to the relevant state or territory agriculture agency through the Exotic Plant Pest Hotline (1800 084 881).

This project has been funded by Hort Innovation using the nursery and garden and vegetable research and development levies and contributions from the Australian Government. The Vegetable and Potato Biosecurity Program is funded by the Plant Health Levy.

Project Number: MT16004

Hort Innovation

KEY PROJECT PERSONNEL

University of Melbourne entomologist Dr Peter Ridland's extensive experience is of great value to the vegetable leafminer project.

Dr Ridland has worked on many different pests of field crops, pastures and vegetables at the Victorian Department of Agriculture (1974-2005) as well as completing his PhD on the biology and ecology of cereal root aphids at La Trobe University in 1988. He also worked on a series of entomological projects in Indonesia looking at pests of vegetables and potatoes in the 2000s.

"I was fortunate to lead an ACIAR project looking at two invasive pests which were considered to be potentially very important pests in Australia: vegetable leafminer (*Liriomyza sativae*) and potato leafminer (*L. huidobrensis*)," he said.

Dr Ridland has an abiding interest in helping farmers manage pests by promoting natural enemies (including parasitoids and predators) in crops by avoiding indiscriminate use of broad-spectrum insecticides and using more specific chemicals in a targeted fashion.

"Our knowledge and experience from the ACIAR project has provided a solid foundation to the Hort Innovation project," he stated.

Dr Ridland also plays a role in developing a contingency plan for VLM, which is being led by Plant Health Australia. He is also assisting other project members with their sub-projects where required and he sits on the Project Steering Committee.

In addition, Ary Hoffman (University of Melbourne) and Paul Umina (Cesar and University of Melbourne) are working alongside Dr Ridland to co-supervise a Masters student, Marianne Coquilleau, whose focus is to determine the distribution and diversity of leafminer parasitoids in key vegetable and nursery production areas in Australia. Her work will involve sampling main agromyzid leafminer species and parasitoids and use molecular tests to identify them.

Xuefen-Xu from Sun Yat-Sen University in China has just enrolled as a PhD student and she is likely to be looking in detail at the genetic structure of VLM populations around the world to assist in the pathway analysis of VLM being undertaken in the project.

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A yellow sticky trap at CERES.


AUSVEG Biosecurity Officer Madeleine Quirk visited CERES in January.

COMMUNITY GARDENS PROVIDE SURVEILLANCE AND SAMPLING OPPORTUNITIES FOR VEGETABLE INDUSTRY

In January 2018, staff from Agriculture Victoria and AUSVEG visited the CERES sustainability centre in Melbourne to set yellow sticky traps for surveillance of tomato potato psyllid (TPP) populations. TPP has not been detected in Victoria, however, urban surveillance efforts such as this and similar efforts in other states will assist with early detection and claiming state area freedom. AUSVEG Biosecurity Officer Madeleine Quirk discusses how various plant biosecurity projects are involving community parks and gardens.

The Centre for Education and Research in Environmental Strategies (CERES) is a not-for-profit sustainability hub for environmental, social and economic sustainability. CERES is set on 4.5 hectares of land in East Brunswick, Victoria.

CERES offers a space for community members to come together and grow their own fresh produce. CERES staff, assisted by volunteers, also grow produce at the CERES Organic Farms. The produce grown at the Organic Farms is sold at the onsite organic market and grocery, as well as being used at the site café, the Merri Table.

TOMATO POTATO PSYLLID SURVEILLANCE

In response to the detection of tomato potato psyllid (TPP) in Western Australia, Agriculture Victoria ramped up surveillance activities for TPP across the state, conducting trapping and engagement activities in metropolitan and rural production areas. These surveillance efforts prove state freedom and provide industry with market access options. In January, staff from Agriculture Victoria and AUSVEG visited CERES to set yellow sticky traps for surveillance of TPP. CERES is well-known for supporting the community and was very willing to allow trapping activities to go ahead at its site.

Agriculture Victoria Officers set traps across the property, which were left intact for seven days before being taken to Agriculture Victoria's diagnostics laboratory for analysis. The CERES site horticulturalist oversaw the trapping activities. In the weeks prior to this visit, yellow sticky traps were erected at community gardens in Avondale Heights and Strathmore Heights. The same surveillance procedures were followed at these sites.

Erecting yellow sticky traps across metropolitan locations is essential for TPP surveillance. As we have learnt from the detection of TPP in a Perth backyard, we never know where an exotic pest will first appear.

Although TPP was not detected in Victoria at the time of writing, the activities being undertaken by Agriculture Victoria in collaboration with community gardens across Melbourne will act as an early warning system for industry and will assist in proving Victoria's area freedom. Other states and territories are also conducting surveillance activities in order to confirm freedom from TPP. These collaborations are integral for safeguarding the vegetable and potato industries.

COMMUNITY GARDENS BENEFIT VEGETABLE R&D

Another collaborative project, *RD&E Program for control, eradication and preparedness for vegetable leafminer* (MT16004) – a strategic levy investment under the Hort Innovation Vegetable and Nursery Funds – highlights how community parks and gardens can assist R&D activities across the country.

The project was developed to raise awareness of vegetable leafminer (*Liriomyza sativae*) and its management. Project partners include Plant Health Australia, Cesar, the University of Melbourne, the Northern Australia Quarantine Strategy (NAQS) and AUSVEG.

The project commenced in 2017 and will conclude in 2020. During this time, project partners will identify the distribution of the vegetable leafminer in Australia, track pathways of spread across the Torres Strait and Australia, develop surveillance strategies, investigate control options (including the use of parasitic wasps to control flies) and communicate the outcomes of the project to growers across Australia.

In spring of 2017, Cesar's Dr Elia Pirtle collected larvae of local species of leafminer flies from nasturtium, chickory and rocket plants at a Marist180 community garden in Brunswick.

"From these collections, I was able to rear several species of parasitic wasps that attack leafminer flies, keeping leafminer populations under control," Dr Pirtle said.

These parasitic wasps included *Closterocerus mirabilis, Hemiptarsenus varicornis, Opius* spp., and an unidentified Eulophid. The wasps emerged from parasitised pupae of what were very likely cabbage leafminer (*Liriomyza brassicae*), a close relative of the vegetable leafminer.

"These collections helped build a better picture of our local community of beneficial wasps, which may play an important role in controlling incursions of the vegetable leafminer," Dr Pirtle said.

The project aims to prepare for the arrival of the vegetable leafminer into vegetable, fruit and nursery production areas across Australia. Community gardens assist the project because they can provide experimental sites for analysis of agromyzid control options.

GENERAL PUBLIC ON THE LOOKOUT

If you notice an unfamiliar or suspicious pest in your garden or on your farm, call the Exotic Plant Pest Hotline on 1800 084 881 to report it.

INFO

For further information, contact Cesar's Dr Elia Pirtle at epirtle@cesaraustralia.com, AUSVEG National Manager – Science and Extension Dr Jessica Lye at jessica.lye@ausveg.com.au or AUSVEG Biosecurity Officer Madeleine Quirk on 03 9882 0277 or madeleine.quirk@ausveg.com.au.

This communication has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

Project number: VG15027

Hort Innovation Strategic levy investment | VEGETABLE FUND

Vegetable leafminer larvae damage on snake bean. Image courtesy of Dr Jessica Lye.

Vegetable leafminer. Image courtesy of bugwood.org.

HORTICULTURAL INDUSTRIES GET ACTIVE IN PREPARING FOR EXOTIC LEAFMINING PEST

A recently launched RD&E project, funded by the nursery and garden industry, and the vegetable industry, will pave the way for effective management of the vegetable leafminer – a recent arrival to Australian shores and a major agricultural pest. AUSVEG National Manager – Science and Extension Dr Jessica Lye reports.

THE PEST

'Agromyzidae' are a group of small flies, the larvae of which feed on plants, often as leaf and stem miners. A few species, including vegetable leafminer (VLM, *Liriomyza sativae*) have become important pests of agriculture in many parts of the world.

With small dark bodies of about 1-2 millimetres in length, the most striking feature of adult VLM are areas of bright yellow cuticle on the head, upper body and parts of the abdomen.

Eggs are laid just beneath the leaf or stem surface and hatch about three days later.

THE DIET

According to preliminary project results, the VLM diet includes cucurbits (e.g. cucumber, bitter-gourd, bottle gourd, zucchini, squash and pumpkin), solanaceae (e.g. eggplant, capsicum, chilli, potatoes and tomatoes), asteraceae (e.g. lettuce), brassiceae (e.g. cabbage, Asian leafy vegetables, and broccoli) and fabaceae (e.g. broad bean and peas). Carrot, celery and spinach, which are important vegetable commodities, have also been identified as hosts. The VLM diet may also extend to other crops such as cotton and lucerne. Ornamental plants such as snap dragon and petunia, and most allium species, including onions and garlic, are also food sources.

THE IMPACT

For growing operations and the agricultural supply chain, exotic plant pest incursions are true crisis situations. As globalisation continues, our biosecurity system will come under increasing pressure.

So, what value should we place on biosecurity preparedness? This is perhaps best answered by looking at what is at risk from the spread of VLM.

Unhappy retailers and consumers: Puncture marks caused during oviposition or feeding leads to a stippled appearance of produce. The major damage, however, is caused by larvae tunnelling inside the leaf resulting in silvery, spiralling tracks that become wider over time.

Sick crops: Multiple 'mines' on each leaf can lead to secondary infections, interrupt the growing ability of plants and ultimately reduce yield.

Disrupted trade: Past detections of exotic pests in Australia have led to domestic and international trade restrictions and bans. Growers may also expect increased compliance costs associated with moving produce from a VLM-affected region.

Costly pest management: VLM is prone to developing pesticide resistance. Establishment in growing areas may disrupt property or regional Integrated Pest Management (IPM) programs and increase pesticide usage – at least until effective management plans have been put in place.

Quarantine: Businesses may be required to seize operations in affected zones for an undefined period of time.

The entire vegetable industry was worth $3.8 billion at the farm gate in 2015-16. International exports are up eight per cent from 2015 and are now worth approximately $246 million. The vegetable industry is investing significant R&D funds into the development of international markets, as well as adoption of IPM.

Valued at $1.17 billion in 2015-16, the nursery and garden industry is the lifeblood of Australian horticulture, supplying healthy seedlings and rootstock to growers around Australia. This dollar amount does not account for the value of this industry in supporting the supply chain. →

Integrated Pest Management is an ecosystem-based approach that focuses on prevention or suppression of pests through a combination of methods such as biological control, habitat manipulation, modification of cultural practices, use of resistant crop varieties and targeted chemistry.

Vegetable leafminer larvae damage on tomato. Image courtesy of NAQS.

THE PROJECT

The project *RD&E program for control, eradication and preparedness for Vegetable leafminer* (MT16004) is a strategic levy investment under the Hort Innovation Nursery Fund and Vegetable Fund, and will run until 2020. After recognising the impact that VLM could have on Australian horticulture were it to move into production areas, this project is all about being prepared. It brings together Cesar, the University of Melbourne, Plant Health Australia, the Northern Australian Quarantine Strategy (NAQS) and AUSVEG.

What will we do?

- We will investigate the best methods of trapping for VLM.
- We will investigate how VLM is spreading to Australia, and model where the pest may spread in future.
- We will develop a management plan for VLM, which will be structured around an IPM approach.
- We will develop a contingency plan that will guide industry and government in a plan of action if VLM is found in production zones.
- We will raise awareness about VLM around Australia with growers, councils and the public through workshops, webinars and fliers.
- We will travel to the Torres Strait and Cape York to educate locals in effective VLM management and detection.

All of the above will support our primary industries in managing VLM should it spread south. Greater knowledge about VLM ecology in Australia may even allow industry and government to contain or eradicate it. We will also have a better understanding of where VLM may first spread, and can proactively educate industry in management practices in these regions. Education in the Torres Strait and Cape York will help us develop a 'buffer zone' to slow the establishment and spread of VLM.

Project Lead, Dr Paul Umina from the Cesar research group, is realistic about the potential for VLM spread, yet hopeful about the impact of the project.

"There is little doubt this species will move from far-north Queensland into key agricultural production areas, so it's important we understand the likely impacts this pest will have in Australia, and be equipped to manage it effectively," Dr Umina said.

"Our team faces a few challenges. VLM being restricted to a small, remote region means undertaking some research activities will prove difficult. For example, we must infer from this isolated context how VLM will behave within Australia's diverse production regions. We'll need to think laterally, and quite creatively, to address these types of questions.

"Together, we hold vast experience across multiple industries in biosecurity and insect pest management, with expertise in ecology, biological control, insecticide resistance, modelling, genetics, policy and industry communication."

There are other exotic agromyzidae found around the globe that could potentially pose a threat to Australian horticulture. These include the American serpentine leafminer and pea leafminer. Hopefully, this preparedness project will also shed some light on these other pests and how we can best prepare for them.

A key researcher on project MT16004 is Dr Elia Pirtle from Cesar.

After studying how reptiles stay cool and hydrated under extreme environmental conditions during her PhD with the University of Melbourne, Dr Pirtle – a native of Nevada, United States – changed track to pursue practical and applied research that promotes sustainability. This led her to join Cesar and the vegetable leafminer (VLM) project team, where she leads the development of toolkits for detecting and monitoring VLM. She will conduct research trips to the Torres Strait and Queensland to collect and rear VLM, test trapping methods, and build distribution maps of the pest, its host plants and its predators.

HAVE YOU SEEN THE VEGETABLE LEAFMINER?

VLM damage may be confused with that of the endemic cabbage leafminer or chrysanthemum leafminer. Suspect detections of VLM should be reported to the Exotic Plant Pest Hotline on 1800 084 881.

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INFO

If you have any questions about the project, please get in touch with AUSVEG National Manager – Science and Extension Dr Jessica Lye on 03 9882 0277 or at jessica.lye@ausveg.com.au.

RD&E program for control, eradication and preparedness for Vegetable leafminer has been funded by Hort Innovation using the nursery industry and vegetable research and development levies and contributions from the Australian Government.

Project Number: MT16004

Hort Innovation

Vegetable leafminer lifecycle – larvae, pupae and adult. Image courtesy of Dr Elia Pirtle, Cesar.

THE JOURNEY OF THE VEGETABLE LEAFMINER (VLM)

1938
VLM is identified in Argentina.

1940-2000s
VLM is detected across the globe in the United States and Central America, parts of Africa, Asia and the Pacific Islands.

2008
VLM is detected on Warraber Island in the Torres Strait.

2008-13
VLM 'island hops' down the Torres Strait until it is detected on Horn Island, only 55 kilometres away from Cape York, the most northerly point of the Australian mainland.

2014
Industry and government decide VLM cannot be feasibly eradicated from the Torres Strait.

2015
VLM is found on Cape York Peninsula. Industry and government decide it cannot feasibly be eradicated from the region.

2015
A working group is formed to investigate strategies for preventing spread to major production areas south of Cape York.

2016
An RD&E project is approved by the nursery and garden, and vegetable industry investment panels through Hort Innovation.

2017
A three-year project is launched by Hort Innovation.

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