Australian Government
Wine Australia

Charles Sturt University

FUNCTIONAL BIODIVERSITY: A FOCUS ON SCALE INSECT PESTS AND ENHANCEMENT OF THEIR PARASITOIDS.



FINAL REPORT TO WINE AUSTRALIA

Project Number: **CSU 1702-8.1**

Principal Investigator: **Geoff Gurr, supported by Drs Jian Liu, Lachlan Jones and Nan Wang**

Research Organisation: **CHARLES STURT UNIVERSITY**

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1. Abstract

This project studied scale insects and how to control them. Grapevine scale was the most common species, usually with patchy distribution. Infestations were worse in vineyard edges near perennial crops and buildings since such woody plants are potential alternative hosts. Parasitic wasps were common on vines in summer but species that attack scale insects were rare, possibly due to ants protecting the scale. Vetch groundcovers to distract ants are not ideal for vineyards. Better cover crop options identified in earlier work should be used. Communication activities have been undertaken to communicate recommendations.

2. Executive summary

Rising concern among winegrape growers regarding increasing infestations of scale insect pests—potentially exacerbated by climate change—prompted Wine Australia to fund the present project. The aim of this work was to capture field data that would underpin the development of an expanded range of management (control) options.

Surveys were conducted over two years across six New South Wales vineyards—primarily in the Riverina region—quantifying scale insect populations on vines. Sampling was undertaken both centrally and along vineyard edges, the latter to detect potential influences from adjacent land uses and vegetation types. In addition to visual inspections, a motorised vacuum sampler was used to collect beneficial insects from vine foliage.

Grapevine scale (*Parthenolecanium persicae*) was the dominant species detected, with only occasional observations of frosted scale (*Parthenolecanium pruinosum*). Scale insects were present at all sites and during each sampling event, though their distribution was highly patchy. While most vines were uninfested, dense localised hotspots were common. Scale were observed across all vine structures, including canes, spurs, petioles, leaves, and berries. Infestation levels varied widely among vineyards, between years, and across seasons. One organically managed site recorded relatively low pest numbers, although scale insects were still present.

Despite the high level of variability in the data, a potentially important trend emerged: scale numbers were higher in vineyard edges adjacent to perennial horticulture or built infrastructure— both areas supporting a variety of alternative host plants, including ornamental shrubs. Built environments, particularly around cellar doors, often included these woody hosts. Such plants constitute potential scale insect harbourage and allow spillover into vines. Whilst adult female scale insects are sessile, other life stages are mobile. Immature scales (‘crawlers’) can be wind-dispersed and adult males are winged, enabling colonisation from nearby vegetation. These findings point to the importance of inspecting adjacent woody plants, which may serve as “donor vegetation” for vineyard reinfestation.

Previous Australian studies have highlighted biological control as a promising management strategy. Parasitic wasps, which oviposit into scale insects and developing larvae consume their hosts internally, leave visible emergence holes when mature wasps exit. In the present study, 669 parasitoid individuals across 165 morphospecies were collected. However, only two of these species are known to specialise on scale insects: *Metaphycus maculipennis* and *Ophelosia bifasciata* and these were rare in vacuum samples collected from vineyards.

Earlier authors have suggested that cover crops such as common vetch (*Vicia sativa*) may attract ants away from vines by providing nectar, potentially exposing scale insects to parasitism. While this approach has reportedly been trialled overseas, it remains untested in Australian vineyards and has logistical complexities such as the tall and climbing habit of this plant. Consequently, growers interested in this strategy are encouraged to consider alternative groundcovers with prostrate, non-climbing habits. An earlier Wine Australia project identified suitable nectar-producing species, such as alyssum and buckwheat, through the Cover Crop Finder Tool (www.covercropfinder.com.au). These plants support beneficial insects, including parasitoids of lightbrown apple moth, and may similarly benefit those attacking scale insects (www.wineaustralia.com/research_and_innovation/projects/functional-biodiversity-solutions-for-australian-vineyards).

In conclusion, integrated pest management (IPM) remains the foundation of best-practice scale insect control. This includes routine monitoring to detect hotspots—guided by signs such as ant trails, honeydew, and sooty mould—and treatment with paraffin oils during winter or other insecticides in spring. Woody plants near vineyard margins, particularly those adjacent to built infrastructure or perennial crops, should be included in inspections. Heavily infested canes can be removed during pruning and either mulched or disposed of off-site to reduce reinfestation. While commercial releases of predatory beetles and lacewings may be cost-prohibitive at broad scale, they may be considered useful for targeted hotspots. Cover crops, if well chosen, offer multifunctional benefits—supporting biological control agents while reducing pest pressure from scale insects.

This work was financially supported by Wine Australia and Charles Sturt University. The authors gratefully acknowledge the cooperating growers for allowing access to their vineyards and Wine Australia for funding the project under the Strategic Research Agreement CSU 1702.

3. Background

Research led by Professor Gurr at Charles Sturt University has shown that biodiversity-driven pest management strategies can be implemented effectively using vegetation management techniques in vineyards[1]. These principles have also proven successful in other key production systems, such as rice paddies and various horticultural crops[2]. Collectively, these findings present a valuable opportunity for the Australian viticulture industry to further embrace ecologically grounded methods—quite literally allowing producers to 'grow sustainable environments.' This ethos aligns directly with the ambitions of Strategy 4 outlined in the Wine Australia 2020–2025 Strategic Plan, which advocates for the adoption of practices that enhance sustainability and resilience in wine production.

While biodiversity-based practices have seen widespread uptake within Australia's rice-growing sector[3], there is increasing recognition that the specific selection of plant species is pivotal to achieving the desired ecological benefits. Inappropriate or poorly matched species may inadvertently cause negative outcomes, underscoring the importance of species choice in integrated pest management programs[1,4]. This consideration is particularly crucial in vineyards, where persistent pest challenges—such as the lightbrown apple moth (*Epiphyas postvittana*)—are complemented by emerging pests including scale insects. Recently, there has been growing concern over the prevalence of scale insect pests, including species such as *Parthenolecanium persicae*.

To date, research in vineyard settings has largely concentrated on a limited range of plant species considered suitable for cover cropping or, in the case of taller or more robust plants, for establishment as insectary habitats. Pioneering studies, such as those by Retallack[5], provided early insight into how specific species might contribute to promoting biological control agents. More recently, a CSU-led project (www.wineaustralia.com/research_and_innovation/projects/functional-biodiversity-solutions-for-australian-vineyards) expanded the scope of investigation by considering not only in-field vegetation but also the broader influence of adjacent land uses and the configuration of surrounding landscapes on vineyard pest dynamics.

Building on this foundation, the current project sought to explore these relationships with regard to scale insects and their natural enemies. It investigated how the land uses and vegetation in vineyard-adjacent areas can influence scale pest pressure.

4. Project Aims

This work aimed to develop practical, evidence-based recommendations for Australian vineyard managers to benefit from biodiversity-based solutions with a focus on scale insect species.

Specific outputs and performance targets are set out in Table 1 but were affected by an approved no-cost, 12 month-long extension that took the final date for reporting to 30 June 2025.

Table 1. Planned outputs and activities for the project 'Functional Biodiversity Project Extension: a focus on scale insect pests and enhancement of their parasitoids'.

Output	Target Date	Activities
Body of knowledge on winter scale identity and density identifying effects of landscape, neighbouring land use and within-vineyard vegetation (groundcovers).	30/09/2023	Vineyard sampling (beneath bark on spurs, canes and cordons) to identify dormant scale species and assess density in Riverina vineyards.
Body of knowledge on identity of parasitic wasps of scale pest from samples collected in the previous two years of the project.	31/12/2023	Deep dive examination of all samples collected and stored in the laboratory from the 2021/22, 2022/23 seasons to examine scale insects and known parasitoids species.
Body of knowledge on summer sampling of vineyards for parasitic wasps and scale insects identifying effects of landscape, neighbouring land use and within-vineyard vegetation (groundcovers).	31/03/2024	Vineyard sampling (foliage and berries) to identify juvenile scale species and assess the density and sooty mould severity in Riverina vineyards. Visual inspection and vacuum sampling of vineyards for a third season to identify parasitic wasps of scale insects and other relevant natural enemies.
A suite of communications	30/06/2024	Data analysis and formulation of recommendations leading to a

outputs.		webinar, a *Grapegrower and Winemaker* article and presentations prepared to use in NSW DPI spring vine health field days.

5. Method

5.1. Vineyard scale insect survey

The survey work extended over two years encompassing the 2023-2024 and 2024-2025 seasons. Six vineyards, most set in the Riverina, one in a warm Central West NSW region, were involved. Each block was visited in summer and winter (Figure 1) when sampling positions were designated in the centre of each vineyard as well as vines close to each edge (Figure 2).



Figure 1: Visual assessment of scale numbers during winter (equivalent assessments also took place in the summer).

Edge sampling was to detect (by comparison with samples from the centre of the same block) any effects that resulted from the differing forms of land use and vegetation growing adjacent to the vineyard. At each position, 5-10 vines were selected and visually assessed for the numbers and identity of scale insects on:

- on each of 10 spurs (winter);
- or canes, foliage and bunches (summer).

Scale insect numbers expressed as mean per vine to allow aggregation of data across vineyards and statistical analyses using R suite software.



Figure 2: Illustration of sampling positions (red dots) in the centre and edges of one study vineyard.

5.2. Vineyard vacuum sampling

A motorised vacuum sampler was used to collect arthropods (including adult parasitoid wasps) from the vine foliage (Figure 3). This took place on the same sites as used for the scale insect survey but took place only in the summer (on the same date as scale insects were counted).

Margin samples were taken in the vines from the second row in from the edge. For edges where the vine rows met at right angles, the samples were taken at about 3m from the ends of the row. Blocks that had contrasting land uses in the immediately adjacent areas were selected. Adjacent land uses were categorised as follows. 1. perennial horticulture including orchards, and vineyards; 2. narrow linear non-crop vegetation including road, tree line, non-crop vegetation belt/line, 3. grassland including grazed or non-grazing areas; 4. built infrastructure (such as a cellar door, residential house, shed) along with the associated vegetation.

Vac-sampling was timed for 2-minutes per sample area. The vacuum samples were immediately placed in a portable freezer to avoid predation of animals and taken back to the laboratory for sorting.



Figure 3: Collection of parasitic wasps and other insects from vines during summer.

5.3. Laboratory Studies

Sampled arthropods were picked out of the vacuum samples and identified into categories of natural enemies. Parasitoids were sorted into morphospecies and compared with published descriptions of known scale insect parasitoids species.

6. Results/Discussion

Among the multiple species of scale insect that have been reported from Australian vineyards (Figure 4), grapevine scale (*Parthenolecanium persicae*) was the most prevalent species recorded across study sites, with frosted scale (*Parthenolecanium pruinosum*) detected only sporadically.

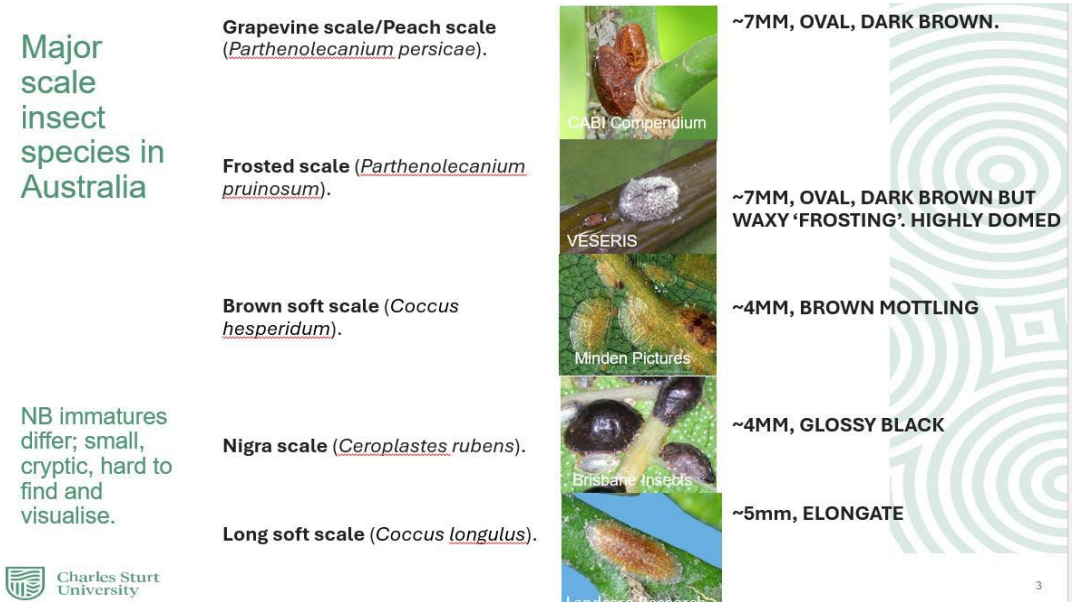


Figure 4. Species of scale insect reported from Australian vineyards showing characteristic form of adult females.

Scale insects were observed at every vineyard on all sampling dates, yet their spatial distribution was highly heterogeneous. While the majority of vines were uninfested or lightly infested, numerous discrete hotspots exhibited substantial pest densities (Figure 5).

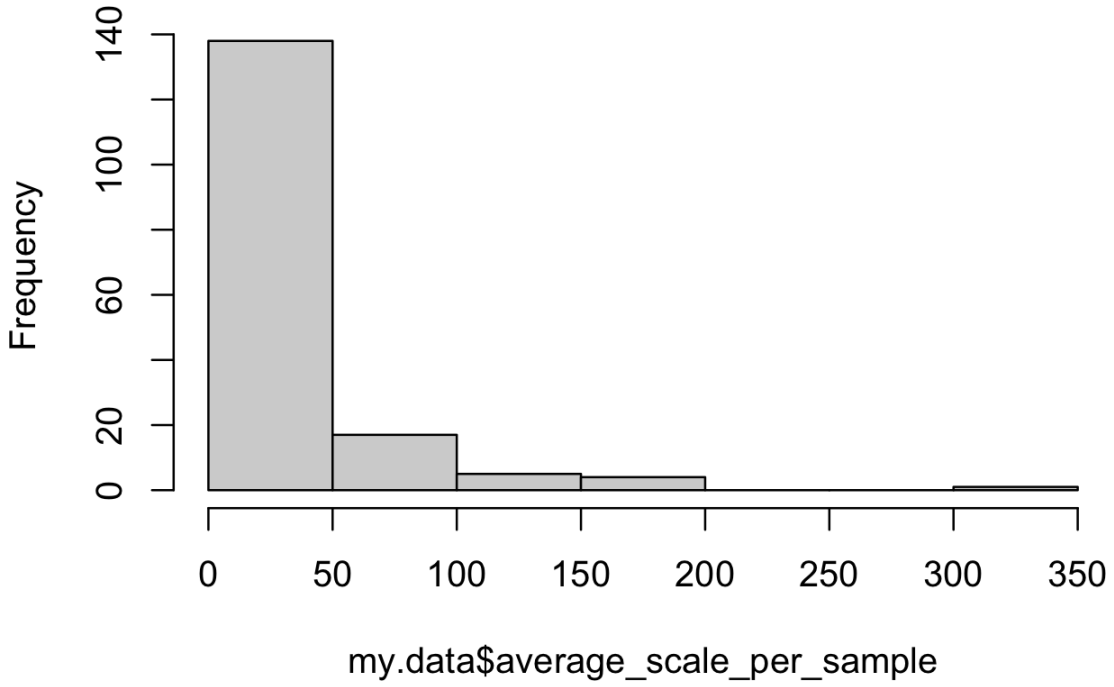


Figure 5. Frequency distribution of mean number of scale insect per vine illustrating that most observations revealed low numbers, there were significant numbers of 'hotspot' infestation with over 50 scale insect per vine.

In terms of plant architecture, scale insects colonised virtually all vine components—including canes, spurs, petioles, leaves, and berries (Figure 6).

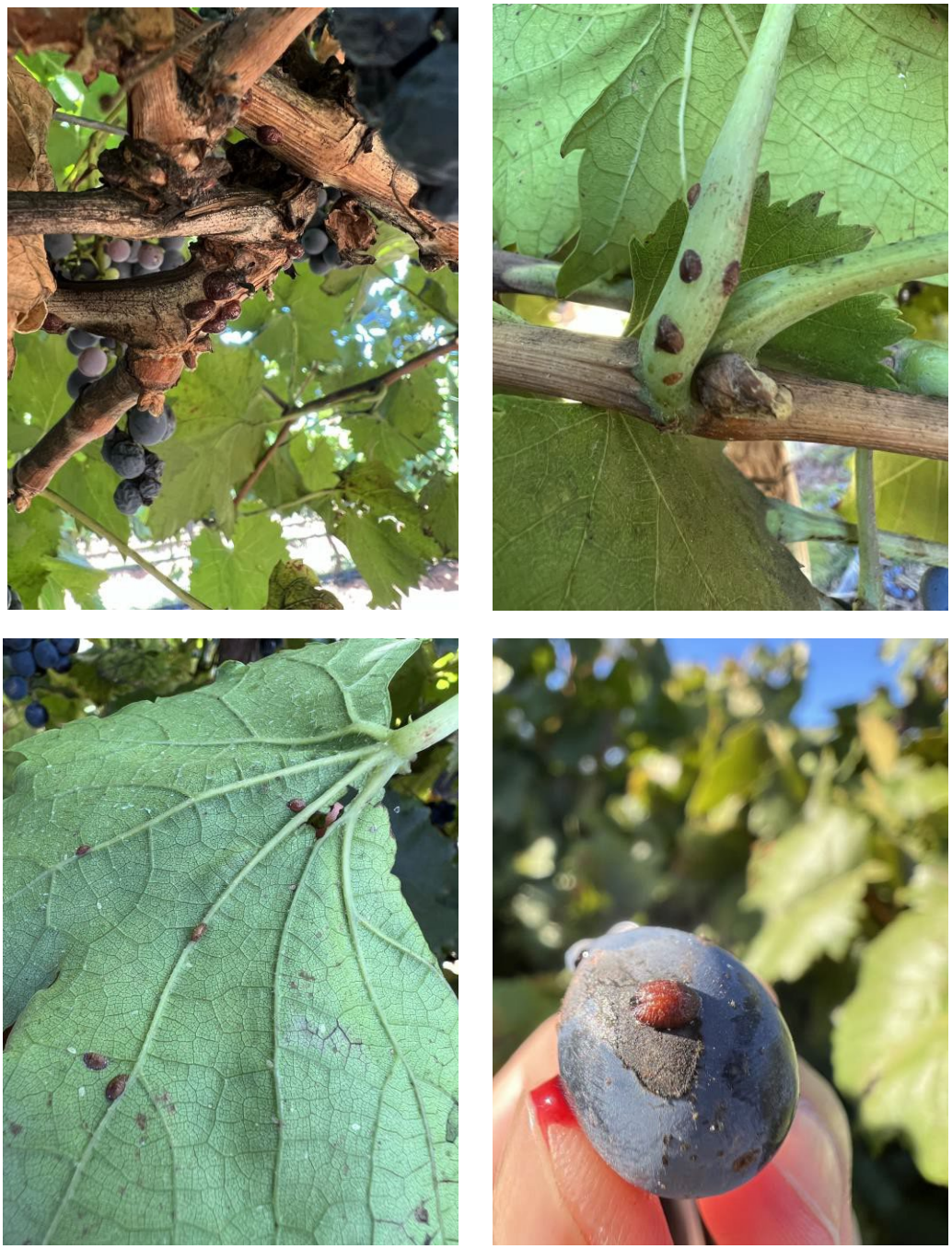


Figure 6: Grapevine scale insect on canes, petioles, leaf and berry.

Scale insect infestation intensity varied markedly across seasons; over all vineyards, numbers were greatest in the first winter of the project (2023) and lowest in the final summer of the project (2025) (Figure 7).

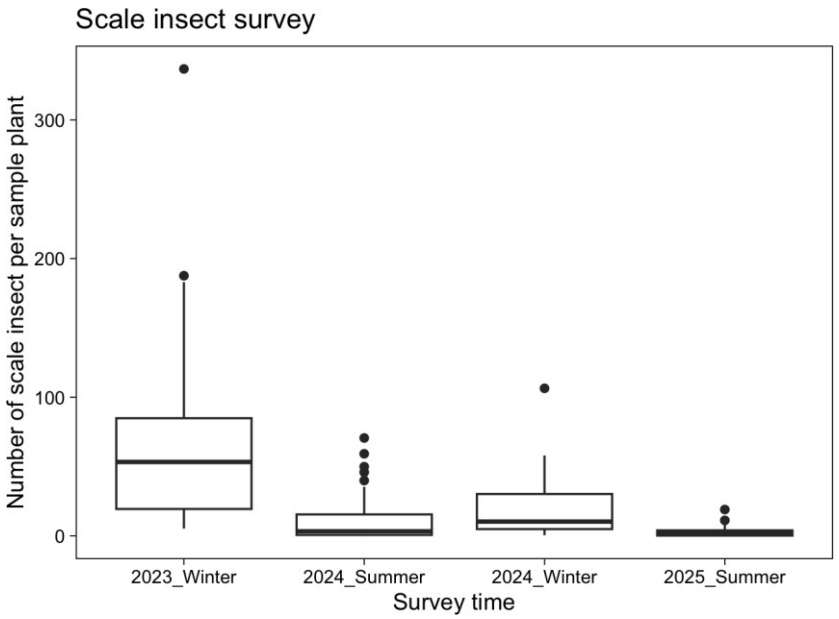


Figure 7. Mean numbers of scale insects per vine over successive seasons.

An additional aspect of variability in the data set was marked difference among vineyards (Figure 8). Highest numbers of scale were present in vineyard #1 which was that in the coolest location, a low elevation and relatively warm part of Central West NSW. Numbers were especially high in the first winter of the project and, after this result was reported to the owners the block was treated with paraffinic winter oil. The remaining five vineyards (in the Riverina) had lower numbers of scale.

Vineyard #3 was operating under organic certification and recorded intermediate numbers of scale. This suggests that removal of synthetic pesticides neither allowed scale to proliferate (though noting that paraffinic winter oils are generally allowed in organic agriculture) nor allowed a build up of natural enemies that completely controlled scale.

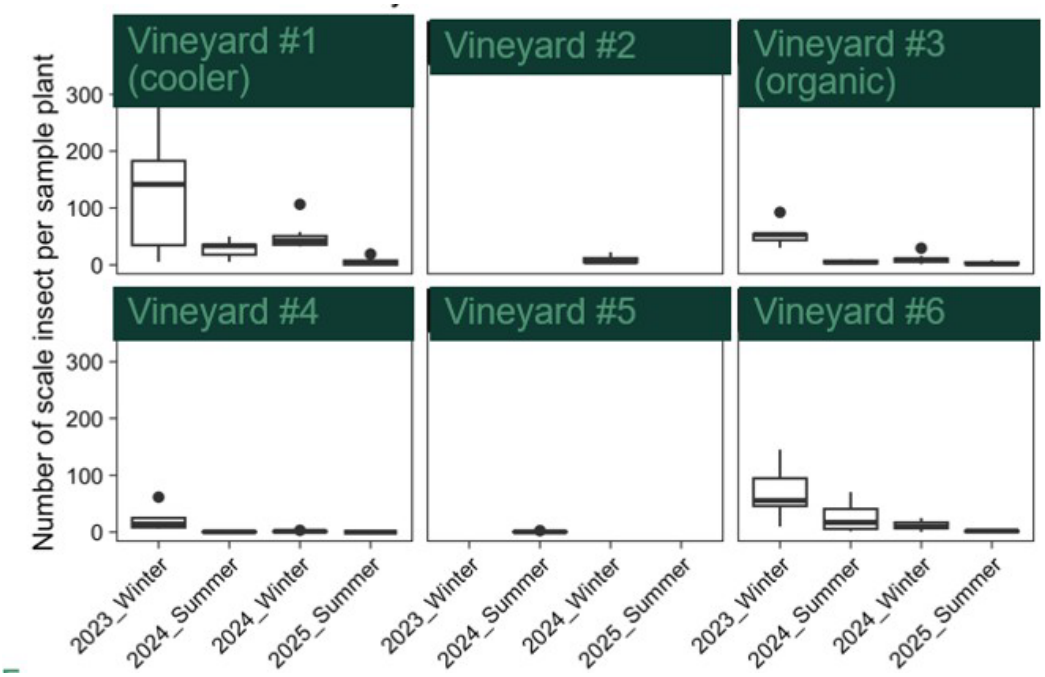


Figure 8. Mean numbers of scale insects per vine over successive seasons for each vineyard study site.

Notwithstanding the high level of temporal and across-site variability in the scale infestation data, a marked spatial pattern emerged when data were aggregated and then partitioned by position within vineyard (i.e. centre versus edges). Vineyard edges adjacent to perennial horticulture or built infrastructure exhibited higher grapevine scale densities (Figure 9). This aligns with the species' polyphagous tendencies—despite its common name, grapevine scale can exploit a wide array of host plants across numerous families, including commercially important crops such as citrus and apple, as well as ornamental woody vegetation. Built environments—especially near cellar doors—frequently include gardens, hedges, and shade trees selected for aesthetic value. Such plantings can serve as refugia for scale insects, supporting resident populations that may later disperse into vineyards. Adult females are sedentary and anchored to host tissues beneath protective covers, but other life stages are highly mobile. Crawlers are sufficiently small to be carried by wind currents, while winged adult males can disperse over moderate distances. As such, reinfestation events are likely facilitated by nearby donor vegetation. These findings underscore the need for broader spatial awareness in vineyard biosecurity, particularly routine inspection of surrounding woody vegetation.

In contrast to the foregoing effect of wood plants on scale insect numbers in vineyard edges, the limited number data on edges adjacent to grassland suggests an opposite effect with

lower densities of scale insects (Figure 9). This likely reflects the host specificity of *P. persicae*, which does not utilise grasses for feeding or reproduction.

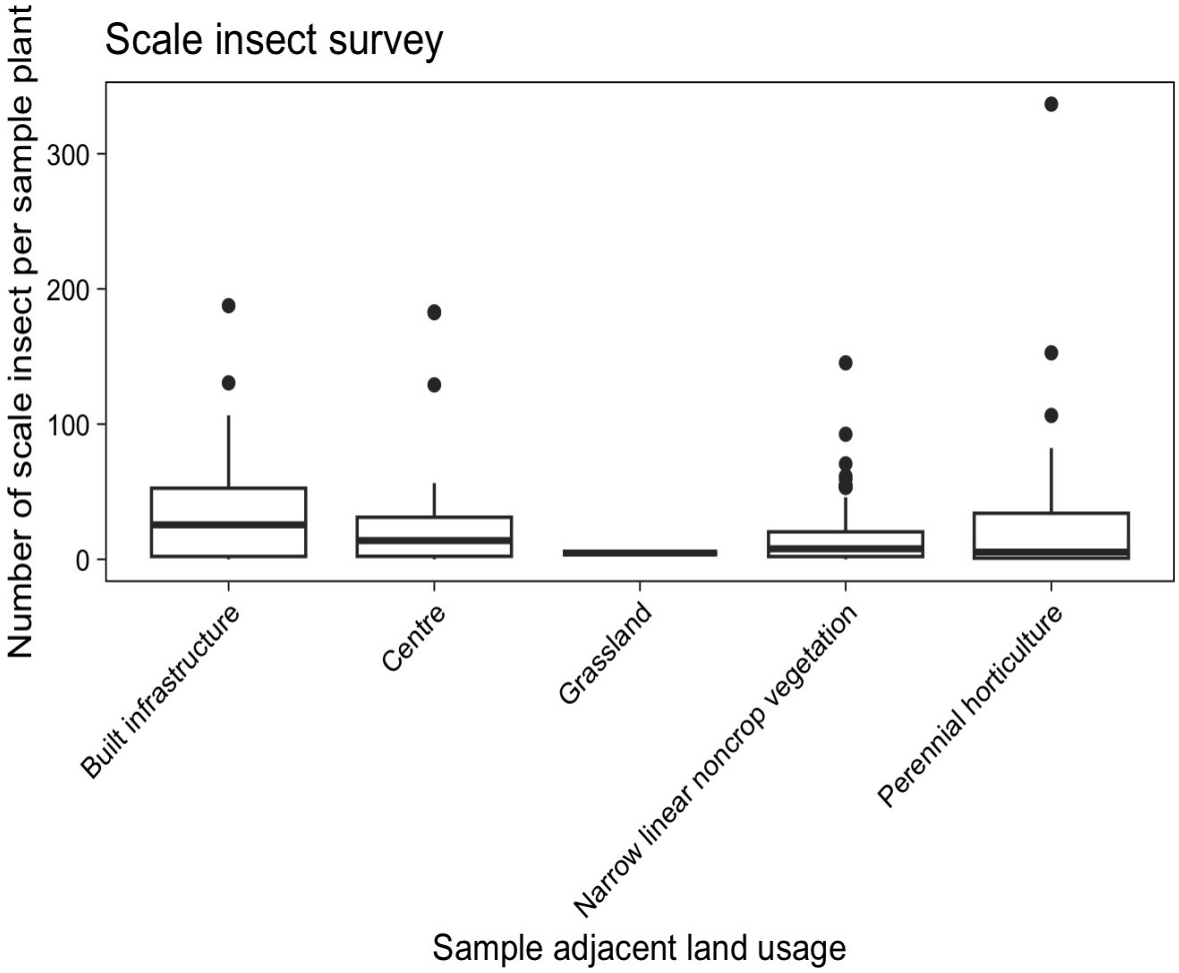


Figure 9. Evidence for spillover effects of scale into vineyard edges. Perennial horticulture and built infrastructure are likely to harbour grapevine scale (which attacks many woody plant species) so numbers are higher in vineyard edges compared with vineyard centre. In contrast, vineyard edges adjacent to grassland have low scale densities since grassy plants do not host scale.

Biological control remains a promising yet underutilised strategy in Australian vineyards. Historical and recent work suggests that hymenopteran parasitoids can be effective natural enemies of scale insects. The adult female wasp oviposits into the scale host, with emerging larvae consuming internal tissues—a process resulting in host mortality. Emergence holes left behind in the dead scale are visible to the naked eye (Figure 10) and these were observed sporadically in the present study.



Figure 10: Parasitic wasps attack scale insects and evidence of the emergence of a wasp from a (now dead scale insect) is the circular puncture wound.

A total of 669 individual parasitoids encompassing 165 morphospecies were collected via vacuum sampling. Numbers were relatively high; sometimes exceeding 10 wasps in each 2-minute-long episode of vacuum sampling from vines but were conspicuously higher in the summer of 2024 than in summer 2025 (Figure 11). Parasitoid numbers also varied markedly among vineyards with numbers especially high in vineyards #1 and #6 but low at the organic site (vineyard #3) (Figure 12).

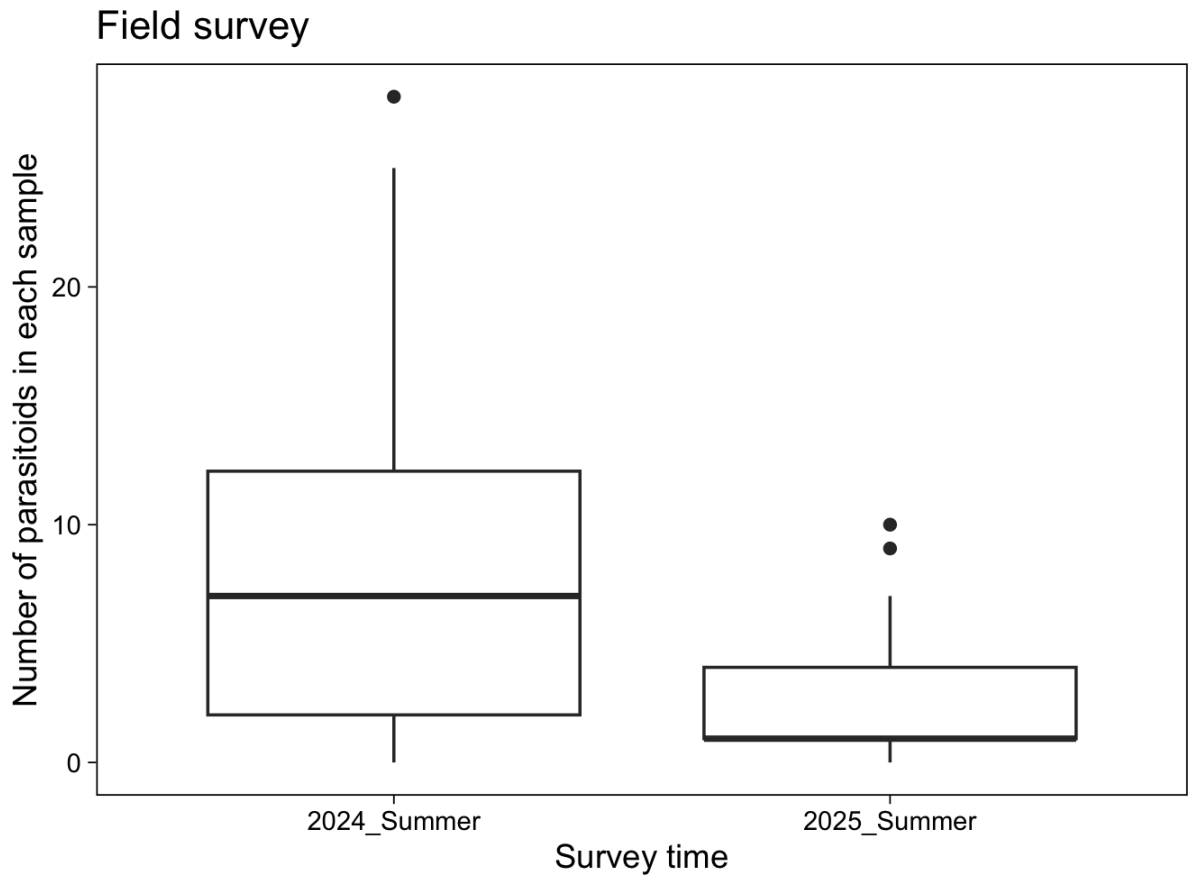


Figure 11: Temporal trend of parasitoids (all species) in vineyards (all positions).

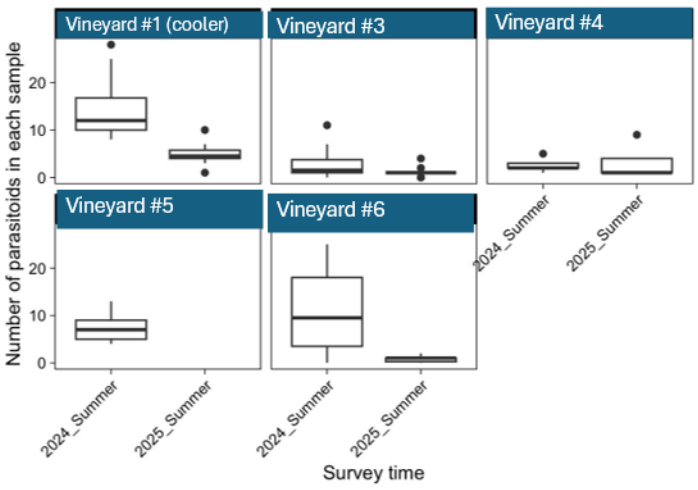


Figure 12. Parasitoid catches (all species) partitioned by vineyard (all positions) and year. (Note, vineyard #2 not sampled).

Notwithstanding the high level of temporal and across-site variability in the parasitoid data, a spatial pattern emerged when data were aggregated and then partitioned by position within vineyard (i.e. centre versus edges) in a manner broadly similar to that observed for scale insect numbers. Vineyard edges adjacent to perennial horticulture or built infrastructure exhibited high parasitoid numbers (Figure 13). This is likely to be associated with the nature of the vegetation there which supported alternative reservoirs of host insects (pests). The lower numbers of parasitoids in the centres of vineyards are consistent with this logic since it is the area furthest from potential donor habitat.

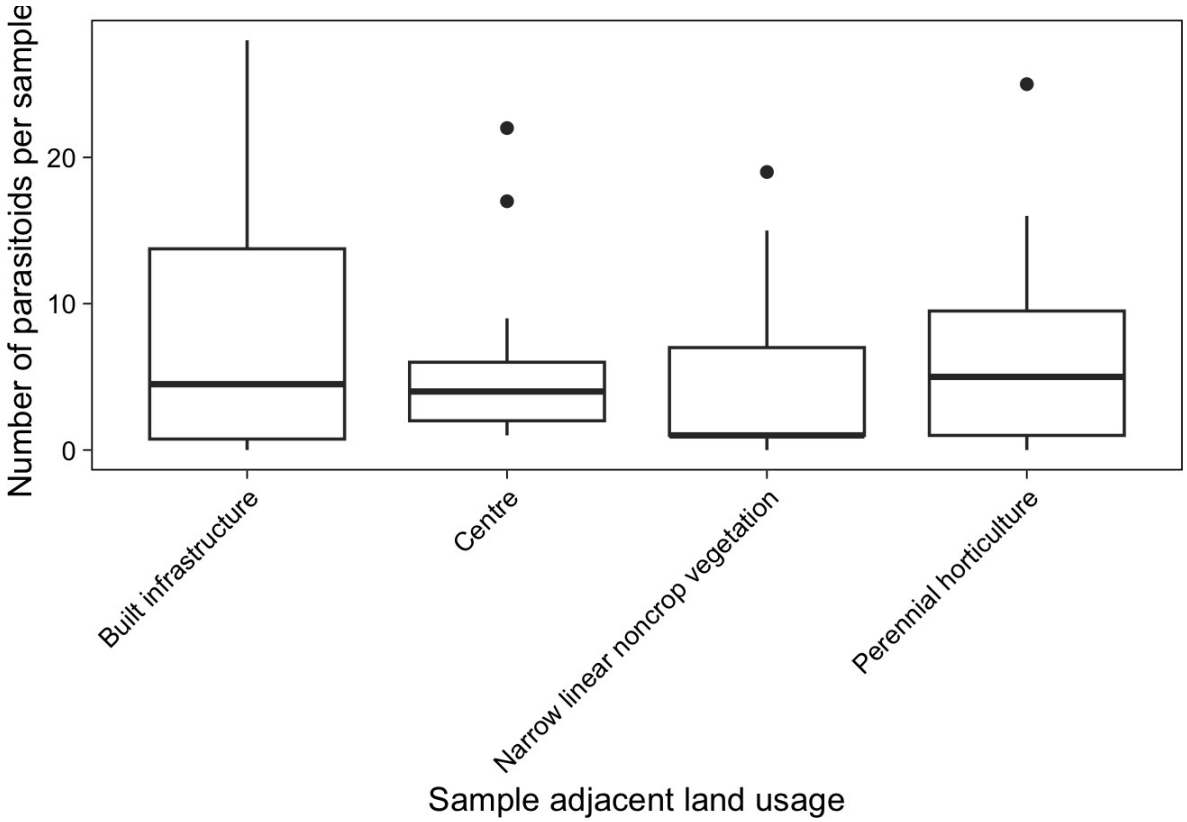


Figure 13: Spatial trend of parasitoids (all species) in vineyard centres and edges adjacent to neighbouring land uses.

Among the total catch of parasitoids, comprising 165 morphospecies, very few were species known to attack scale insects. *Metaphycus maculipennis* and *Ophelosia bifasciata*—both previously confirmed as scale specialists—were detected, though only rarely. The first was present in just two vineyards studied whilst the second species was found in only one

vineyard. The low abundance of these beneficials may be attributable to interference from tending ants, which aggressively defend scale insects from predation or parasitism. Ants were often seen in sampled vineyards in association with groups of scale insects (Figure 14).



Figure 14: An ant attending scale insects on a vine spur and collecting honeydew. The ants protect scale from parasitic wasps and predators so can limit the efficacy of biological control.

One tactic proposed by earlier authors for overcoming this antagonistic interaction involves cover crops of common vetch (*Vicia sativa*), to divert ant activity away from vines. While reportedly used overseas, this approach appears not to have been tested in Australia—possibly due to concerns that vetch is an agricultural weed and its tall (<1.3m), climbing habit may negatively influence air circulation, increasing the risk of frost or fungal disease. As an alternative, low-growing, non-climbing species may offer ecological benefits without these drawbacks. Previous work funded by Wine Australia at Charles Sturt University identified suitable candidates such as alyssum and buckwheat (Figure 15).



Figure 15. a) Left: The low-growing native shrub, *Myoporum parvifolium*, can grow vigorously beneath vines achieving, by late summer, significant levels of ground cover. b) Right: Successful early season establishment of buckwheat sown in midrow.

Alyssum was the tallest growing of the undervine treatments tested in that earlier work but even this species reached a mean height of only 23.7 cm by late summer, leaving plenty of open space between it and the vines to air flow. Further information on these is accessible via the Cover Crop Finder Tool (www.covercropfinder.com.au). These plants are known to support key parasitoids of *Epiphyas postvittana* and are likely to benefit those targeting *P. persicae* as well (Wine Australia biodiversity project). Materials from that earlier work can be accessed via the following links:

1. Website with project information and photographs complemented by a video case study production on project sampling and sorting of arthropod catches, and PowerPoint presentation of (earlier) cover crop project results with audio voice-over (https://sway.office.com/EWpG5dAN9LikpIrN).

7. Outcome/Conclusion

Overall, this program of laboratory, field trial and field survey studies has completed the planed activities and generated the associated outputs (Table 1).

Key findings are as follows.

1. Scale insects are commonly found in NSW vineyards (even when not 'suspected'), but distribution is very patchy.
2. Grapevine scale insect was the most common species.
3. Scale insects are commonly tended by ants (which help detection).
4. Many dozens of parasitoid wasp species present (but few were scale insect specialists).
5. Suggestions from edge effect results: check for scale in neighbouring perennial horticultural crops and landscaping shrubs around buildings.
6. No major effect of organic/conventional on scale or parasitoids.
7. Common vetch groundcover **may** attract ants from scale and boost biological control but weak evidence base and several cons (including height and climbing habit).
8. Scope to use groundcovers tested in earlier Wine Australia project: short plants that suppress lightbrown apple moth & bunch rot.
9. Scale control in vineyards will remain a case of integrated pest management but this is now expanded by:
    1. Scouting and management of scale in adjacent areas where woody plants are present.
    2. Use of prostrate or short-growing nectar-producing cover crops which may attract ants from vines, so allowing biological control to increase as well as providing shelter and foods for natural enemies (a double benefit).

8. Recommendations

The major, future direction recommended as a result of this report is to undertake work to understand the extent to which short, prostrate plant species can be used as cover crops in vineyards to provide the dual benefits of attracting ants away from the vines and to provide nectar specifically to parasitoid species that target scale insects. This project idea will be

presented to future candidates applying to commence a PhD in Professor Gurr's group at Charles Sturt University.

The communications outputs appended can be used to assist growers to better understand and manage the threat of scale insects to the Australian wine sector.

Communications - Outputs & Publicity

The project has produced a suite of communications outputs and associated publicity. The major items are listed below and appended.

Appendix 1. AWRI Webinar

Appendix 2. Talk to Murray Valley Wine Growers Association

Appendix 3. Article for Australian Grapegrower and Winemaker

Appendix 4. Powerpoint slide deck for NSW DPI Spring Vine Health Field Days

Appendix 5. Keynote talk at Environment Institute of Australia & New Zealand

Appendix 6. Factsheet.

References

1 Begum, M., Gurr, G. M. et al. Using selective food plants to maximize biological control of vineyard pests. J. Appl. Ecol. 43, 547-554, doi:10.1111/j.1365- 2664.2006.01168.x (2006).

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4 Danne, A. et al. Effects of Native Grass Cover Crops on Beneficial and Pest Invertebrates in Australian Vineyards. Environ. Entomol. 39, 970-978, doi:10.1603/en09144 (2010).

5 Retallack, M. et al. Predatory arthropods associated with potential native insectary plants for Australian vineyards. Australian Journal of Grape and Wine Research 25, 233-242 (2019).

9. Appendices

Appendix 1: AWRI Webinar

Appendix 2: Talk to Murray Valley Wine Growers Association

Appendix 3: Article for Australian Grapegrower and Winemaker

Appendix 4: PowerPoint slide deck for NSW DPI Spring Vine Health Field Days

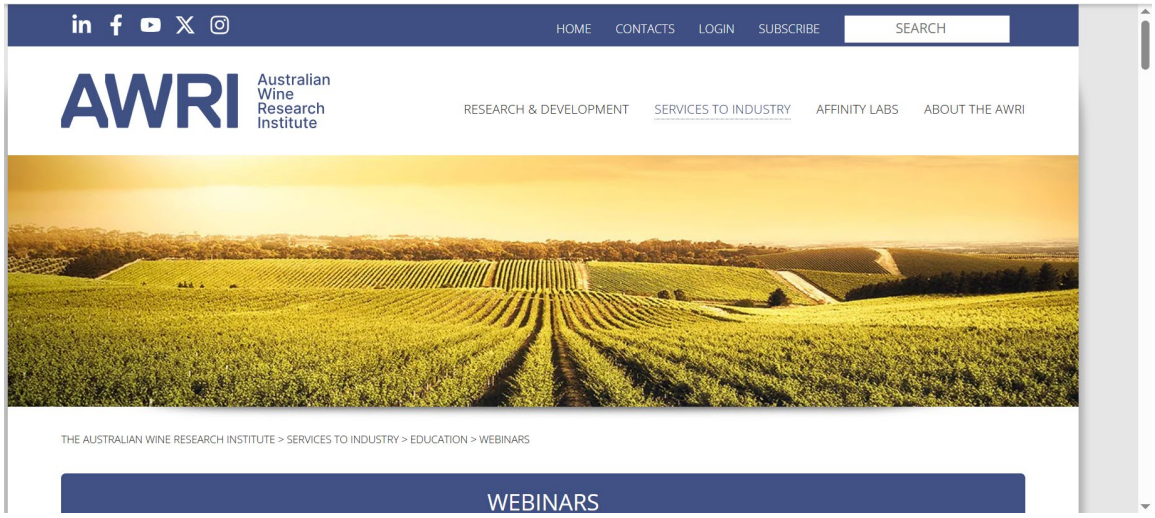
Appendix 5: Keynote talk at Environment Institute of Australia & New Zealand

Appendix 6: Factsheet

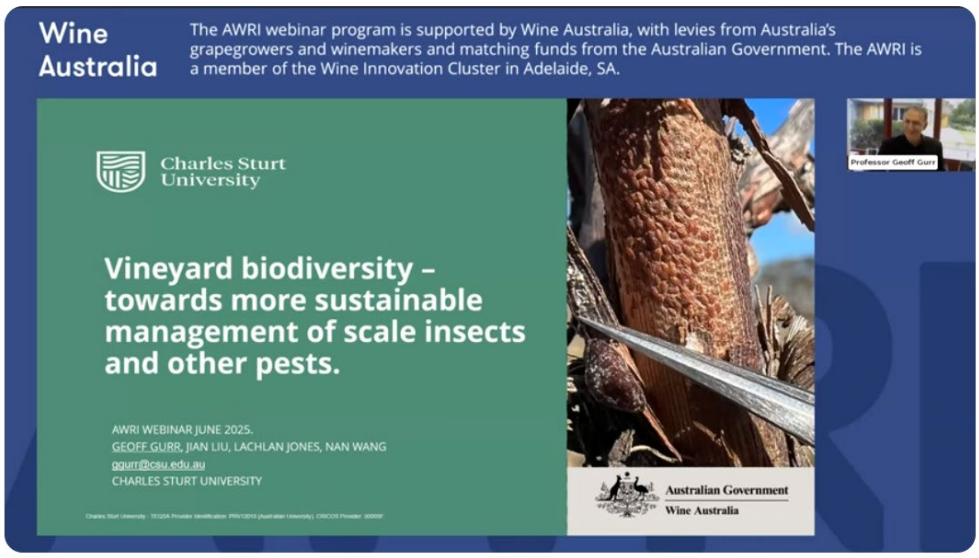
FUNCTIONAL BIODIVERSITY: A FOCUS ON SCALE INSECT PESTS AND ENHANCEMENT OF THEIR PARASITOIDS.

Appendix 1. AWRI Webinar

Web link: https://youtu.be/y-MBMyFAcLQ



Vineyard biodiversity – towards more sustainable management of scale insects and other pests (more)	Professor Geoff Gurr	12 June 2025		



FUNCTIONAL BIODIVERSITY: A FOCUS ON SCALE INSECT PESTS AND ENHANCEMENT OF THEIR PARASITOIDS.

Appendix 2. Talk to Murray Valley Wine Growers Association

At the CRC One Basin Griffith Hub on 17 June 2025.

Attended by 16 members of the Murray Valley Wine Growers and Anna Hooper, Manager of Industry Policy at Australian Grape & Wine.

A talk was also presenred by the new Wine Australia/One Basin funded PhD student Champika Jayaweera who commenced studies based in Griffith in April 2025.




Murrumbidgee Irrigation
From Sri Lanka to Griffith
My PhD Journey Begins

Pests & Disease

Scale insect pests in vineyards

Can biodiversity help suppress densities?

Geoff Gurr, Jian Liu, Lachlan Jones and **Nan Wang**
Charles Sturt University

Scale insects have become a hot topic in recent years. Winegrape growers are increasingly concerned about escalating numbers of these insect pests in vineyards, possibly as a result of climate change. Wine Australia has responded to this by investing in research to better understand the nature of this threat to vineyard productivity and to expand the range of control options. This article provides a summary of a project by Charles Sturt University which explored whether aspects of vegetation biodiversity in and around vineyards offers scope to enhance biological control of these pests.



Figure 1: Visual assessment of scale numbers during winter.

Despite the high level of variability in data there was a trend that showed the number of scale insects on vines were low in vineyard edges that bordered grassland.

Surveys over the last two years in six vineyards, located mostly in the Riverina, involved counting the numbers of scale insects on vines (Figure 1). This was done in the centre of each vineyard as well as vines close to each edge in order to detect any effects that resulted from the differing forms of land use and vegetation growing adjacent to the vineyard. In addition to these visual observations of the vines themselves, a motorised vacuum sampler was also used to collect beneficial insects from the vine foliage (Figure 2).



Figure 2: Collection of parasitic wasps and other insects from vines during summer.

We found that grapevine scale (*Parthenolecanium persicae*) was the dominant species present, with only occasional detection of frosted scale (*Parthenolecanium pruinosum*). Scale insects were detected in every vineyard and on every inspection date but their distribution within vineyards was extremely patchy. Whilst most vines were free of scale, hot spots with many scale insects were often detected. Scale insects were found to be present on virtually all parts of vines including canes, spurs, petioles, leaves, and berries (Figure 3).

Whilst scale insects are relatively easy to detect during the winter months when foliage is absent and the insects themselves are large in size, it tends to be much more difficult to detect scale during the growing season. During these periods, when scale insects are small and obscured by the presence of foliage, it is worth knowing some 'give-away' indicators of scale presence. ▸





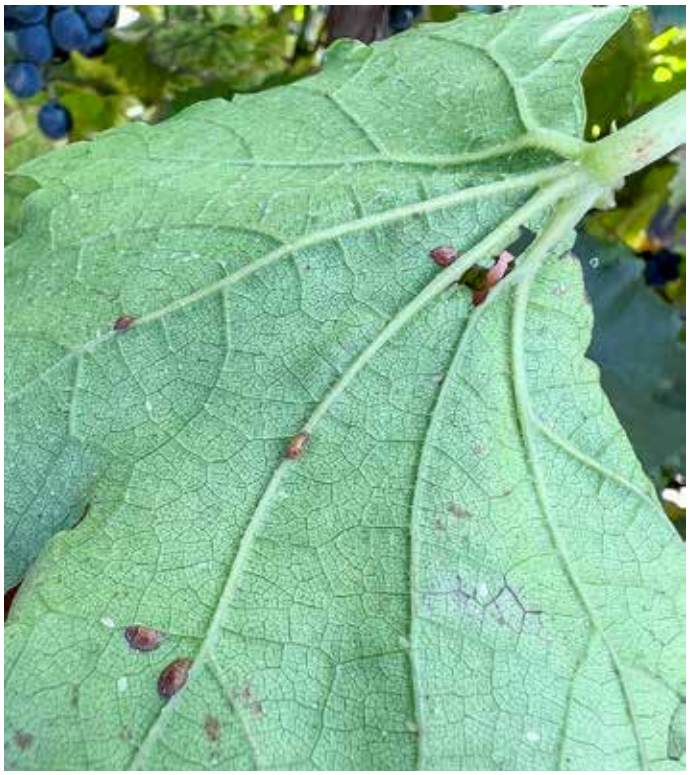




Figure 3: Grapevine scale insect on canes, petioles, leaf and berry.



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Figure 4 : An ant attending scale insects on a vine spur and collecting honeydew. The ants protect scale from parasitic wasps and predators so can limit the efficacy of biological control.

First, ants tend scale insects in a manner similar to humans farming dairy cows, except they are gathering the honeydew — the sticky liquid waste product produced by scales (Figure 4). If ants are seen on the vines you can often follow their trails and find clusters of scale insects.

Second, the honeydew itself can be a useful indicator of the presence of scale insects, especially when it builds up as a sticky layer over areas of foliage and bunches.

Growers who are interested in testing the use of cover crops to attract ants away from scale insects are advised to consider using different ground cover species with a more prostrate and non-climbing growth habits.

Finally, sooty mould fungus can grow on honeydew deposits and the dark coloration of this can make scale insect detection easier. It is useful to mark hotspot areas of scale insect infestation using high-visibility flagging tape so that these areas can be kept under scrutiny and, potentially, spot sprayed. During winter months application of paraffin oil (winter oil) can be made which would otherwise prove to be phytotoxic if applied when foliage is present.

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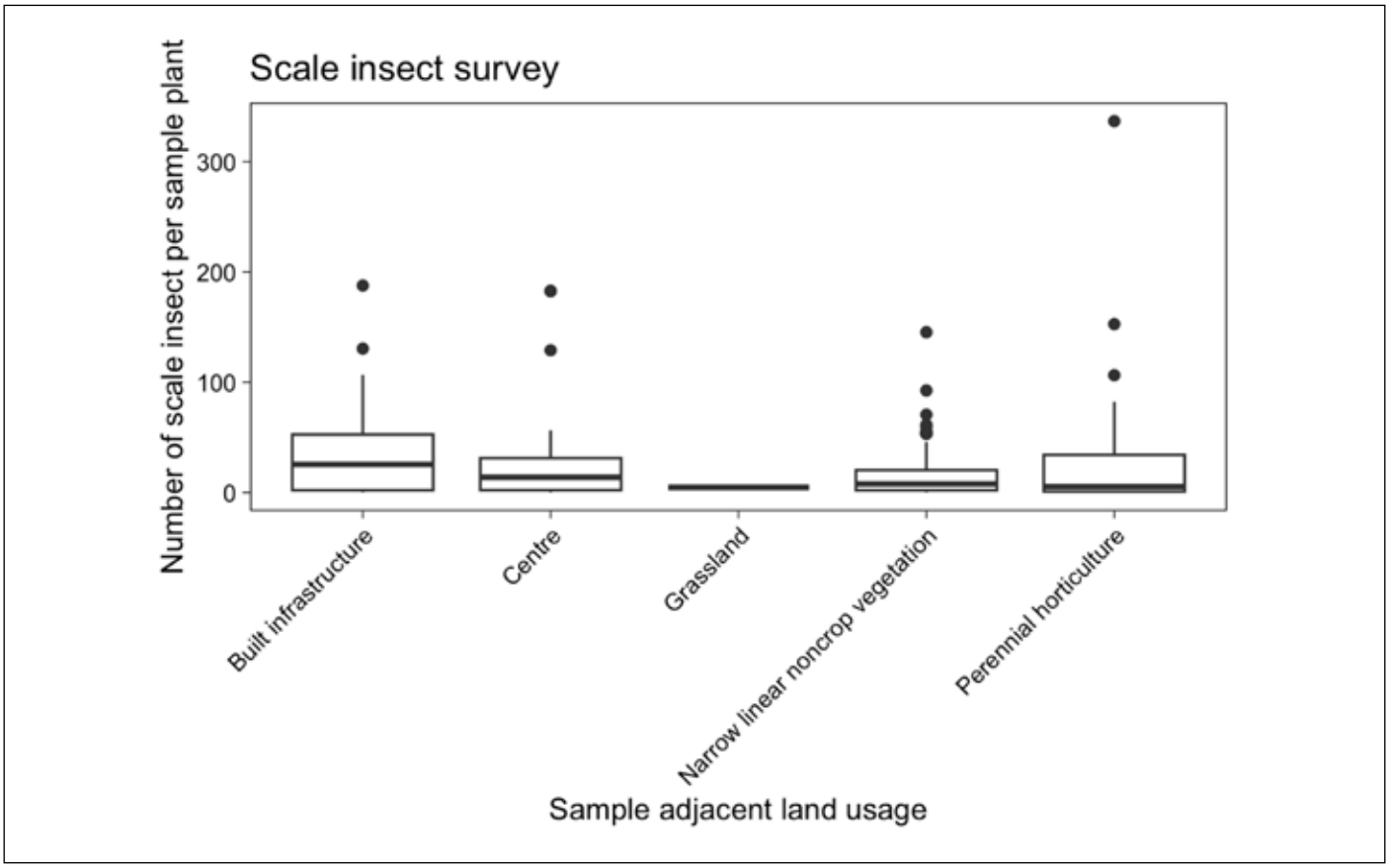


Figure 5: Evidence for spillover effects of scale into vineyard edges. Perennial horticulture and areas with sheds and buildings (built infrastructure) are likely to harbour grapevine scale (which attacks many woody plant species) so numbers are higher in vineyard edges compared with vineyard centre. In contrast, vineyard edges adjacent to grassland have low scale densities since grassy plants do not host scale.

We found that infestation levels of scale insects were highly variable from vineyard to vineyard and also from year to year and between summer and winter. One of our study sites was under organic production. The number of scale insects at this site was relatively low compared to other vineyards under conventional management, but scale was nonetheless still present. Despite the high level of variability in data there was a trend that showed the number of scale insects on vines were low in vineyard edges that bordered grassland (Figure 5). This is likely to reflect the fact that grapevine scale does not feed on grassy vegetation so opportunities for these pests to move into the vineyard from the neighbouring area is low.

In contrast, number of scale insects was high in vineyard edges that were adjacent to perennial horticulture or areas with sheds and buildings. This is consistent with the fact that grapevine scale, despite its name, actually uses plant hosts from dozens of different plant families. These include important horticultural crops such as apples and citrus as well as numerous ornamental woody plants. In our study sites, areas with sheds and buildings often included ornamental shrubs, home gardens, shade trees and other woody plants, especially in areas around cellar doors visited by customers where an aesthetically-pleasing appearance is important. Consequently, the presence of any such alternative hosts opens opportunities for scale insects to be harboured where they can build-up in large numbers only to spill over into adjacent areas of vines.

It is important to realise that whilst the adult females of grapevine scale are covered by a tough covering and anchored to the plant, this is not the case for other life stages. Young scale insects, known as 'crawlers', are small enough to be dispersed by wind. Additionally, adult males are winged so can easily disperse relatively long distances. This combination of factors means that spillover of scale insects into vineyards is likely from adjacent 'donor vegetation'. The discovery of evidence for this effect in this project points to a need for future management of scale insects in vineyards to involve inspection of woody plants in areas adjacent to vineyards in case these are providing opportunities for scale insect to persist locally and reinfest vineyards.

Earlier Australian work on scale insects suggested that biological control may be useful. Parasitic wasps, small natural enemies that lay their eggs inside the body of scale insects, might be especially useful. When the wasp's eggs hatch, the larvae eat the body contents of the scale insect, resulting in its death. Evidence of this gruesome activity can be seen with the naked eye in vineyards in the form of circular holes in the scale insect's covering which are made as the mature parasitic wasp emerges (Figure 6). In this recent study, vacuum sampling captured 669 individual parasitic wasps belonging to 165 distinct forms. Two of these, *Metaphycus maculipennis* and *Ophelosia bifasciata*, are known from earlier studies to be specialised parasites of scale insects. Unfortunately, however, these scale enemies were not common; the first was present in just two of the six vineyards studied whilst the second species was found in only one vineyard. It is likely that scale insect parasitic wasps were relatively uncommon because of the

activity of ants that will fight off any insects attacking the scale insects.

It has been proposed that cover crops of common vetch (*Vicia sativa*) may attract ants away from vines by producing nectar so that they leave scale insects unattended and more vulnerable to the attentions of biological control agents. Whilst this approach has apparently being used in some overseas areas it does not appear to have been tried in Australia. This may reflect the fact that vetch is often considered a weed in Australia. Additionally, it grows over a metre tall and has a climbing growth habit so is likely to impede airflow in vineyards with adverse consequences for frost damage and humidity-loving fungal diseases. Growers who are interested in testing the use of cover crops to attract ants away from scale insects are advised to consider using different ground cover species with a more prostrate and non-climbing growth habits. An earlier Wine Australia-funded project at Charles Sturt University identify the range of potential plant species including alyssum and buckwheat. Details on these and other potential plant species are available from the Cover Crop Finder Tool (www.covercropfinder.com.au). That earlier research identified plant species that were excellent nectar sources for the types of parasitic wasps that attack light brown apple moth so it is likely that these will also be attractive to ants and could also benefit parasitic wasps that attack scale insects (https://www.wineaustralia.com/research_and_innovation/projects/functional-biodiversity-solutions-for-australian-vineyards).



Figure 6: Parasitic wasps attack scale insects and evidence of the emergence of a wasp from a (now dead scale insect) is the circular puncture wound.

In conclusion, best practice management of scale insects will continue to be integrated pest management (IPM). This will include monitoring scale insects in the vineyard to identify hot spots that can be treated with paraffin oils in winter or other insecticides during the spring. Key to this are inspections to identify hotspot areas using signs of ants, honeydew and sooty mould . Reflecting the finding that scale insects tend to be more numerous in vineyard edges close to perennial horticulture or areas with sheds and buildings, woody plants in those areas should also be inspected for scale insects and appropriate management applied. Pruning operations can be directed to remove heavily-invested spurs during winter. Ideally, the prunings should be removed from the vineyard and destroyed to avoid the risk of the crawlers that emerge in early spring making their way back onto vines, potentially by wind dispersal. If prunings are left on the vineyard floor, mulching can be used to hasten their decomposition and minimise subsequent scale risk. Predatory beetles and lacewings can be purchased from biological control agent companies and released into vineyards in the warmer months, but the cost of this option will limit it to hotspot areas. Cover crops can provide a wide range of benefits to vineyards and merit further evaluation as a means of suppressing scale by promoting beneficial insects including parasitic wasps. Cover crops may also serve to attract ants away from scale insects on vines but low-growing plant species are recommended.

Acknowledgement

We thank cooperating growers for allowing access to their vineyards. This research was supported by funding from Wine Australia. Wine Australia invests in and manages research, development and extension on behalf of Australia's grape growers and winemakers and the Australian Government. GW



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FUNCTIONAL BIODIVERSITY: A FOCUS ON SCALE INSECT PESTS AND ENHANCEMENT OF THEIR PARASITOIDS.

Appendix 4. Powerpoint slide deck for NSW DPI Spring Vine Health Field Days

This planned output is inteded to be a resource for later use by the project team or other Wine Australia stakeholders to use in extension events, especially the Spring Vine Health Field Days.

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Vineyard biodiversity – towards more sustainable management of scale insects and other pests.



GRIFFITH ONE BASIN CRC JUNE 2025.
GEOFF GURR, JIAN LIU, LACHLAN JONES, NAN WANG
ggurr@csu.edu.au
CHARLES STURT UNIVERSITY

Australian Government
Wine Australia

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What are scale insects?

- ‘Couch potato aphids’ – adult female sedentary (juveniles (‘crawlers’)(Fig.1), and adult males motile, but inconspicuous (Fig.2)).
- Attack many crop species, several attack grapevines.
- Suck sap (phloem), inhibit growth
- Produce honeydew -> sooty mould, bunch rejection.
- Vector viral diseases of vines (“Shiraz disease”)
- Attacked by parasitoid wasps, predatory beetles, lacewings, spiders, birds (Fig. 4).
- Thought to be of growing importance in Australian viticulture (climate change).



Fig. 1. CABI Compendium



Fig.2. University of Wisconsin-Madison



Fig.3. ONfruit



Fig. 4. UC Statewide IPM Program (UC IPM)

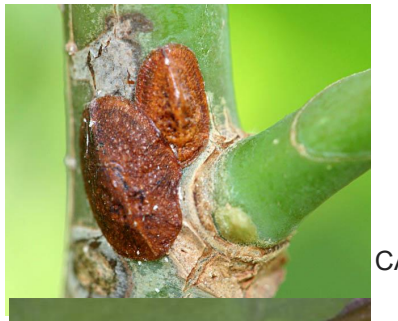
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Major scale insect species in Australia

Grapevine scale/Peach scale (*Parthenolecanium persicae*).

7MM, OVAL, DARK BROWN.



CABI Compendium

Frosted scale (*Parthenolecanium pruinosum*).

7MM, OVAL, DARK BROWN BUT WAXY 'FROSTING'. HIGHLY DOMED



VESERIS

Brown soft scale (*Coccus hesperidum*).

4MM, BROWN MOTTLING



Minden Pictures

NB immatures differ; small, cryptic, hard to find and visualise.

Nigra scale (*Ceroplastes rubens*).

4MM, GLOSSY BLACK



Brisbane Insects

Long soft scale (*Coccus longulus*).

5mm, ELONGATE



Landcare Research

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Ants Farming Scale Insects:





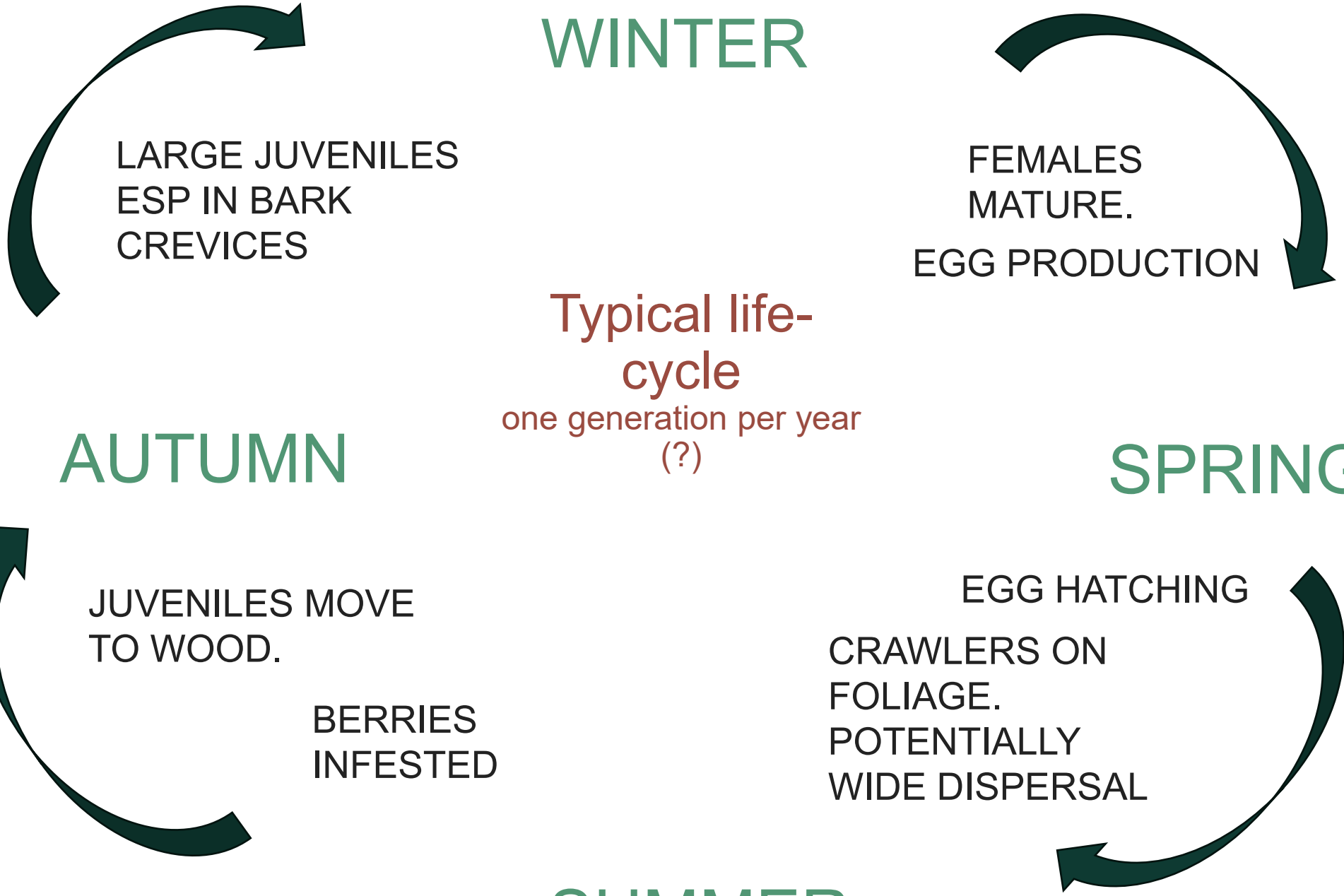

The ‘give-away’ sign of scale infestation

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Typical life-cycle

one generation per year (?)



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Scale sampling method

Six NSW vineyards.

Each block visited in summer and winter.

Sampling positions in central area, plus each of the edges.

At each position: selected 5-10 vines.

For each vine, visual assessment of no. scale insects on:

- on each of 10 spurs (winter)
- or canes, foliage and bunches (summer).

Scale insect numbers expressed as mean per vine.

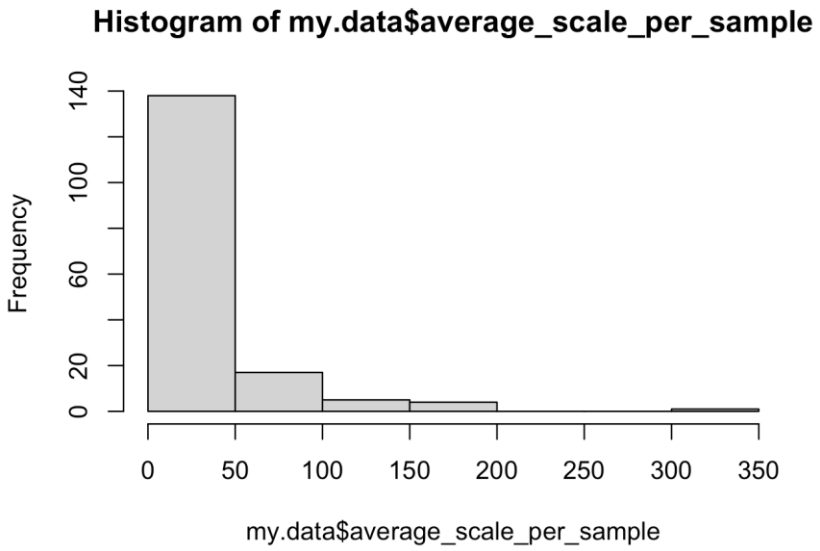




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Results

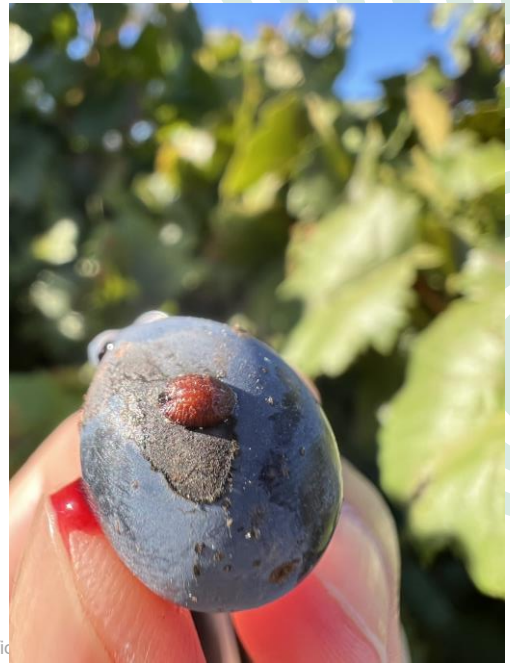
- Scale insects detected on most sites.
- Present on many plant parts:
  - Canes, petioles, leaves, berries.
- Mostly grape vine scale (occasional frosted scale).
- Distribution very ‘patchy’ (many zeros or low values in data set).



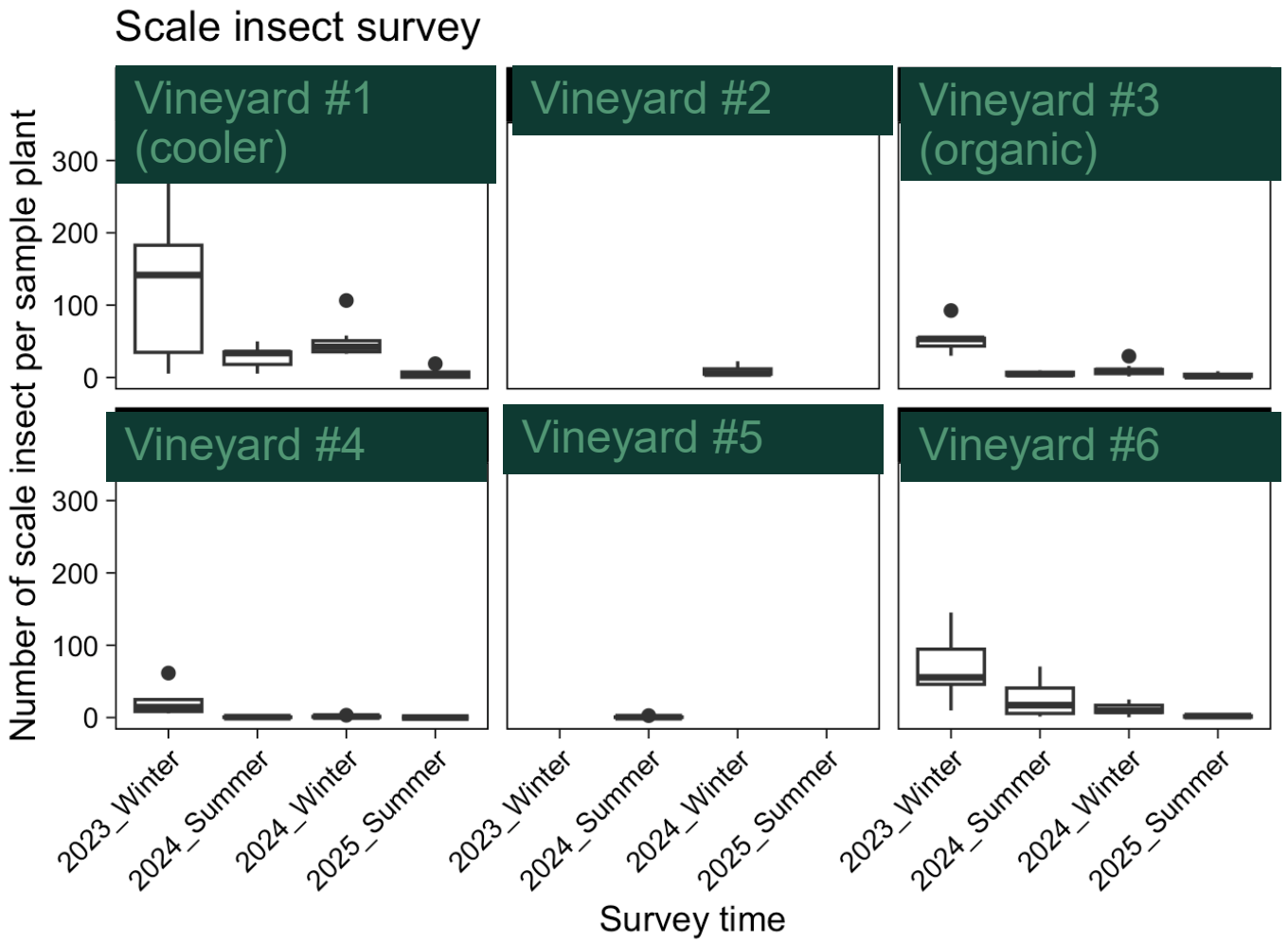








Mean count of scale insects per vine



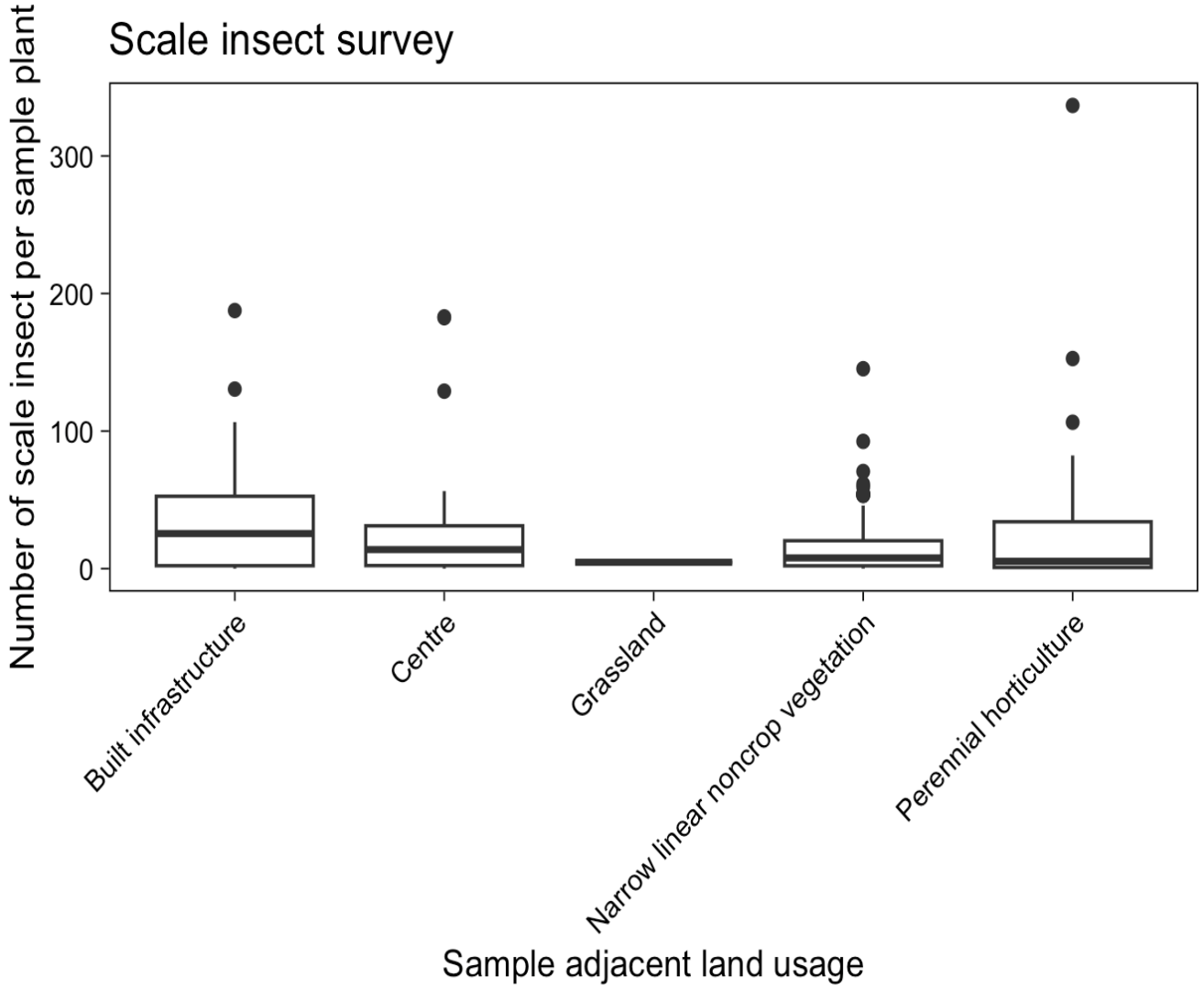
Cooler district vineyard: highest numbers initially; Well controlled by winter oil.

Organic vineyard: intermediate numbers.

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Effect of position in vineyard (centre vs edges)



Noisy data but:

Lowest numbers of scale in vineyard edges adjacent to grassland (absence of alternative hosts?).

Highest numbers adjacent to buildings and perennial hort (spillover?).

Parasitoid exit holes






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Scale Insect Parasitoids: Background

State Government Victoria Department of Primary Industries

Australian Government
Grape and Wine Research and Development Corporation

Biological control of grapevine scales



FINAL REPORT to
GRAPE AND WINE RESEARCH & DEVELOPMENT CORPORATION

Project Number: DNR 03/01

Principal Investigator: **Dr. Greg Buchanan**

Research Organisation: Department of Primary Industries, Victoria

Date: 30 June, 2008

"Metaphycus maculipennis was the most abundant and effective parasitoid of grapevine scale…

(but) maximum rate of parasitism … about 20%

… previous observations…over 60% (Buchanan, unpublished)."

~2mm long



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Vacuum collection method: NSW Survey

video



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Scale Insect Parasitoids: Results from NSW Survey

669 parasitoid individuals captured.

165 morphospecies.

Two known scale insect parasitoids detected.

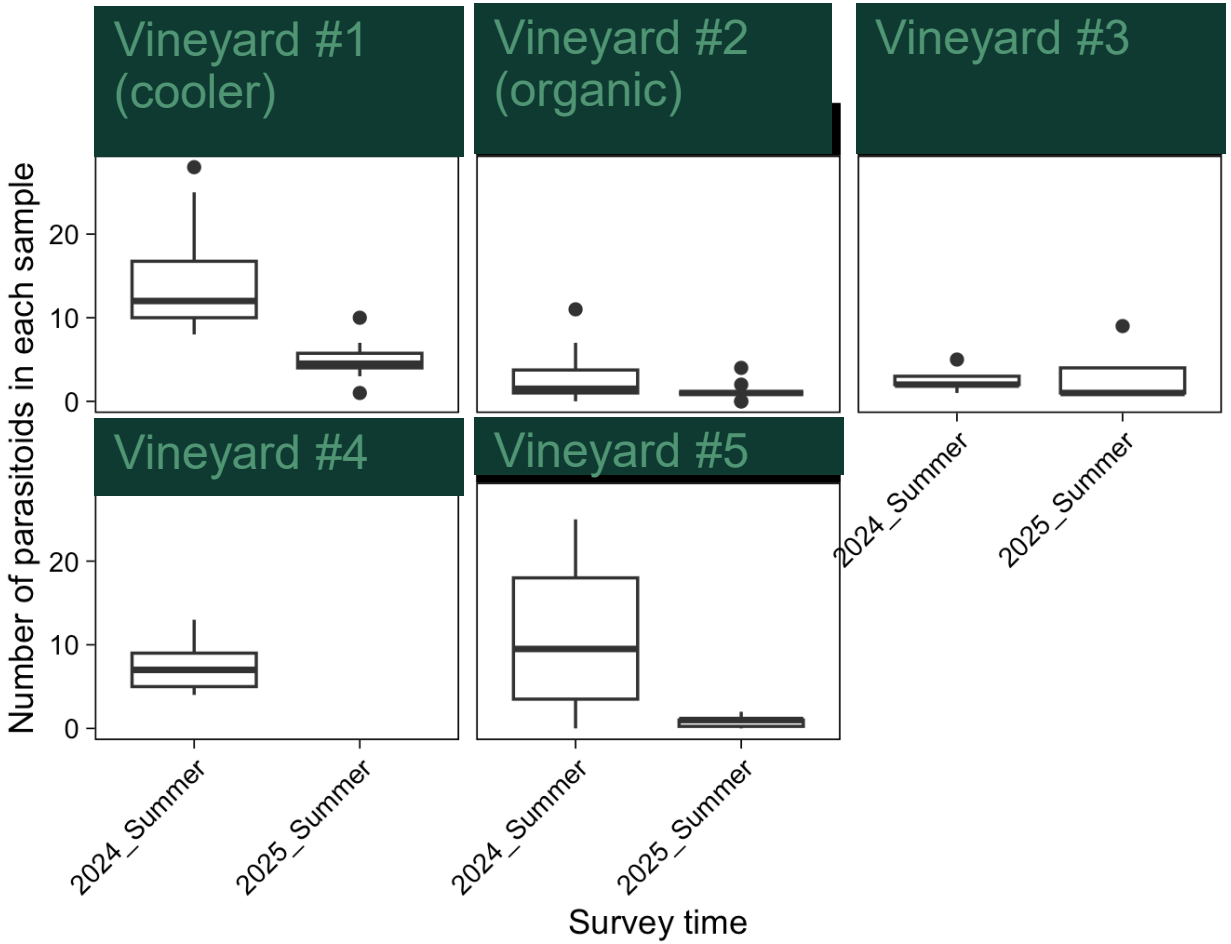
- *Metaphycus maculipennis* most common, but only in two vineyards.
- *Ophelosia bifasciata* found in one other vineyard.





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Total Parasitoids: Results from NSW Survey



Noisy data but:

Cooler district vineyard: among sites with most parasitoids.

Organic vineyard: among sites with fewest parasitoids.

Inconsistent across successive summers.

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ECO VINEYARDS
GROWING RESILIENCE NATURALLY

FIELD GUIDE

BIOCONTROL OF COMMON GRAPEVINE INSECT PESTS

By Dr Mary Retallack, Retallack Viticulture Pty Ltd

PREDATORY ARTHROPODS: Predators such as ladybird beetles (*Rhyzobius pulchellus, Rhyzobius forestrii, Cryptolaemus montrouzieri, Coccinella transversalis, Hippodamia varigata*), predatory moths (*Mataeomera dubia* and *Stathmopoda melanochra*), carabid beetles, soft-winged flower beetles, and lacewings all contribute to the control of grapevine scale (Rakimov et al., 2015).

The predatory mite *Anystis baccarum* is a predator of the eggs and crawlers of soft scales (Bernard et al., 2004; Winter et al., 2018). Green lacewings and ladybird beetles are available for release commercially.

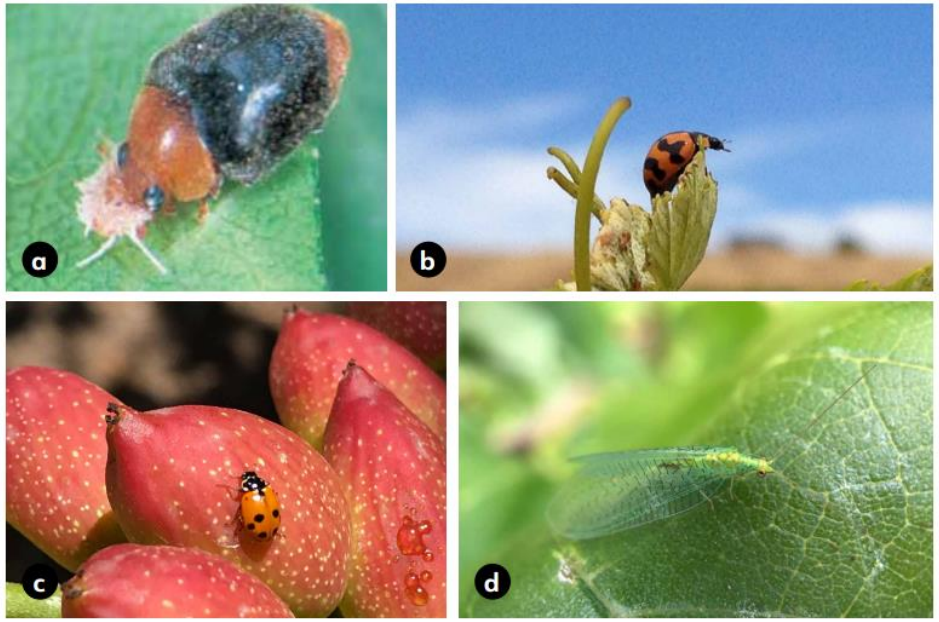
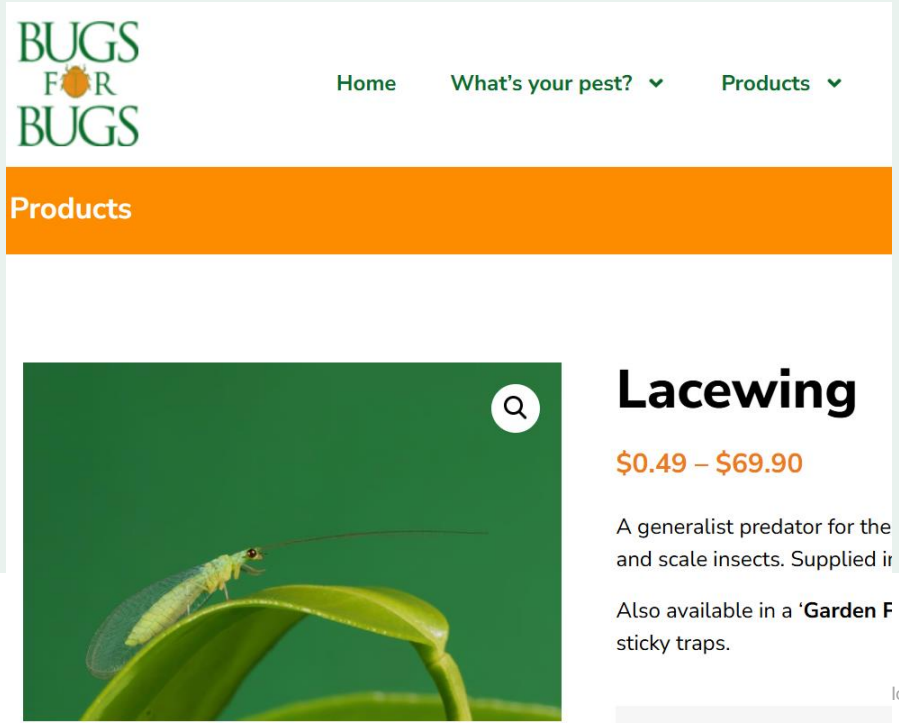


Figure 12. (a) Adult mealybug destroyer, *Cryptolaemus montrouzieri* [Photo: David Madge], (b) transverse ladybird beetle, *Coccinella transversalis*, (c) spotted amber ladybird beetle, *Hippodamia variegata*, (d) and green lacewing adult [Photos: Mary Retallack].



$71.90 X 1000/20=**$3,595/ha**

Hotspot treatment only?



$69.90 X 600/2000 **<$20.97/ha** (if 100% hatch & survive)

More affordable.

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Outlook for scale control by mass releases of predators:

- Costly!
- Largely unproven in vineyards.

but what about other approaches for predators…and parasitoids?



Cover crops benefit the natural predators of pests in vineyards. CALIFORNIA AGRICULTURE/UCANR

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Ants – protect scale insects from predators and parasitoids






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Cover crops to suppress scale insects:

Vicia sativa (common vetch)
reportedly used in Californian vineyards to attract ants away from scale insects.

PROS

- Nectar distracts ants from tending scale to collect honeydew and deterring parasitoids & predators.
- Extrafloral nectaries.
- Cheap and easy to obtain seed (~$100/ha).
- Fixes N, forage crop.
- Green manure, sequesters C to soil.
- Drought hardy.
- May suppress some nematodes pests.

CONS

- Weak evidence base for efficacy against scale.
- Considered a weed in some areas/circumstances.
- Logistical complications of cover crop establishment & management.
- Annual.
- Autumn-sown so may not persist into summer.
- Climber (grows into vines)
- Tall (<1.3m) so impedes airflow (greater risk of frost damage and fungal diseases).



OVERALL: Weak evidence base (untested in Australia) Significant cons



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Alyssum under vine



Buckwheat midrow

Previous Wine Australia-funded project: “Functional biodiversity solutions for Australian vineyards: harnessing groundcovers, vineyard surrounds and native plants to deliver key ecosystem services”

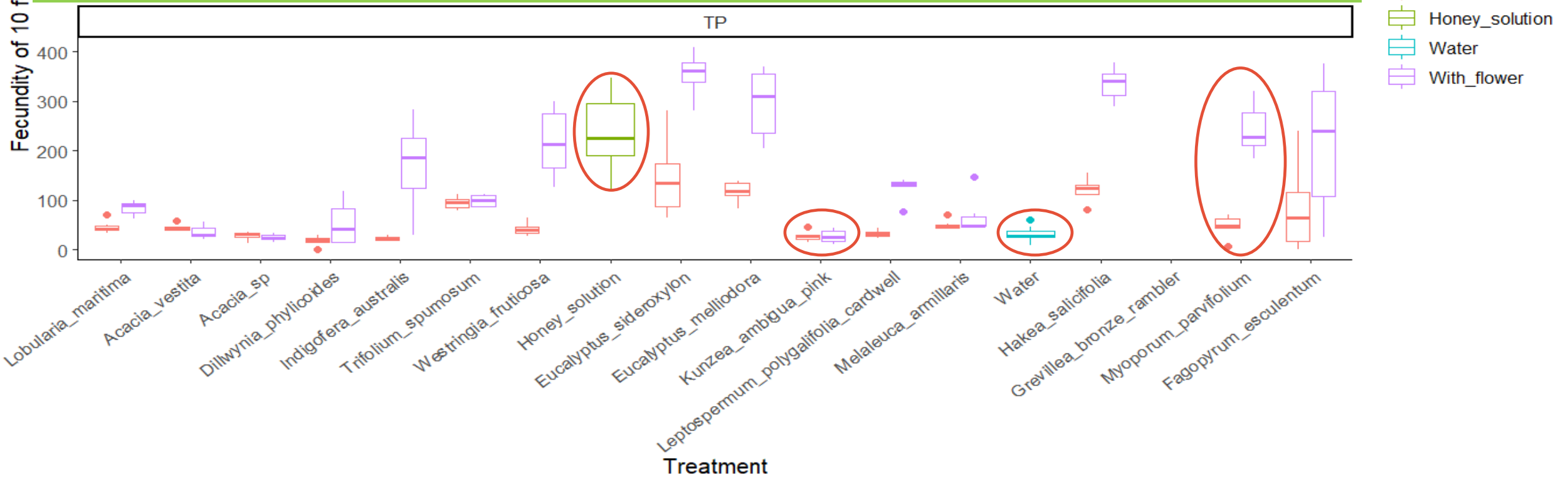
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Trichogramma parasitoids of LBAM

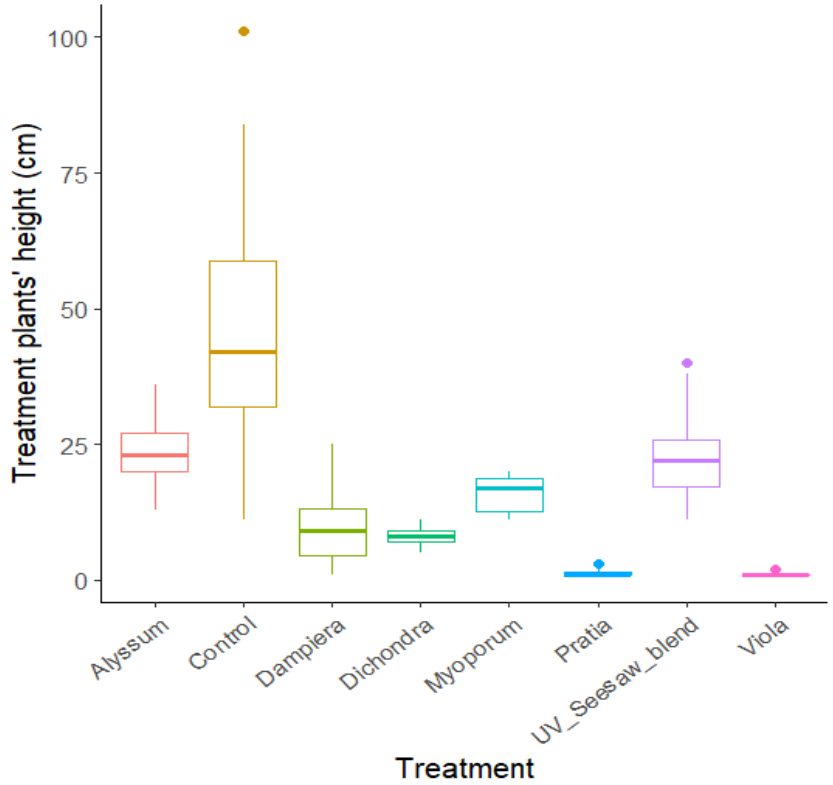


- Some flowers greatly improved performance of wasps.
- Effect arises from nectar feeding.
- Guide for selection of species to use as groundcovers in vineyards, plantings or landscape.
- **Not all natives are 'good'!** For example, the *Eucalyptus* species tested were great but both *Acacia* species were useless.



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Cover crop plant height



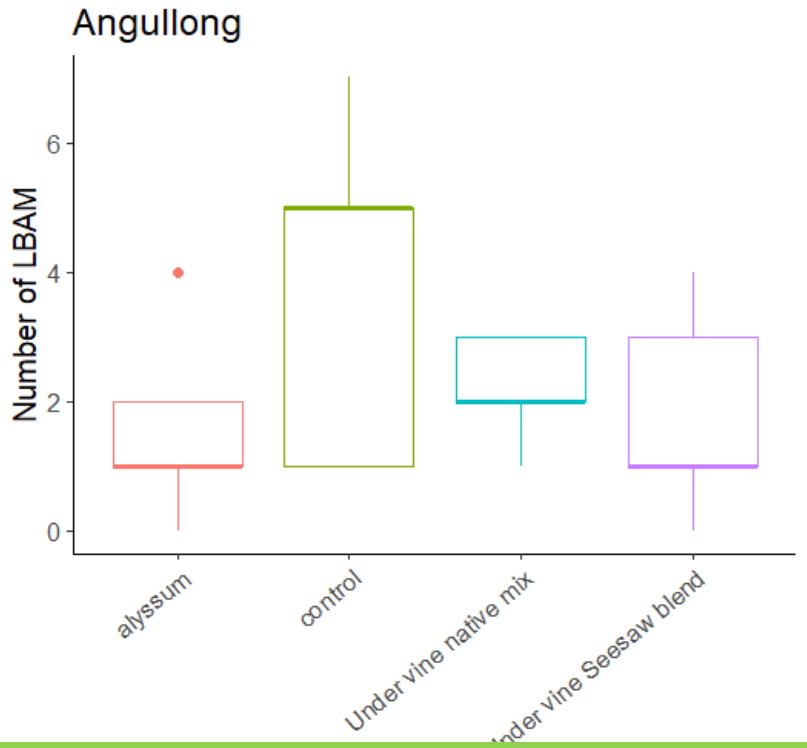
Work in previous Wine Australia-funded project: "Functional biodiversity solutions for Australian vineyards: harnessing groundcovers, vineyard surrounds and native plants to deliver key ecosystem services"

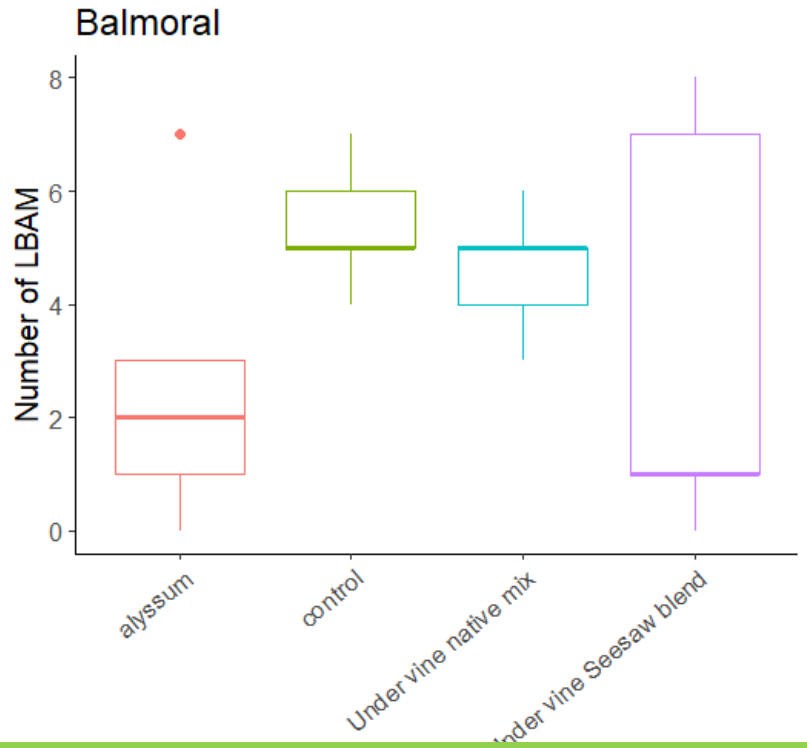
Several cover crop species are much shorter than the control vegetation ('weeds').
Likely to favour air flow under vines and reduce risk of fungal disease (and frost).

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Cover crop and evidence of **insect pest control:** fruit bunches attacked by lightbrown apple moth (LBAM)





Work in previous Wine Australia-funded project: "Functional biodiversity solutions for Australian vineyards: harnessing groundcovers, vineyard surrounds and native plants to deliver key ecosystem services"

Under vine cover crops reduce numbers of bunches with LBAM
Flowers attracted and supported beneficial insects that attack LBAM.
Alyssum had strongest effect.

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Future prospects for enhancing biological control of scale (and other) pests

- Focus on groundcovers.
- Use low-growing species (tested in earlier Wine Australia project)
- Aim to promote a suite of enemies, including generalist predators, not just *Metaphycus* parasitoids.
- Look at the big picture – overall basket of ecosystem services promoted by groundcovers…

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- Suppress weeds,
- Fixes N,
- Forage crop,
- Green manure,
- Sequester C,
- Reduces erosion,
- Suppress diseases,
- etc

- (Green finance eg payment for ecosystem services, carbon offsets) New project with Wine Australia and One Basin CRC.

Additional ecosystem services



Biological control

Immediate IPM options for scale insect pests

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WINTER

EASIEST TIME TO DETECT. PRUNE, WINTER OIL SPRAY (VINE DORMANCY!)

LARGE JUVENILES ESP IN BARK CREVICES

NATURAL ATTACK BY NATURAL ENEMIES (~YEAR-ROUND)

LARGE MATURE FEMALES.

EGG PRODUCTION

SOW VETCH (?) TO ATTRACT ANTS FROM SCALE (TILLAGE TO DISRUPT NESTS)

AUTUMN

RELEASE PREDATORS

SPRING

JUVENILES MOVE TO WOOD.

EARLY SEASON (SPOT) SPRAY

EGG HATCHING

LATER SEASON (SPOT) SPRAY

CRAWLERS ON FOLIAGE

BERRIES INFESTED

SMALL. DIFFICULT TO DETECT. LOOK FOR ANTS, SOOTY MOULD

SUMMER

AWRI Australian Wine Research Institute

Fact Sheet
VITICULTURE

Vineyard scale insects: factors influencing their prevalence and control

Charles Sturt University - TEQSA Provider Identification: PRV12018 (Australian University). CRICOS Provider: 00005F.

Major findings

1. Scale insects commonly found in NSW vineyards (even when not ‘suspected’) but v patchy.
2. Grapevine scale insect was the most common species.
3. Commonly tended by ants (which help detection).
4. Many dozens of parasitoid wasps present (but few were scale insect specialists).
5. Suggestions from edge effect results: check for scale in neighbouring perennial hort crops and landscaping shrubs around buildings.
6. No major effect of organic/conventional on scale or parasitoids.
7. Common vetch groundcover **may** attract ants from scale and boost biological control but weak evidence base and several cons (including height and climbing habit).
8. Scope to use groundcovers tested in earlier Wine Australia project: short plants that suppress LBAM & bunch rot.

8. Immediate option for scale control in vineyards = integrated pest management.

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Acknowledgements

We thank AWRI for the webinar opportunity and Wine Australia for funding projects:

"*Functional biodiversity solutions for Australian vineyards: harnessing groundcovers, vineyard surrounds and native plants to deliver key ecosystem services*" and

"*CSU functional biodiversity project extension: a focus on scale insect pests and enhancement of their parasitoids*".

Australian Government

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FUNCTIONAL BIODIVERSITY: A FOCUS ON SCALE INSECT PESTS AND ENHANCEMENT OF THEIR PARASITOIDS.

Appendix 5. Keynote talk at Environment Institute of Australia & New Zealand

https://www.eianz.org/events/event/eianz-2025-insects-in-crisis-symposium

Results from the Wine Australia-funded project work showcased in the invited keynote talk by Prof Gurr entitled "The value of insects in agricultural systems and practical methods for their conservation and enhancement of ecosystem services"



	**OPENING	FRIDAY 4 JULY 2025**
8:45am - 8:55am	Serena Williams	Welcome to Country
8:55am - 9:00am	Opening and welcome
	**SESSION ONE	CLIMATE CHANGE**
	How does the change to our climate impact Australia's and New Zealand's insects? What insect species have we recently lost in Australia and New Zealand due to the more intensive and frequent heatwaves, droughts, bushfires and floods?
09:00am - 9:30am	**Keynote Speaker	Ary Hoffmann, The University of Melbourne** Is there any capacity for Australian insects to "evolve out of trouble" and not be impacted by climate change?
09:30am - 9:45am	Heloise Gibb, Deakin University	Impacts of bushfire on the poorly known ground dwelling insects of the south-east forests of Australia
09:45am - 10:00am	Andrew Mitchell, Australian Museum	The beetles of the Lord Howe Island group and human impacts, including climate change
10:00am - 10:30am	Panel discussion facilitated by Paul Keighley FEIANZ, CEnvP
10:30am - 11:00am	MORNING TEA
	**SESSION TWO	ECOLOGY**
	What is the current status of conservation of Australian and New Zealand insects? What Australian and New Zealand insects are threatened but not yet listed as threatened?
11:00am - 11:30am	**Keynote Speaker	Nick Porch, Deakin University** Can we conserve the unseen, uncollected and undescribed? Insights about insects from the Southeastern Australian montane archipelago
11:30am - 11:45pm	Andy Austin, The University of Adelaide	Diversity of Australian insects and the state of their taxonomy
11:45pm - 12:00pm	Allonsina Arriaga Jiménez, Queen Victoria Museum and Art Gallery -Launceston	Safeguarding Australia's insects: The Role of Taxonomy in IUCN Red Listing and Conservation
12:00pm - 12:15pm	Timothy Collins and Kiarrah Smith, NSW Department of Climate Change, Energy, the Environment and Water	Listing Threatened Ecological Communities can help conserve insects and other poorly known biota
12:15pm - 12:45pm	Panel discussion facilitated by Richard Sharp FEIANZ, CEnvP
12:45pm - 1:45pm	LUNCH
	**SESSION THREE	IMPACT ASSESSMENT & ENVIRONMENTAL DATA**
	Does the impact assessment process in Australia and New Zealand adequately address the protection and conservation of insects? What changes are needed to planning laws to better protect and conserve Australian and New Zealand insects? Do we properly measure and account for Australia's and New Zealand's insects? What is the economic impact on Australia and New Zealand if our insects disappear?
1:45pm - 2:15pm	**Keynote Speaker	Cameron Slayer	Project Manager, National Biodiversity Data Initiatives** Current data insights for future insect conservation
2:15pm - 2:30pm	Chris Sanderson, BAAM Ecology	Barriers to conserving moths and butterflies in policy and practice
2:30pm - 2:45pm	Katja Hogendoorn & Gary Taylor, The Australian Entomological Society	Conservation of Australian insects requires protection of habitat through effective impact assessment and planning laws
2:45pm - 3:15pm	Panel discussion facilitated by Richard Sharp FEIANZ, CEnvP
12:45pm - 1:45pm	AFTERNOON TEA
	**SESSION FOUR	HERITAGE & LAND**
	What is the cultural connection between Australia's First Nations people and New Zealand's Maori people and insects? Can the knowledge of Australia's First Nations people and New Zealand's Maori people help us to improve our care of insects? To what extent is contaminated land in Australia and New Zealand impacting our insects? What land management practices in Australia and Zealand need to change to better prot
3:45pm - 4:15pm	**Keynote Speaker	Geoff Gurr, Charles Sturt University** The value of insects in agricultural systems and practical methods for their conservation and enhancement of ecosystem services
4:15pm - 4:30pm	Jacqui Knight, Moths and Butterflies of NZ Trust	The biggest threat facing the endemic insects of Aotearoa
4:30pm - 4:45pm	Renee Rossini, Bush Heritage Australia	How Bush Heritage Australia, as a not-for-profit, is protecting insects in their reserve network
4:45pm - 5:00pm	George (Clancy) Lesier, The University of Melbourne	Floral visitation in the face of climate change: a collaborative study of native bees with Arnhem Land's Yolŋu First Nation
5:00pm - 5:25pm	Panel discussion facilitated by Chris Murphy MEIANZ
5:25pm - 5:30pm	Closing Statement	EIANZ Communiqué: Insects in Crisis
5:30pm - 7:00pm	NETWORKING DRINKS AND NIBBLES

THANKS TO OUR EVENT PARTNERS

INVERTEBRATES AUSTRALIA

Australian Entomological Society

CSIRO

Fact Sheet

Managing Scale Insects in Vineyards: Can Biodiversity Help?



Project Leads

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Charles Sturt University

Supported by Wine Australia (CSU1702)

Why This Matters

Scale insects are becoming an increasing concern for winegrape growers. Numbers are rising, potentially linked to climate change. Multiple species of scale insect have been reported in Australian vineyards.

Scale insects can be difficult to manage, in part because all the small size of the immatures ('crawlers') as well as the adult males. The adult females are more conspicuous because they can reach up to 8 millimetres in length and have a characteristic scale-like covering over their body. However infestations in vineyards can be very patchy in nature, so they may escape notice until numbers are quite dense in hotspot areas.

Scale insects are most obvious during the winter when foliage is absent and large nymphs or adult females are relatively conspicuous on spurs and canes. During the winter, pruning operations can remove heavily infested areas. The remaining pests can be killed with the application of paraffin or winter oil. In the spring, applications can be made of various insecticides to control young scale insects.

Potentially, biological control using predators such as lacewings and predatory beetles, as well as parasitic wasps can help reduce scale insects. Unfortunately, ants, which harvest the honeydew produced by scale insects, protect scale from beneficial insects. This csn limit the impact of biological control.

This project aimed to expand the range of methods available to growers for integrated pest management of scale insects. Surveys were undertaken in six NSW vineyards over the course of two years during which scale insect' numbers were monitored and vacuum sampling used to capture beneficial insects from the vines.

What we found

- Among the various species of scale insects previously reported from Australian vineyards, grapevine scale (Parthenolecanium.persicae) was widespread; frosted scale (P$_{1}$.pruinosum) was rare.
- Scale occurred on all vine parts including leaves, petioles, canes and berries.
- Every vineyard had some scale insects—but usually in low numbers but with hotspot areas of high infestation.
- Numbers of scale insects were relatively low in the centres of vineyards and higher in the edges of vineyards when adjacent to perennial horticultural crops or areas where woody ornamental plants were present such as around buildings.

- Though parasitic wasps were found to be common in vineyards, the particular species that are known to attack scale insects were scarce, likely reflecting the observed presence of ants.
- Cover crops of vetch (Vicia.sativa) have reportedly been used overseas to attract ants away from vines, in order to boost the impact of biological control but this tall and climbing plant is not ideal for use in vineyards.
- Shorter plant species such as alyssum (Lobularia.maritima) are more suitable and offer the advantage of providing nectar to various species of natural enemies of vineyard pests.



Figure.7¿Grapevine.scale.insect.on.canes?petioles?leaf.and.berry

When to Look

Winter

- Easier to spot; scales are larger, and foliage is absent.

Growing season

- Harder to see—look for signs like:
  - Ants tending scale for honeydew
  - Sticky honeydew on foliage and bunches
  - Dark sooty mould growing on honeydew

Landscape Clues

- Lower scale numbers in vineyards near grasslands and in the centre of blocks
- Higher numbers in vineyards near perennial horticulture or trees and shrubs associated with buildings
- These areas often have alternative host plants like citrus, apples, and ornamentals
- Adult males (winged) and 'crawlers' (potentially wind dispersed) can move from nearby woody vegetation

Tip: Check shrubs and trees adjacent to vineyards—perennial horticulture and ornamental/landscape plantings near cellar doors and other buildings.



Figure.8¿Collection.of.parasitic.wasps.and.other.insects.from.vines.during.summer¡

Natural Enemies: Where Are They?



Parasitic wasps:

Are known to attack scale insects.

We found 669 individual wasps (165 types)—but only two were scale-specific.

Their scarcity may be due to ants protecting scale from predators

Cover Crops: A Potential Tool

Figure.9¿Parasitic.wasps.attack.scale.insects¡.Circular.puncture.wound.is.evidence.of.the.emergence.of.a.wasp.from.a.(now.dead).scale.insect¡

- Some crops (e.g. common vetch) may lure ants away from vines—but vetch grows tall and climbs, which can elevate frost and disease risks. It is also considered a weed in many regions across Australia.
- Better option: Use low-growing, non-climbing species like alyssum or buckwheat. These:
  - → Support beneficial wasps of various types and may also attract ants away from vines
  - → Improve airflow and weed control
  - → Find options with Cover Crop Finder Tool

Best Practice: Integrated Pest Management (IPM)

- Monitor: Use signs like ants, honeydew, and sooty mould to help locate hotspots
- Treat: Apply winter oil during dormancy or insecticides in spring
- Manage: Prune and remove infested material (mulch thoroughly)
- Support: Encourage beneficial insects with smart cover cropping
- Inspect: Don't forget to check for scale in woody vegetation around the vineyard

Acknowledgements

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