Charles Sturt University

Promoting biological control and additional ecosystem services for sustainable vineyards

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Where I work
Geoff Gurr

Photographed for *Nature* by Matthew Abbott.

This photograph was taken at the Angullong estate in New South Wales, Australia, which hosts some of my field trials. The aim is to study sustainable agriculture in vineyards. You have to dodge the odd brown snake, but, as offices go, this one – among the grapevines of such a picturesque part of the world – makes my job quite a privilege.

It's a November evening, which is springtime here in the Southern Hemisphere, and this time of year is when pests such as the light brown apple moth (*Epiphyas postvittana*) start to emerge. That means that ecologists such as myself, as well as the commercial winemakers we collaborate with, move into data-capture mode to track the presence of the insects. These moths produce multiple generations every year, so they can be quite numerous by harvest time, and can cause real damage by getting into the grapes.

We're conducting experiments to see whether positioning various plant species between and under grapevines can help to reduce the population of pests by encouraging their predators. Parasitoid wasps, for example, target the eggs of light brown apple moths, injecting them with their own eggs. When the wasp larvae hatch, they eat the moth larvae from the inside out. Although quite gruesome, parasitoid wasps could provide an environmentally friendly way to control moth populations.

In my laboratory at Charles Sturt University in Orange, we're incubating moth eggs that we then put on special cards in the vineyard. Because parasitoids love nectar, we expect to see more attacks on the moth eggs in areas where we've planted flowering shrubs than in the control areas, where grass predominates. We collect the cards after about 48 hours in the field, and incubate the moth eggs to measure the level of parasitism. In the next couple of years, with more data, we hope to identify the optimum mix of plant species to manage pests without resorting to chemicals.

Geoff Gurr is a professor of applied ecology at Charles Sturt University in Orange, New South Wales. **Interview by Benjamin Plackett.**

Alyssum under vine

Buckwheat midrow

Results:

1. **Field trials**
2. Lab results
3. Landscape survey

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Insect pest control:
fruit bunches attacked by lightbrown apple moth (LBAM)

Results:
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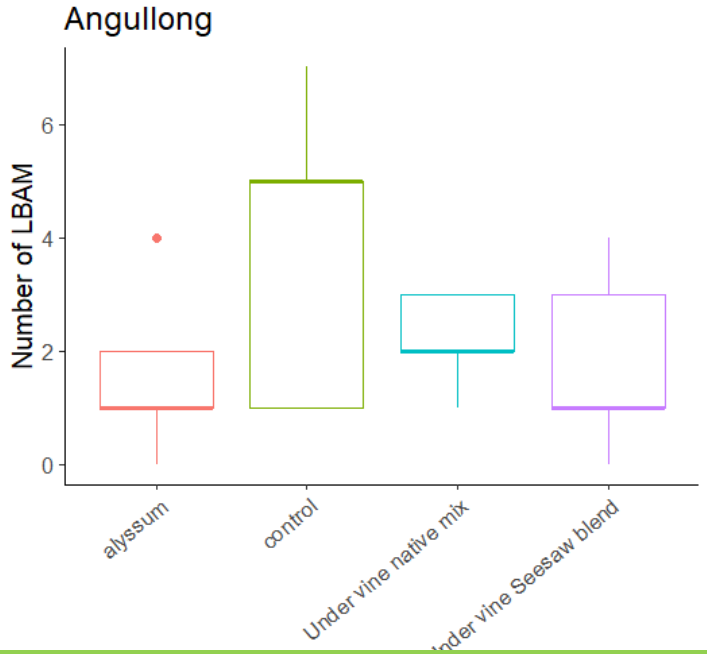

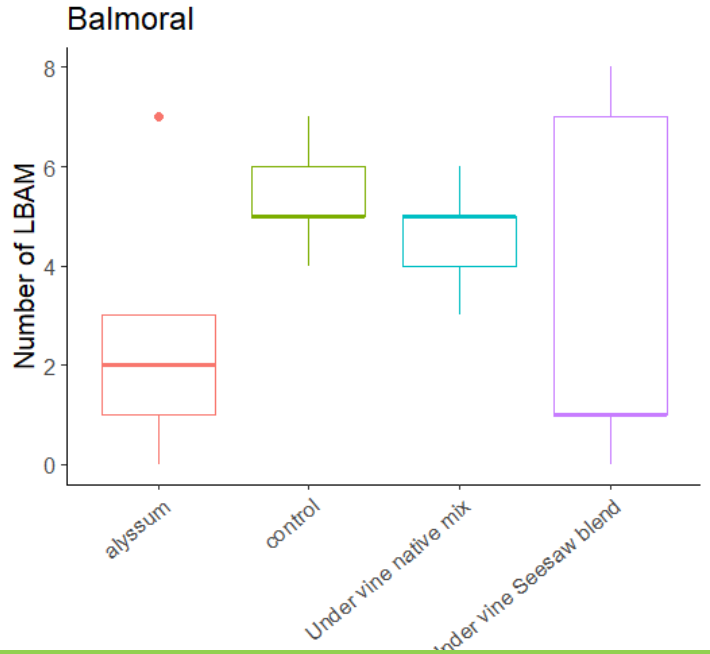

Under vine cover crops reduce numbers of bunches with LBAM
Flowers attracted and supported beneficial insects that attack LBAM.
Alyssum had strongest effect.

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Disease suppression - fruit bunches affected by botrytis.

Results:
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2. Lab results
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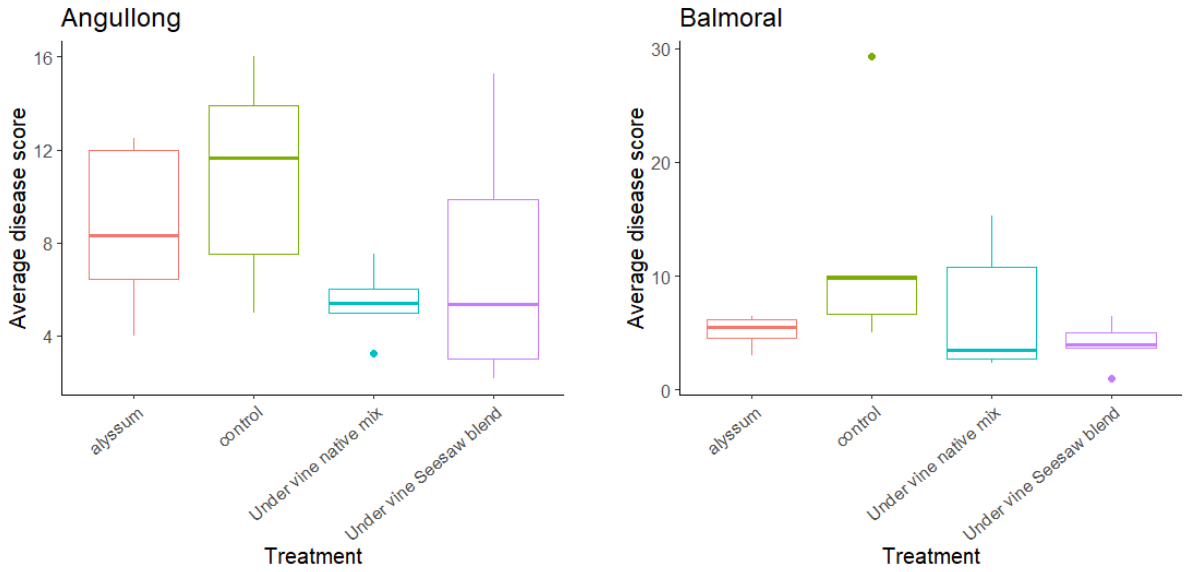
Botrytis severity



Under vine cover crops reduce severity (and incidence) of botrytis.
Flowers attracted enemies of LBAM, reduced LBAM damage reduced fungal infection

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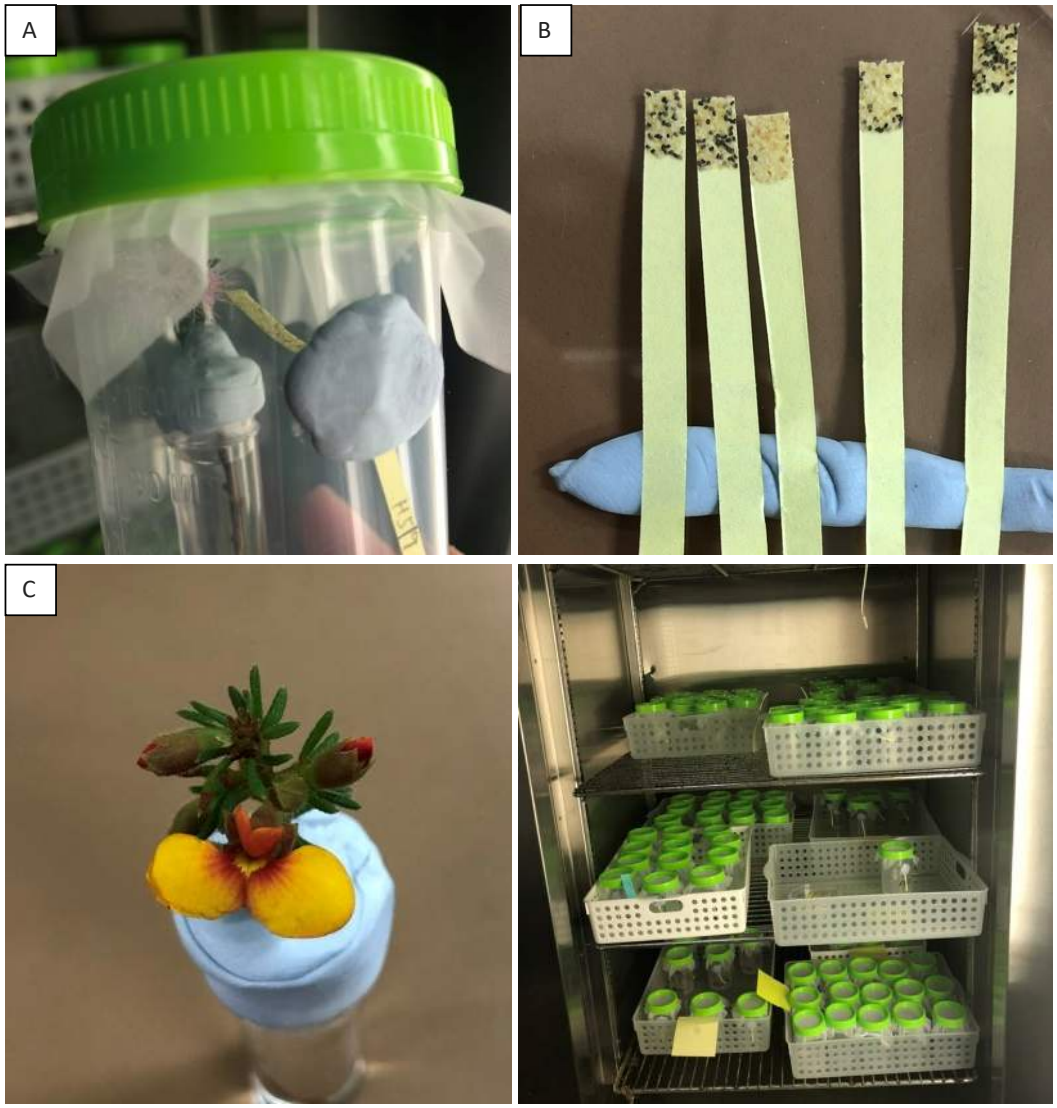

Laboratory test of parasitic wasp *Trichogramma* performance with plant flowering resources. A, flight cage assembly. B, egg cards showing parasitied eggs (black) and unparasitized eggs (cream). C, shoot of test plant held in water vial to maintain turgidity. D, Randomised flight cages in incubator.

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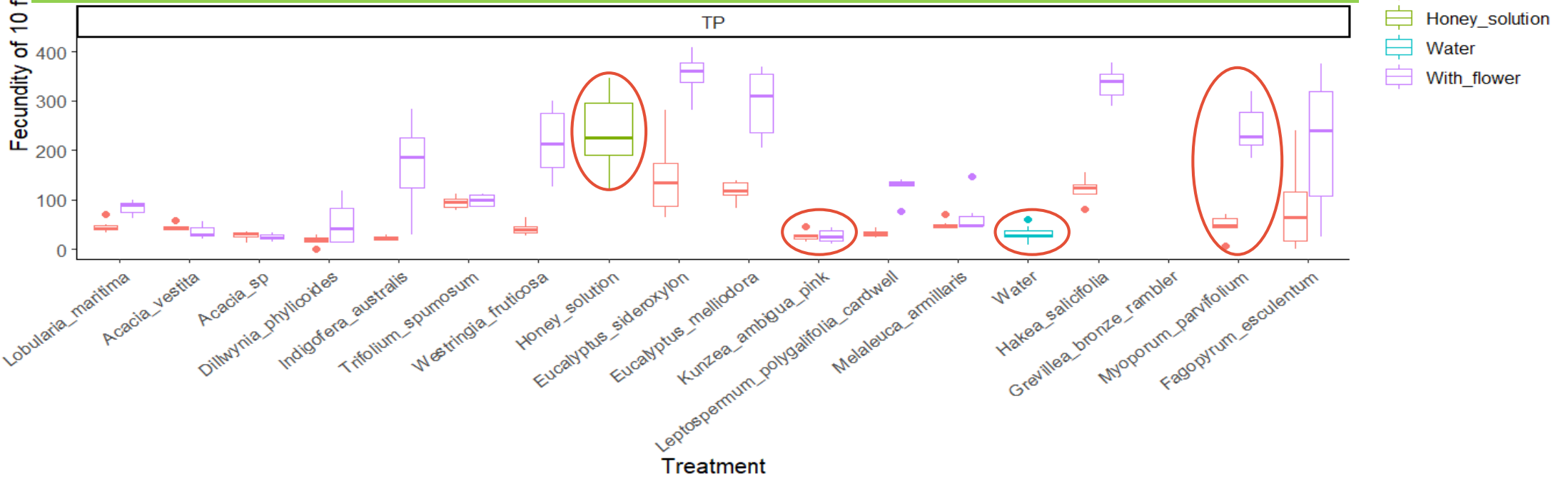
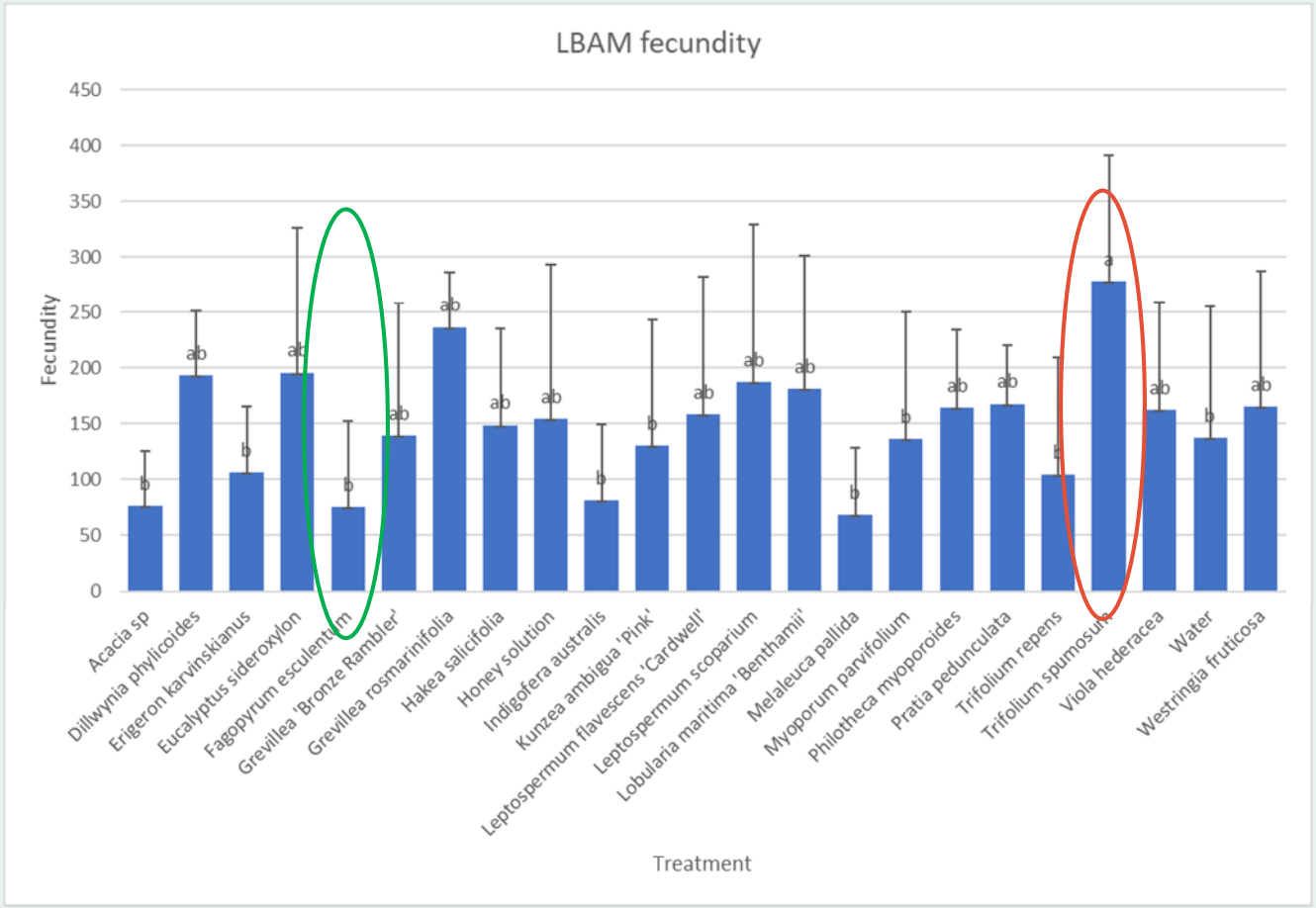
Trichogramma parasitoids of LBAM

Results:
1. Field trials
2. **Lab results**
3. Landscape survey

- 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.



Effect of flowering plant on fecundity of lightbrown apple moth (LBAM).



Results:

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Good choice:

buckwheat, white clover, and the natives *Acacia, Erigeron, Indigofera, Melaluca, Myoporum*

Bad choice:

Trifolium spumosum

Survey of 30 NSW vineyards: larger scale effects (neighbouring land use and wider landscape)

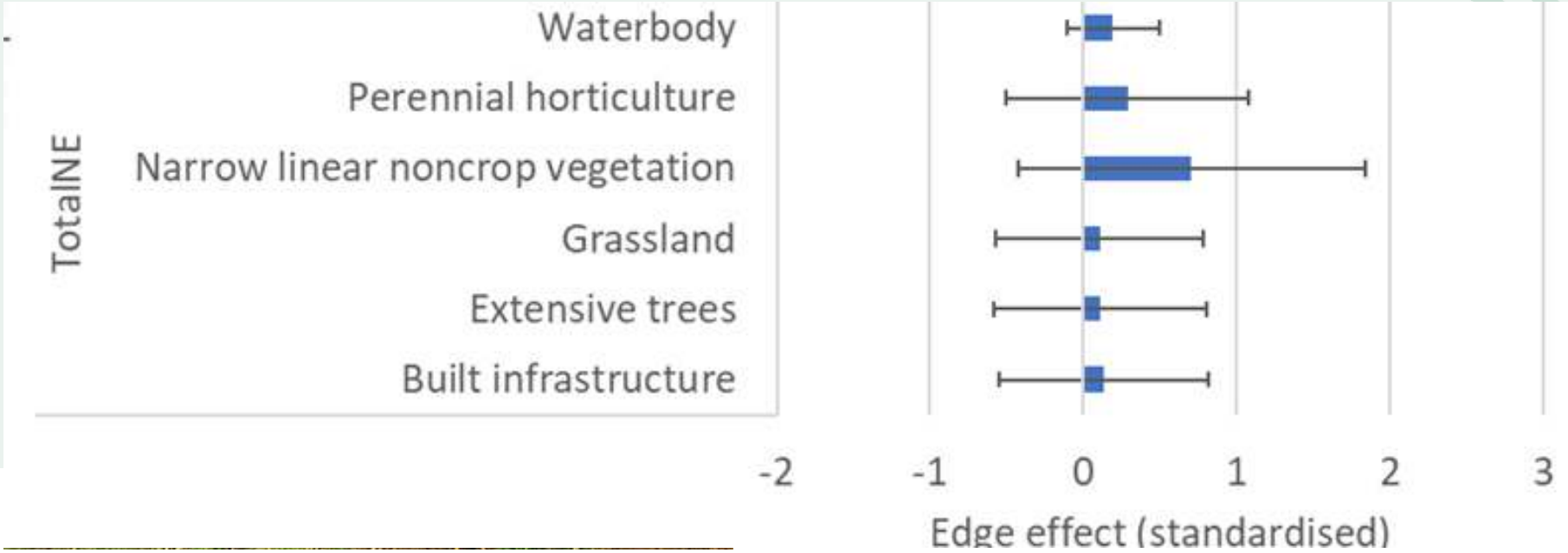
Survey of 30 NSW vineyards: Effect of adjacent land use on natural enemies (NE) in adjoining areas of vineyards compared with the centre of the vineyard

Results:
1. Field trials
2. Lab results
3. **Landscape survey**

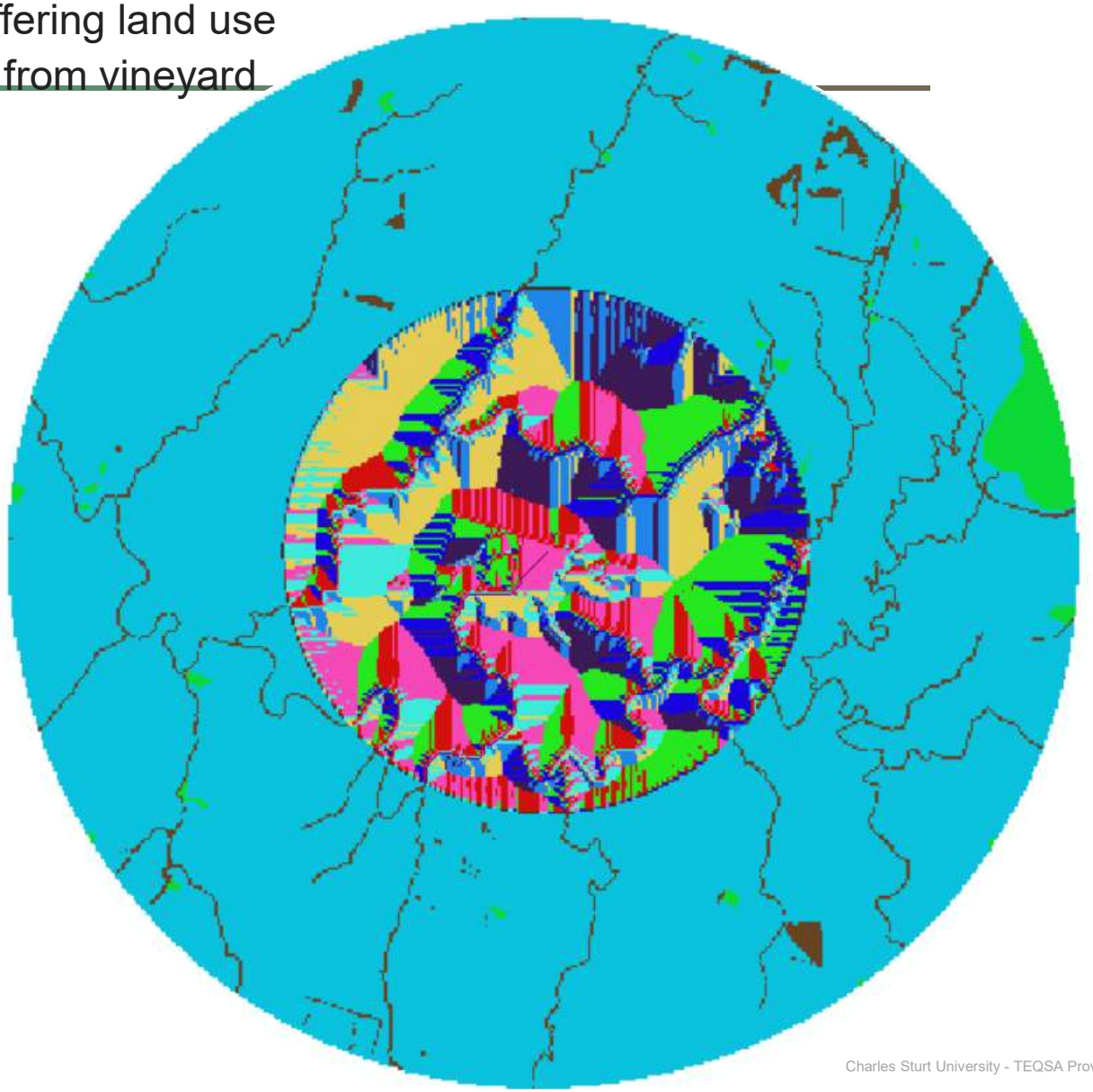
Natural enemies (dominated by spiders and parasitoids wasps) were relatively scarce in the centre of vineyards.

More natural enemies on vines close to areas that provide resources to natural enemies.

Most natural enemies if adjacent habitat provides resources AND provides connectivity for movement of beneficials.



GIS analysis of differing land use types, 5km radius from vineyard centre.



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Survey of 30 NSW vineyards: larger scale effects

on natural enemies (NE) in vineyard centre

Results:

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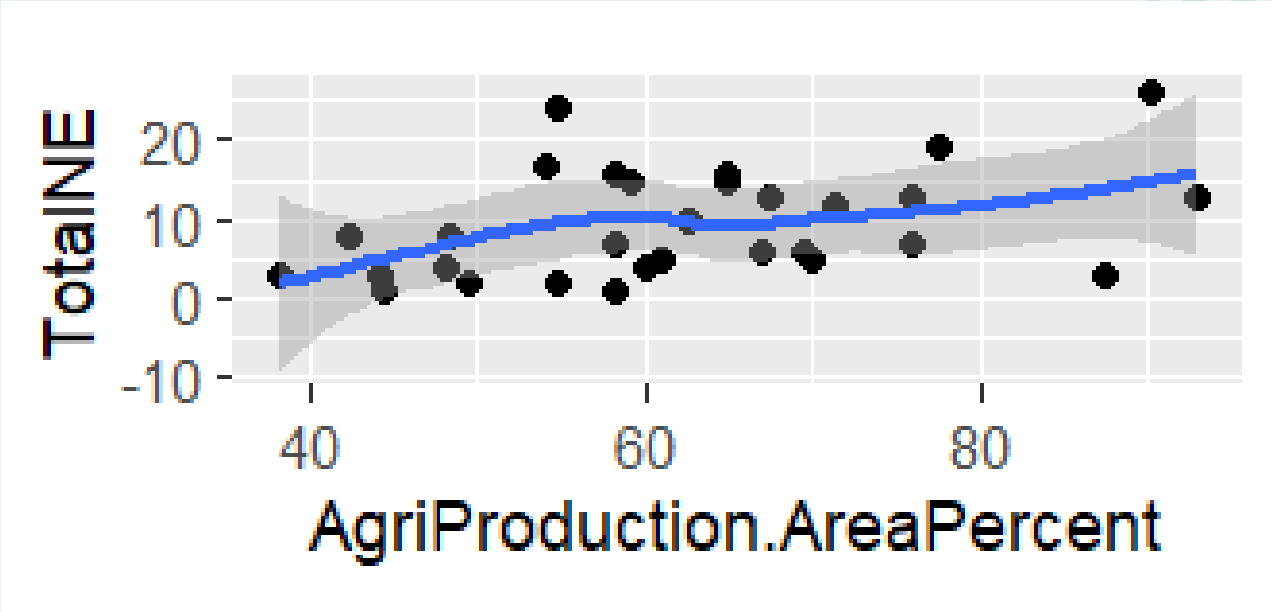
Key finding:
Vineyards in landscapes with annual crops and pastures tended to have more natural enemies.



Overall findings

1. Several plant species produced nectar that promoted beneficial wasps (and denied benefit to lightbrown apple moth).
2. Field trials showed that groundcovers could suppress LBAM and Botrytis.
3. But groundcovers can be costly and hard to establish.
4. Vineyard-adjacent (linear, non-crop) vegetation can promote densities of beneficials.
5. Annual crops and pastures in the wider landscape (to 5km) also promoted beneficial in vineyards (lots of flux in natural enemies from disturbed habitats).
    - High vs low risk sites,
    - Scope to manage to exploit effects.

Acknowledgements

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More information

Australian Government

Wine Australia