Recommendations for native vegetation selection taking into consideration some major horticultural insect pests

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Why re-establish our native vegetation in horticultural landscapes?

Re-establishment of native vegetation in horticultural landscapes can play a vital role in improving the regulation of many important ecosystem services including soil health,[1] water conservation, pollination[2] and pest regulation[3,4]. It also contributes to the conservation of biodiversity, providing habitat for diverse Australian native plants, birds, mammals and insects.

Each native plant species hosts their own suite of insects, and these insects play a variety of functional roles in the environment, for example, pollinators, predators/parasitoids, detritivores, herbivores, just to name a few. All native insects are important as they play a part in a complex food web.[5] However, there are a very small number of native herbivorous insects that can cause major economic damage to Australia's horticultural crops. Two closely related native insects that are particularly damaging to a wide range of crops are the spotting bugs: *Amblypelta nitida* (fruitspotting bug) and *Amblypelta lutescens lutescens* (banana spotting bug) (Hemiptera: Coreidae)[6].

Lateral view of an adult female spotting bug (image by Alana Govender)

Spotting bugs are major economic pests of subtropical crops including macadamia, avocado, papaya, custard apple, passionfruit, lychee, and mango. Other crops that can suffer spotting bug damage include grapes, guava, mulberry, pomegranate, figs, citrus, longan, carambola, stone fruit, cashew, banana, lemon aspen, rambutan, raspberry, white sapote, and many other exotic species.

Another native insect which has more recently emerged as a pest in macadamias are the soapberry bugs, *Leptocoris* spp. (Hemiptera: Rhopalidae). *Leptocoris* bugs have a much more specific host range compared to spotting bugs, known only to feed on plants from the family Sapinidae (except macadamias)[7].

Aggregation of *Leptocoris tagalicus* (image by Jarrah Coates, Coates Horticulture Pty Ltd.)

The aim of this document is to help land managers, ecologists, native revegetation specialists and others become more aware of spotting bugs and *Leptocoris* bugs, and the specific native plants that may host them. This will allow people to make informed decisions when buying or selling native plant species, allowing them to confidently plant for the many benefits of native vegetation, while avoiding key risks for horticulturalists.

Spotting bugs: major pest insects of Australia's horticultural industries

Fruitspotting bugs (FSB) and banana spotting bugs (BSB) are sap-feeding insects from the family Coreidae (order Hemiptera). They feed on fruits and/or shoots of plants using their sucking

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mouthparts to pierce the plant cells and remove their contents.

Top left to right: FSB feeding on avocado leaving distinctive dimples; dead shoots on mango from BSB feeding damage; feeding damage to figs by BSB
Bottom left to right: feeding damage on bananas by BSB; BSB on mango flowers; feeding damage by BSB to papaya plant (note the fungal problems associated with spotting bug feeding) (all images by Richard Llewellyn)

Range of spotting bugs
Between them, the two species of spotting bugs cover the geographic range of the entire east and northeast coastline of Australia. Fruit spotting bug, *A. nitida*, have been observed from as far south as Melbourne, Vic, and north of the Sunshine coast, QLD (source: inaturalist.org). Banana spotting bugs, *A. l. lutescens* have been observed as far south as Brisbane and north to Cairns, QLD, and along the northern coastal areas of the Northern Territory (source: inaturalist.org).

Life stages of spotting bugs
Spotting bugs have seven life stages:

- an egg
- five nymphal instars, and
- the winged adult.

Male spotting bugs are smaller than females. Once mated, females will lay single green eggs on the undersides of leaves, within the cracks in the bark and other protected locations near to a food source.

All nymphs and adult stages of spotting bugs feed on plant material, however, it is the adults that do most of the damage in crops. Adult spotting bugs are the only life stage that have wings and can fly in and out of crops.

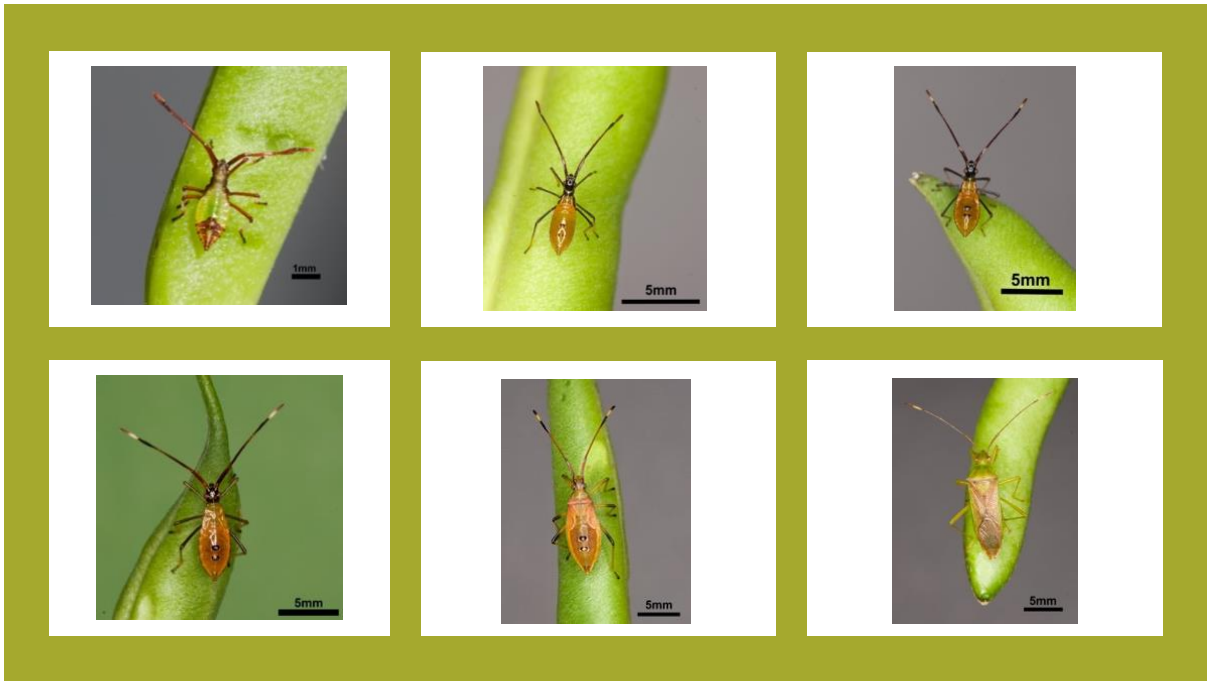
Locating and observing spotting bugs
Adult spotting bugs are noted to be difficult to observe both in crops and bushland. They are elusive, sensitive to the presence and movement of humans, and well camouflaged on their host plants. It is often the feeding damage that we see on host plants that provides the first indication that they are present.

There are many plants upon which adult spotting bugs will feed but not lay eggs because these plants do not support nymphal development; we call these 'feeding hosts'[8]. A smaller number of plants are used by spotting bugs for both feeding and breeding, which we call 'feed and breed hosts'[8].

This document does not detail exotic hosts as the objective is to provide guidance for people working on native revegetation. However, one well-known and possibly singularly troublesome exotic breeding host of spotting bug is *Murraya paniculata*, or mock orange – it is something to consider targeting for replacement.

Native plants that are utilised for both feeding and breeding, hence supporting the entire lifecycle of the spotting bug, are the focus of this document.

The life stages of *Amblypelta lutescens lutescens* (banana spotting bug). Top left to right: 1st instar, 2nd instar, 3rd instar. Bottom left to right 4th instar, 5th instar and adult stage (images by Alana Govender)



The life stages of *Amblypelta nitida* (fruit spotting bug). Top left to right: 1st instar, 2nd instar, 3rd instar. Bottom left to right 4th instar, 5th instar and adult stage (images by Alana Govender)

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Leptocoris species: occasional pests within Australia's native macadamia industry

Leptocoris species feed on developing macadamia nuts when their native host plants have no fruit. These incursions of *Leptocoris* often occur in hot, dry conditions when spotting bugs are not active within macadamia orchards[9].

Range of _Leptocoris_

There are three species of *Leptocoris* that may, because of their distribution, feed on macadamias in Australia: *L. mitellatus, L. rufomarginatus* and *L. tagalicus* (the coastal form as opposed to the inland form)[7]. *L. mitellatus* is the most widespread and is present across most of Australia (excluding Tasmania). *L. rufomarginatus* is relatively restricted to the far eastern and northern moist subtropics and tropics; it has been found from mid north coast NSW to Cairns. The coastal form of *L. tagalicus* occurs along the entire east coast Australia from Victoria and north to Cairns in Queensland (source: inaturalist.org).

Life stages of _Leptocoris_

Leptocoris bugs have seven life stages:

- an egg
- five nymphal instars, and
- the winged adult

Recognition of *Leptocoris* to species can be difficult due to the variation in body size and markings within each species, however, Carrol *et al.* 2005 tabulated the various body measurements of these species in Australia (Table 1), making identification somewhat easier.

Species	Body length (mm)	Live weight (g)
L. mitellatus	12.41 ± 0.76 (228)	79.6 ± 16.4 (12)
L. tagalicus (coastal form)	13.25 ± 0.85 (27)	57.9 ± 8.5 (18)
L. rufomarginatus	17.69 ± 0.74 (15)	93.1 ± 15.0 (16)

Table 1. Body length and live weight of three Australian *Leptocoris* species. Taken from Carroll *et al.* 2005.

Locating and observing _Leptocoris_

Feeding and reproductive adults and larvae form prominent, mixed-instar aggregations on host plants, which can number in the thousands to perhaps millions. Because of this tendency to aggregrate, and their red-coloured bodies, *Leptocoris* are easily observed.

The life stages of *Leptocoris tagalicus* (coastal form). Top left to right: 1st instar, 2nd instar, 3rd instar. Bottom left to right 4th instar, 5th instar and adult stage (images by Alana Govender)

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Non-host plants

The following native plant species have not, to date, had any recorded associations for spotting bugs or *Leptocoris* pests.

Table 1. List of native plant species that are not known hosts of spotting bugs or *Leptocoris*

Common name	Binomial name
Bunya Pine	*Araucaria bidwillii*
Callistomon	*Callistomon spp.*
Casuarina	*Casuarina spp.*
Davidson Plum	*Davidsonia spp.*
Eucalyptus	*Eucalyptus spp.*
Grevillea	*Grevillea spp.*
Hoop Pine	*Araucaria cunninghamii*
Lemon Myrtle	*Backhousia citriodora*
Leptospermum	*Leptospermum spp.*
Melaleuca	*Melaleuca spp.*
Native Gardenia	*Atractocarpus fitzalanii*
Tukeroo	*Cupaniopsis anacardioides*
Walking Stick Palm	*Linospadix monostachyos*

This list of plant species is based on review provided by: Ray Johnston, *Gin Gin Landcare*; Dr Gavin Chirgwin, Bundaberg; Eddy Dunn, *Total Grower Services*; Jarrah Coates, *Coates Horticulture*; Alan Coates, *Coates Horticulture*; Richard Llewellyn, *BioResources & BioResEd*; Dr Alana Govender, *BioResEd*; Dr Abigail Makim, *BioResEd*, Dr Christopher Carr, *BioResEd* (April-June 2022).

This list is subject to revision based on ongoing observations and data collection. There will be many additional native plant species not included in this list that do not host FSB, BSB and/or *Leptocoris*.

This list is provided as a low-risk starting point for people interested in establishing native vegetation areas in horticultural landscapes. It can also assist in getting people started in making their own observations of insect-plant interactions.

Pest host plants

Table 2. List of plants observed to be 'feed and breed' hosts of banana spotting bug (BSB), fruitspotting bug (FSB) or *Leptocoris*. Level of host association risk has been categorised as 'high' or 'low'.

Common name	Binomial name	Insect pest	Pest risk
Bangalow Palm	*Archontophoenix cunninghamiana*	BSB	Low
Beach Alectryon	*Alectryon coriaceus*	*Leptocoris*, BSB	High
Bleeding Heart	*Homalanthus populifolius*	FSB	High
Boonaree, Inland Rosewood	*Alectryon oleifolius*	*Leptocoris*	High
Brachychiton	*Brachychiton* spp.	BSB, FSB	Low
Cabbage Palm	*Livistona australis*	FSB	Low
Cheese Tree	*Glochidion* spp.	BSB	Low
Clausena	*Clausena brevistyla*	FSB, BSB	Low
Cocky Apple	*Planchonia careya*	BSB	Low
Cotton Tree	*Hibiscus tiliaceus*	BSB	High
Desert Lime	*Eremocitrus glauca*	FSB	Low
Foambark	*Jagera pseudorhus*	*Leptocoris*	Low
Hairy Alectryon	*Alectryon connatus*	*Leptocoris*	High
Hard Alectryon	*Alectryon subdentatus*	*Leptocoris*	High
Lillypily	*Syzygium* spp.	FSB, BSB	Low
Macadamia	*Macadamia* spp.	FSB, BSB	High
Mangroves	Various	BSB	Low
Moreton Bay Fig	*Ficus macrophylla*	BSB	Low
Native Quince, Bird's Eye	*Alectryon subcinereus*	*Leptocoris*	High
Orange Boxwood	*Denhamia celastroides*	BSB	Low
Pittosporum	*Pittosporum undulatum*	FSB	High
Red Kamala	*Mallotus philippensis*	FSB, BSB	High
Ribbonwood	*Euroschinus falcatus*	FSB, BSB	High
Rough-leafed Fig	*Ficus coronata*	FSB, BSB	Low
Scrub Boonaree, Holly Bush	*Alectryon diversifolius*	*Leptocoris*	High
Silver Quandong	*Elaeocarpus kirtonii*	FSB	Low
Stephania	*Stephania* spp.	FSB, BSB	High
White Ash	*Alphitonia petrei*	FSB, BSB	High
White Cedar	*Melia azedarach*	FSB	Low
White Tamarind	*Elattostachys xylocarpa*	*Leptocoris*	High
Wooly Rambutan, Hairy Bird's Eye	*Alectryon tomentosus*	*Leptocoris*	High

This list of plant species is based on review provided by: Ray Johnston, *Gin Gin Landcare*; Dr Gavin Chirgwin, Bundaberg; Eddy Dunn, *Total Grower Services*; Jarrah Coates, *Coates Horticulture*; Alan Coates, *Coates Horticulture*; Richard Llewellyn, *BioResources & BioResEd*; Dr Alana Govender, *BioResEd*; Dr Abigail Makim, *BioResEd*, Dr Christpher Carr, *BioResEd*.

This list is subject to change based on ongoing observations and data collection. There will be additional native plant species not included in this list that host FSB, BSB and/or *Leptocoris*.

It is recommended that high density plantings of these species are avoided in horticultural landscapes.

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Next steps for native plant revegetation in horticultural landscapes

Select for diversity overall.

- Biodiversity can be linked to a number of important ecosystem services in horticultural landscapes, including soil health, pollination and pest regulation.[10]

Favour non-hosts.

- Non-host plants identified in this document will not support the life cycle of pest insects.
- Non-host plants provide habitat for important beneficial insects including pollinators, parasitoids and generalist predators.[11] This includes native bees, wasps and spiders, which can make important contributions to the productivity and sustainability of orchards. This vegetation also provides habitat and resources for insectivorous native birds, which are known to feed on pest insects.[12]

Avoid hosts.

- Industry professionals observe that the host species identified in this document can bring insect pests into orchard environments.
- Avoiding these species as much as possible within horticultural landscapes, within the context of planting for diversity overall, will support beneficial invertebrates and birds without encouraging problem insects.

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