The functional diversity of predator arthropods in vineyards

Natural enemies commonly found in association with native habitat and vineyards in South Australia

Mary Retallack, from The University of Adelaide and Retallack Viticulture, highlights common natural enemies often found in association with selected native plants and vineyards. This is the fourth in a series of articles that has provided practical insights for growers on the practicalities of enhancing biodiversity in vineyards.

Introduction

In last issue's article ('Practical examples of ways to establish native insectary plants in and around vineyards', December 2018), I outlined practical ways to incorporate native insectary plants in and around vineyards. They are consistently reported as having low occurrence of pests and contribute towards conservation biological control (Van Emden 2003, Fiedler *et al.* 2008, Begg *et al.* 2017). Many natural enemies that attack vineyard pests are native (Gagic *et al.* 2018), and an increase in predators is reported where there are stands of native vegetation adjacent to cropping areas (Landis *et al.* 2000, Landis *et al.* 2005, Parry *et al.* 2015).

In this article, I will highlight the findings from recent research by Retallack *et al.* (2018), including the common predators that winegrape growers are likely to see on selected native insectary plants, Christmas bush, *Bursaria spinosa*, prickly tea-tree, *Leptospermum continentale*, wallaby grasses, *Rytidosperma ssp.* and grapevines. This will help growers to identify the diversity of predatory arthropods present with greater confidence. The functional diversity of natural enemies can be increased by more than three times when either Christmas bush or prickly tea-tree is planted in association with grapevines. Wallaby grasses often attract a complementarity of natural enemies that are not as abundant on the woody plants. When they are added, this could result in a net increase in predator morphospecies richness in the order of 25%.

When are you most likely to see predators?

Grapevines are deciduous and enter into a period of dormancy during winter. The reduction in insectary resources during this period may result in a 'resource bottleneck', resulting in an interruption in the presence of predators and parasitoids that would otherwise breed continuously (Schellhorn *et al.* 2015). By contrast native woody, insectary plants are evergreen. They have the capacity to support populations of mobile predators throughout the year, which can passively populate vineyards and provide continuity of resources. This is important as spiders and other predators can successfully overwinter in vineyards, albeit in low abundance (Costello and Daane 1999, Thomson and Hoffmann 2007) and are likely to feed on larvae of moths and other pests that often shelter on broad-leafed weeds early in the growing season.

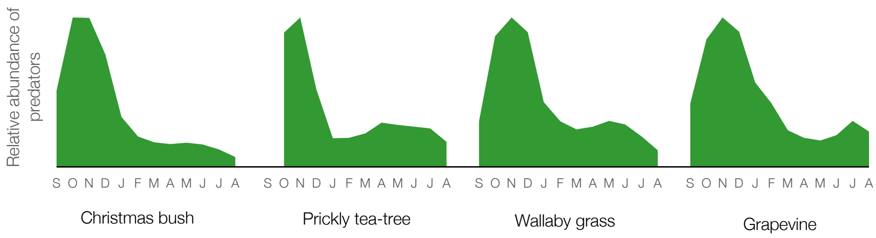

Figure 1. Relative abundance of predators over a 12-month period (September to August).

It was reported in a recent study (Retallack *et al.* 2018) that predator abundance starts to rise from September onwards, and peak in October or November, depending on the flowering time of each plant (Figure 1). This period coincides with the typical grapevine flowering period when biocontrol is needed to minimise damage to developing bunches of grapes. Predator abundance tends to drop off from December, when the weather conditions become hotter and drier.

It is important to note that predators are present throughout the fruit ripening period and can contribute to biocontrol right through until harvest. In fact, predators provide a first line of defence throughout the season, particularly once bunches have closed, when chemical control options are limited and the efficacy of spray coverage inside bunches is poor (Wise *et al.* 2010).

Introducing spiders (Araneae) found in high abundance

Spiders are voracious predators and are found throughout the year, but not always in each habitat. Some species live on the ground, and others are active in the canopy of plants (Costello and Daane 1995), and different functional groups have different hunting methods. Some families of spiders are active hunters or ambush predators, such as jumping spiders (Salticidae) (Figure 2a, page 24) and flower or crab spiders (Thomisidae) (Figure 2b, page 24). They are commonly found on woody perennial plants. Wolf spiders (Lycosidae) (Figure 2c, page 24) are found on wallaby grasses and other vegetation close to the ground. Still other spiders, such as orb weavers (Figure 3a, page 24) and bird dropping spiders (Araneidae) (Figure 3b and c, page 24), are sedentary or web dwelling, and wait for their prey to come to them.

Jumping spiders (Salticidae)

Jumping spiders are tiny, often only a 1cm or less in size. But are very effective hunters, and sometimes kill other spiders. This behaviour of getting rid of potential competitors is called intraguild predation. ▸

Some species of jumping spider may slowly advance onto a web and vibrate the silk with their pedipalps (the two appendages on the front of a spider's head) and legs. If the web occupant approaches to deal with the ensnared prey, the predator attacks. You may have also heard of peacock spiders which are getting lots of attention in the media due to the elaborate mating dances of the colourful males. These also belong to the Salticid family and some species may be found on prickly tea-tree if you look hard enough. Jumping spiders are commonly found on Christmas bush and prickly tea-tree (Retallack *et al.* 2018).

Flower or crab spiders (Thomisidae)

Flower or crab spiders derive their name from both their tendency to rest in flowers and the shapes of their legs, which resemble those of crabs and enable them to scuttle sideways or backwards. They lay in wait for their prey and attack insects as they approach.

Wolf spiders (Lycosidae)

Wolf spiders are most active at night. If you shine a light into their eyes, then they will reflect it back producing a glow that is easily seen. They are active, solitary hunters with excellent eyesight. The presence of wolf spiders is enhanced by grassy and woody understorey vegetation (Tsitsilas *et al.* 2006, Thomson and Hoffmann 2009, D'Alberto *et al.* 2012). They were found abundantly in association with wallaby grasses, but seldom on the other plants (Retallack *et al.* 2018).

Bird-dropping spider, *Celaenia excavata* (Araneidae)

The bird dropping spider derives its name from defensive mimicry of bird droppings. It stays motionless on its web during the day, and only hunts for prey at night. It hangs down from a silk thread and releases a scent which mimics the pheromones released by female moths. When a male moth approaches, the spider will capture it with its powerful front legs (Henderson 2018).

Native shield bugs (Hemiptera: Pentatomidae)

Two predatory shield bugs, the glossy shield bug and the predatory shield bug (Pentatomidae) are often observed in association with native vegetation and grapevines. They use their piercing-sucking mouthparts to suck out the body fluids of caterpillars and other soft-bodied insects.

Glossy shield bug, *Cermatulus nasalis*

The glossy shield bug, *C. nasalis* (Figure 4a), is a predator of a range of pests including moths (Mensah 1997, Gurr *et al.* 2004). The glossy shield bug is found on a wide range of plants, including wallaby grasses and grapevines. It is anticipated that the incorporation of wallaby grasses in the mid-row or under-vine will support populations of the glossy shield bug in vineyards.

Predatory shield bug, *Oechalia schellenbergii*

The predatory shield bug, *O. schellenbergii* (Figure 4b), is commonly found on Christmas bush, prickly tea-tree and grapevines but less in association with wallaby grasses (Retallack et al. 2018). They lay rafts of eggs, with a distinctive ring of white spines on top (Figure 4c). It is anticipated that the incorporation of Christmas bush and prickly tea-tree in association with vineyards will help to support populations of the predatory shield bug in vineyards. Both species of shield bug can be found throughout the entire season.

Ladybird beetles *(Coleoptera: Coccinellidae)*

At least four species of ladybird beetle are often found in vineyards (Figure 5). The transverse ladybird beetle and common spotted ladybird beetle are easily identified with the naked eye, but the minute two-spotted ladybird, *Diomus notescens* and *Scymnus* spp., are not. Both the adults and larvae of ladybird beetles are generalist feeders that will attack the immature states of moths and beetles (Evans 2009) and grapevine scales (Rakimov *et al.* 2015). They will also feed on pollen and nectar from native insectary plants when suitable prey is not available, and at other times throughout the year whenever flowers are present.

Figure 2. Jumping spiders (Salticidae) are active hunters (a), flower or crab spiders (Thomisidae) ambush their prey (b), and wolf spiders (Lycosidae) are well camouflaged on the ground (c).

Figure 3. Web dwelling spiders (eg, orb weavers, Araneidae) are sedentary (a), as is this bird dropping spider on prickly tea-tree with egg sacs (each ball contains more than 200 eggs) (b) and camouflaged on a grapevine leaf (c).

Transverse ladybird beetle, *Coccinella transversalis*

The transverse ladybird beetle, *C. transversalis,* is an introduced species that is commonly found in Australia. It is predominantly orange, with a black head and three distinctive lobed markings on each elytron (hardened forewing).

Common spotted ladybird beetle, *Harmonia conformis*

The common spotted ladybird, *H. conformis,* is native to Australia and is commonly found on grapevines, Christmas bush and prickly tea-tree, among other plants.

Lacewings (Neuroptera)

Green lacewing, *Mallada signata* (Neuroptera: Chrysopidae)

Green lacewing adults (Figure 6a) are easily identified due to their slender pale green bodies, large lace-like wings and long antennae. The larvae carry the debris of dead insects on their backs and are known as 'junk bugs' (Figure 6b). They are predators of a wide range of soft-bodied insects such as mealybugs, soft scales, mites, caterpillars and moth eggs. They will also eat their own eggs, which is one of the reasons why the eggs are suspended on long stalks to protect them from their siblings as they hatch. They are found on a range of plants, and are commonly seen on Christmas bush.

Brown lacewing, *Micromus tasmaniae* (Neuroptera: Hemerobiidae)

Brown lacewing adults (Figure 6c) and larvae are predators of a wide range of pest species. The larvae do not carry debris on their backs like green lacewing larvae do. The adults are readily found on a range of plants throughout the growing season, often in higher abundance than green lacewings.

Mantid lacewing (Neuroptera: Mantispidae)

The mantid lacewing (Figure 6d) has 'raptorial' fore legs which look similar to a praying mantis and distinctive lacewings. They are predators of a range of insects.

Assassin bugs (Hemiptera: Reduviidae)

Orange assassin bug, *Gminatus australis*

The orange assassin bug, *Gminatus australis* (Figure 7a, page 26), is often sighted on Christmas bush and prickly tea-tree. There are a number of other species that can be found in association with grapevines and wallaby grass. These bugs are assassins by name and by nature. They use their hollow, needle-like mouthparts to inject their prey with a lethal saliva that liquefies the body tissues of the prey, which are then sucked out (Figure 7b, page 26). Other species of Reduviidae found either in vineyards or on native plants include the black ground assassin bug, *Peirates* ssp., brown assassin bug, *Coranus granosus* (Figure 7c, page 26), and *Pnirsus cinctipes.*

This article provides a snapshot of some of the most common predators found in

Figure 4. Native shield bugs, glossy shield bug, *C.nasalis* on Christmas bush (a) predatory shield bug, *O. schellenbergii* (b) and a raft of predatory shield bug eggs on a grapevine leaf (c).

Figure 5. Ladybird beetles, transverse ladybird beetle, C. transversalis (a) common spotted ladybird beetle, H. conformis (b), and minute two-spotted ladybird, D. notescens (c).

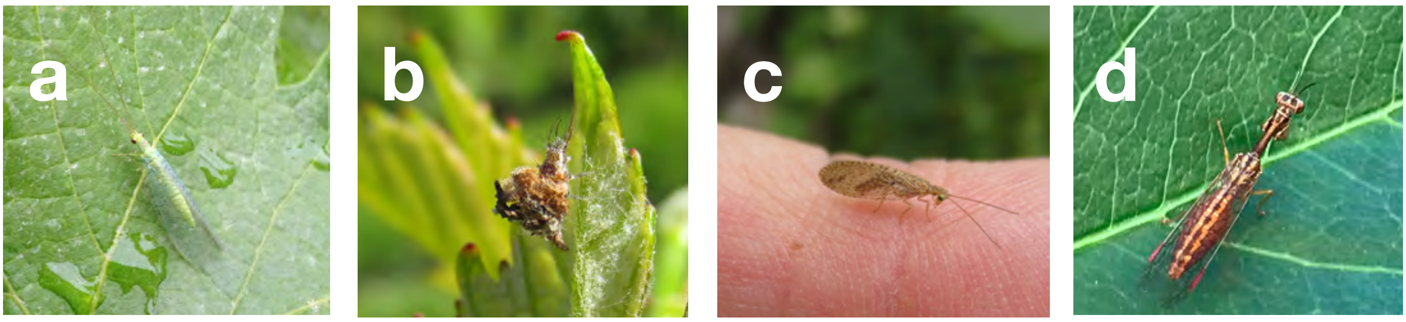

Figure 6. Green lacewing, M. signata (a) Green lacewing larva 'junk bug' (b), Brown lacewing, M. tasmaniae (c), and mantid lacewing (d).

Figure 7. Orange assassin bug, G. australis on Christmas bush (a) orange assassin bug consuming the contents of a moth (b), and Coranus granosus (c).

association with selected native plants and in vineyards in South Australia. Fifty-five morphospecies of predators were found in vineyards in a recent study (Retallack *et al.* 2018), and more than 100 predatory morphospecies overall. In addition to the native insectary plants discussed, there are more than 21,000 flowering plants that are native to Australia (Anon 2015), some of which have the potential to support predators that suppress pests. In the next article, I will discuss different techniques used to survey the presence of predatory arthropods in the field.

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