# Multiple benefits from bush

GRAEME JENNINGS

That 'bit of bush' in the bottom corner or along the track may be more valuable than you think, with increasing evidence that insects provide a variety of in-crop benefits.

Precision agriculture technologies that enable paddocks to be zoned according to soil type and crop performance have seen some growers replant poor cropping land with native vegetation to improve biodiversity and so they can focus inputs on their most productive soils.

This approach can also provide direct benefits to the cropping program by providing habitat for beneficial insects and other invertebrates that help control pest numbers and improve pollination of crops such as pulses and canola.

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Many growers see 'bush' as a source of pests, but research data suggest that, while remnant bushland can harbour crop pests, they are likely to be living on weeds, not native vegetation, which can be a valuable source of 'free' biological services such as pest control and pollination.

A three-State GRDC-funded 'pest-suppressive landscapes' project focused on pest and beneficial insects relevant to wheat and canola has found that 'good quality' native vegetation can help reduce pest pressure in grain crops. It is estimated that invertebrate pests cost Australian agriculture around $500 million in lost production each year.

The researchers, who monitored insect populations in native vegetation monthly for two years, found that native vegetation is unlikely to contain significant populations of crop pests unless it is infested with broad-leafed weeds.

According to Dr Sarina Macfadyen, a CSIRO research scientist involved in the project, pastures are more likely to be a source of crop pests than good-quality weed-free native vegetation.

RECENT RESEARCH HIGHLIGHTS THE POTENTIAL IMPACT SHELTERBELTS CAN HAVE ON INVERTEBRATE BIODIVERSITY AS WELL AS ON PEST CONTROL.

"Weediness significantly increases the risk of bushland harbouring crop pests.

"Where there were crop pests in bushland they were usually on weeds. The pattern was the same in pastures. The pests were on broad-leafed weeds, not necessarily the pasture plants.

"For example, in NSW Rutherglen bug, a pest of canola and cereals, was more likely to be found on weeds in pastures and native vegetation.

"It seems that growers can maximise the pest control-benefits of native vegetation by keeping it free of broad-leafed weeds.

"Even quite degraded areas of bush can provide significant benefits, but there is potential to improve the level of benefit by removing weeds."

Many beneficial predators and parasitoids (parasites) feed on a variety of pests and are able to travel quite large distances, Dr Macfadyen said, so growers should assess their native vegetation on a farm scale, rather than paddock by paddock.

DR SARINA MACFADYEN

## DAISIES MORE THAN PRETTY FLOWERS

**WA farmer Rob Egerton Warburton, who grows everlasting daisies for seed, told growers at the SANTFA annual conference that he has had less pest problems in his crops since he began sowing daisies in his cropping paddocks.**

**In 2011 he began sowing strips of daisies around the perimeter of his wheat paddocks as a refuge and food source for pollinators and other beneficial insects, with the aim of improving biological diversity and reducing reliance on chemical pest and disease control.**

**Since adopting this approach he has had no problems with aphids in his crops, he said.**

**This observation is in line with the findings of formal research into the effects of remnant bush and 'diverse landscapes'.**

"Determine the total area, including planted trees and shrubs along roadways, and assess the quality of what is there, particularly in relation to weediness.

"Broad-leafed weeds can harbour high numbers of pests, so pest pressure can also be reduced by removing weeds from pastures.

"Our findings indicate that some native vegetation is better than none, and weed-free bushland is likely to support more beneficials and less crop pests.

Results from the landscape-scale study, conducted over a total of 264 ha in WA, NSW and Queensland, are being incorporated into computer models it is hoped will improve understanding of the dynamics of insect populations in different landscapes and enable scientists to predict the impact of changes in land use or management.

The models may also make it possible to provide landholders with data-based advice on how much of what type of native vegetation to establish where on their properties to gain maximum pest control benefits from it, Dr Macfadyen said.

"We may be able to suppress pest outbreaks in the landscape by managing native vegetation in order to minimise its attractiveness to crop pest sand maximise its ability to support beneficial insects.

"There is little doubt that good-quality native vegetation is a good source of beneficial insects and we need to prevent pest build up if we are to reduce reliance on insecticides for pest control.

"In the future we may be able to help growers choose plant species that support beneficial insects, and provide guidance on where to plant them to can reduce pest pressure, improve pollination and general biodiversity and achieve carbon sequestration."

Researchers at the University of Melbourne have shown that shelter belts or windbreaks in south-western Victoria harbour beneficial insects that suppress pest mites in adjacent pastures.

Dr Paul Umina, a scientist with the University of Melbourne and cesar, an independent company that grew out of the Centre for Environmental Stress and Adaptation Research, said shelterbelts with considerable ground cover generally contained low numbers of pest species and higher numbers of beneficial species. These beneficials move into adjacent paddocks and prey on pests such as redlegged earth mites, blue oat mites and lucerne flea, with research showing they can provide pest control up to 30 metres from the shelterbelt.

This work was conducted in pastures but the results should be applicable to cropping systems, which can be severely damaged by earth mites and lucerne flea, he said.

"Farmers often spray the edges of paddocks because mites are thought to move in from neighbouring paddocks, roadsides and fence lines. However, the low numbers of mites we found suggest such control measures are not warranted where

SHELTER BELTS CAN IMPROVE INVERTEBRATE BIODIVERSITY AND PEST CONTROL; WITH THE BENEFITS LIKELY TO BE GREATER WHERE THERE IS AN UNDER-STOREY OF VEGETATION.

there is appropriately-managed adjacent native vegetation."

Dr Umina advocates that shelterbelts be fenced and managed to promote development of a complex understorey, with grasses an important element. Grass strips alone may increase numbers of spiders and predatory mites that will help control some pest species.

"Farmers can manage non-crop vegetation such as shelterbelts specifically for pest control, with the biological control benefits likely to increase with the complexity of the vegetation in the windbreaks.

"Maintaining a cover of plants with heights of 12 to 40 cm under trees and shrubs in windbreaks has been shown to maintain populations of beneficial organisms including predatory mites, spiders, predatory beetles and other insects large enough to provide a level of pest suppression."

Another University of Melbourne study has shown that numbers of predatory carabid beetles, which feed on slugs, are higher in crops adjacent to areas of native grasses.

A survey of 20 properties in western Victoria found high numbers of carabids in remnant grasslands and adjacent crop paddocks, with beetle numbers decreasing with distance from the grasslands.

This indicates that beetles disperse from remnant grasslands deep into cropping paddocks, suggesting that growers can conserve remnant grasslands to maintain populations of bio-control agents of crop insect pests.

## Pollination

The value of native vegetation and diverse landscapes has also been highlighted in a global study of the value of native and other wild insects as pollinators.

An international team including Australian scientists found that wild insects pollinate crops more effectively than honey bees, which generally supplement, rather than replace, pollination by wild insects.

Many of the 41 production systems examined in the study involved horticultural crops but the findings are also relevant to field crops such as canola and pulse crops, including faba beans, said Dr Cunningham, who is the team leader for 'Biodiversity in Managed Landscapes' in CSIRO.

## SOME BUSH BETTER THAN NONE

**When it comes to refuges for native insects, some native vegetation is better than none.**

**A few mallee trees on a rocky outcrop, some native gasses in the bottom corner of the paddock or native trees and shrubs along a laneway or fence line can all support populations of beneficial insects that can provide pollination or pest control benefits in crops.**

**Given these potential benefits, it pays to think about how these remnant refuges are treated.**

**According to CSIRO scientist Dr Saul Cunningham, there is growing evidence that even small areas of native vegetation can improve the number of beneficial insects in a cropping system.**

**Even a patch of native grass or trees and shrubs along a laneway can support native and other insect species, he said.**

**"Large, linked areas of bush are the ideal but are not the only option. Multiple small areas can also have significant benefit and have the bonus of distributing populations of beneficial insects and other organisms across a property or region.**

**"And numerous smaller areas of native vegetation can often be more achievable than revegetating large areas.**

**"The important thing is to recognise the value of small areas of native species and manage them to maximise their benefit as habitat for beneficials, he said.**

**"That means not spraying them with insecticides, and a bit of weed control wouldn't go astray."**

**While some beneficial species can fly significant distances, Dr Cunningham sees advantages from a landscape with native vegetation distributed across a property. He suggests growers aim for a diverse landscape including areas of vegetation from which populations of native insects can move into crops to provide a 'pollination service', or help control crop pests such as aphids.**

"There is clear evidence that well-managed honey bees can significantly increase faba bean yields, which implies a lack of wild pollinators.

> **Agricultural industries that rely on insect pollination need to establish a mosaic landscape in which cropping and remnants or plantings of native vegetation coexist."**

"The results with faba beans suggest better pollination should also increase the yield of other pulses, and that pulse growers can expect a fall in production if pollination is reduced by a drop in honey-bee numbers or a reduction in habitat for wild pollinators."

Canola yields are also influenced by insect pollination, despite the fact that the crop is technically self-pollinating, he said.

"There is a significant body of research that clearly shows canola and Brassica juncea yields are increased by good numbers of pollinators including feral honey bees, solitary native bee species, most of which nest in soil or in wood or pithy stems, and hoverflies."

He suggests, based on some of his canola pollination research, that smaller paddocks interspersed with beneficial habitat such as woody vegetation could improve the number of pollinators in canola crops.

"Canola yields increase with the diversity and abundance of insect pollinators and the amount of native vegetation around the crop."

CSIRO and University of Queensland scientist Dr Margaret Mayfield, one of the Australian researchers involved in the global pollination project, said the results

showed that a combination of wild pollinators and managed honey bees were needed to maximise the yields of insect-pollinated crops.

"Honey bees are important, but so are wild pollinators such as weevils, butterflies, wasps, flies and bees other than honey bees. Honey bees do not compensate fully for the absence of wild pollinators, which are generally more effective at increasing yields than honey bees."

Dr Cunningham agrees, but points out that in landscapes such as broadacre almond monocultures that provide no refuge or food sources for native species, managers have to rely on managed honey bees to compensate for the lack of wild pollinators.

"The ideal would be to manage the landscape so there are good numbers of wild pollinators, but if you have a crop that relies on pollination and there are no wild pollinators, there is little option but to bring in managed honey bees."

"Growers who want the benefits of native species, whether for pollination or bio-control of pests, need to create a varied landscape that provides habitat for them, in locations that enable them to move into the crop to do their work."

The almost inevitable arrival of varroa mite in Australia, the only food-growing country in the world without this destructive pest, is focusing attention on the role of native pollinators, he said.

"An outbreak of varroa would reduce the number of managed bees and almost wipe out feral honey bees, which currently provide a lot of crop pollination, so it is vital to provide habitat for native insects in locations that enable them to be effective as crop pollinators.

"Land holders who wish to encourage bees to visit their properties should retain or plant native vegetation," he said.

"Agricultural industries that rely on insect pollination need to establish a mosaic landscape in which cropping and remnants or plantings of native vegetation coexist."

According to Argentinian scientist Lucas Garibaldi, who headed the global pollination study, there are 20,000 species of bees and other insects involved in crop pollination world-wide, plus bats and birds in some crops.

The study was prompted by concern about a word-wide decline in insect species, which he suggests could be due to factors including climate change and monocultures that do not provide refuges or food sources for pollinators.

Pointing out that pollinators need to feed year round, not just when a particular crop is in flower, Dr Garibaldi said landholders looking to encourage populations of native insects need to provide shelter and food sources for them by designing diverse landscapes, rather than 'huge monocultures', growing a variety of crops and not using insecticides during flowering.

"Changing land use to monocultures means the landscape can't support wild pollinators.

"Landholders and policy makers should aim for conservation or restoration of natural or semi-natural areas within croplands, 'patchy' land-use, so there are not uninterrupted areas of a single crop, provision of diverse floral and nesting resources.

"Without such changes, the on-going loss of wild insects is destined to compromise agricultural yields worldwide."