

CASE STUDY - DIVERSE COVER CROP BRINGS POLLINATORS, PREVENTS EROSION, IN LATEST SUBTROPICAL HORTICULTURAL RESEARCH



The Regenerative Agriculture Alliance and the Centre for Organics Research at Southern Cross University is currently undertaking a three-year research study investigating multispecies cover crops in subtropical horticultural plantations. The research is focused on soil health and insect ecology. There are five farms participating in the study in the Northern Rivers Region of NSW: three macadamia farms, a coffee plantation and an avocado farm.

Project lead, Professor **Terry Rose** said cover crops are sown either as single or multiple species. He said multispecies plantings increase biodiversity and can provide a greater range of benefits than single species.

"Multispecies plantings are also more robust. We've found that planting multiple species can mitigate the risk of failure of any given species in a season due to adverse weather events."

The cover crop trial has been running for 12 months, with plantings in the crop interrow occurring twice a year in winter and spring on some farms, or in winter on other farms depending on the circumstances. The selection of species in the cover crop mix varies between the time of year and the site, but the aim is to fill as many functions as possible.

"We plant legumes like cowpea, lablab and white clover to fix nitrogen and other deep drilling tap-rooted species, including chicory and tillage radish that can break up soil compaction," Professor Rose said.

"Brassicas like mustard act as biofumigants and can help to reduce nematode populations in the soil, and buckwheat along with other flowering species, can feed beneficial insects and attract pollinators to the crop.

Increase in the number of beneficial insects and pollinators

✖ A hoverfly on a lab lab leaf, one of the cover crop species planted at a coffee site. Hoverflies are generalist pollinators and some also predate on soft-bodied pest such as aphids.

Entomologist, Dr **Christopher Carr**, has been monitoring insects in the cover crop trial and reports some interesting trends are emerging.

"Over just four months I am seeing an increase in the number of beneficial insects and pollinators present on most sites," he said.

"This is a great example of conservation biological control. The increased plant diversity in the interrow supports a diversity of insect herbivores, that are non-crop pests. These provide an additional food source that supports the beneficial insect predators and increases their population in the crop.

"For example, in the Zentveld Coffee farm trial we've observed a higher number of ladybeetles, lacewings and predatory flies on the coffee plants in the cover cropped rows compared to the control rows without cover crops.

These predators are utilising the resources of the cover crop to increase their numbers then spreading out to occupy the crop. This is particularly evident in the spider populations.

"Spiders are generalist predators. They use a range of strategies to predate on orchard pests. This really means the greater the diversity of spiders, the more effective your pest control. We are seeing ambush predators like wolf spiders, delicate flower spiders and jumping spiders, and intricate web spinners like the orb weavers, all thriving within the cover crop and on the coffee.

"We've also observed a five-fold increase in lacewing populations in one of the macadamia trial sites. Lacewings are beneficial insects, the larvae feed on macadamia tree pests such as thrips.

"By increasing resources for lacewings in the cover crop, nectar for energy and non-tree crop aphids for food, we're supporting the lacewing population to thrive. They then provide pest control in the macadamia trees, which is excellent," Dr Carr said.

The mixture of species in the cover crop trial have been selected to maximise the range of benefits from the plantings, but Dr Carr said growers can achieve increased biodiversity with a simple change of mindset.

The challenges at harvest time

"Allowing managed weed growth in the interrow is a less intensive form of cover cropping. Weeds contribute to plant diversity and in the coffee and avocado trial sites we are also seeing increased numbers of beneficial insects and pollinators where weeds have been allowed to grow and flower," he said.

The management of perennial cover crops in interrow planting can have its challenges, especially during the 2-5 months of the year when macadamias are harvested.

"We have to consider the production cycle of the crops we are working with. By consulting with growers on what is and isn't working we can adapt our cover crop sowing times, as well as the species used for the best outcomes," Professor Rose said.

No signs of erosion despite extreme rainfall

✖ Despite extreme rainfall, there have been no signs of erosion or exposed soil, thanks to the ground covers, native grasses, legumes and now cover crops planted between the rows

Co-owner of Zentveld's Coffee Plantation and Roastery, **Rebecca Zentveld** is extremely pleased with the results she has seen.

"It's been a phenomenal growing season with almost daily rainfall from December to April. Even with the extreme rain events we've had in the Northern Rivers, we've hardly got any signs of erosion or exposed soil, thanks to the ground covers, native grasses, legumes and now cover crops planted between the rows," she said.

"The mix of cover crop species all helped hold the soil together as well as offering their nutrient-gathering powers and biodiversity benefits. Digging a hole for planting, or even just to take a look, the number of worms is fantastic, and if the insect and wildlife amongst the cover crops is an indication of the health of the soil below, we are absolutely confident our cover crops are enhancing our soil health, for the good of our coffee trees too."

✖ Rebecca Zentveld observes the Cover Crop

Summary of the project research to date

The second round of cover crop plantings was completed in November, excellent growing conditions meant these establish well and grew vigorously. Only one site decided not to complete a summer planting. Most cover crops have now been terminated, those with macadamia orchards were terminated in February to allow for harvester access. Winter planting will commence soon. Soil samplings have been increased to bimonthly with the Summer planting and will continue for all of 2022. Entomological studies are producing some interesting trends and an increase in beneficial predators.

✖ Researcher Karina Griffin at Zentvelds coffee farm with the growers looking at seed prior to sowing

Research impacts

How do you anticipate the research will enhance the awareness and understanding of regenerative agricultural practices?

Participating growers are showing interest in the plantings and are keen to see soil test results comparing cover crops with control areas. Other growers and industry representatives are also showing interest in the results.

Positive results from beneficial insect and other biota assessments on two sites, in particular, are demonstrating to host growers the benefits of the cover cropping approach. However, it has also been highlighted that the practical aspects of having a cover crop must be considered. All three macadamia farms did not have sufficient space in their inter-rows to accommodate cover crops whilst harvesting. With the macadamia harvest extending for 4-5 months this means that there is a significant period where the ground must remain mowed, otherwise, yields can be reduced as they cannot harvest their nut effectively.

What impact do you anticipate the research will have on restoring degraded soils?

Soil health data for this project is not yet available due to the long processing time required to complete all analyses. Previously published studies suggest soils will be restored over time and this is of significant interest to growers and industry stakeholders.

Opportunities

Horticultural industries in this region are under significant pressure from the non-farming community to demonstrate sustainable practice, many growers are very proactive and are working under best practice both for the environment and their business' profitability but this is not necessarily the portrait that people not in the industry see. There need to be more positive news stories and community awareness initiatives to promote what growers are doing.

Future Thinking

What specific advice (e.g. such as change of agricultural practices) would you give other farmers about how they could improve soil health?

Soil health data for this project is not yet available due to the long processing time required to complete all analyses, therefore it is difficult to make a comment on how new knowledge generated from this research can be applied as specific advice to farmers.

Pre-termination assessment day at one of the macadamia farms

Further reading

Read about the [first round \(Spring\) of research progress at Zentveld's Coffee Plantation](#)

[Read about all eight soil research projects](#)

The 'Multispecies Cover Crops in Subtropical Horticultural Plantations' project is set to run until 2023. The project has been funded by the Australian Government Department of Agriculture, Water and Environment and is conducted in partnership with the Australian Macadamia Society, the Australian Subtropical Coffee Growers' Association and local avocado grower networks.