



Photography by Kim Shirley Photography.

Using ecological zones to combat potato pests

WHILE A HIGH YIELDING CROP IS THE ULTIMATE GOAL FOR ANY POTATO GROWER, THE IMPLEMENTATION OF RESPONSIBLE FARMING PRACTICES IS IMPORTANT TO SECURE THE LONG-TERM SUSTAINABILITY OF A FARM. STEFANIA CEFOLA SPEAKS TO NEW SOUTH WALES POTATO GROWER GARRY KADWELL ABOUT THE BENEFITS OF INTRODUCING DEDICATED ECOLOGICAL ZONES ON HIS CROOKWELL PROPERTY.



NSW potato grower Garry Kadwell stands near a dedicated ecological zone on his Crookwell farm.

Garry Kadwell grew up with farming in his blood and his feet firmly planted in the seed potato industry.

The fourth-generation grower from Crookwell, on the Southern Tablelands of New South Wales, has always enjoyed the groundwork of agriculture and fondly recalls his childhood spent exploring the native vegetation on his grandparents' property.

Fast-forward several decades and it is obvious that Mr Kadwell has always been driven by a desire to succeed, both on a personal and commercial level. Today, he is among a class of Crookwell farmers that supply approximately 10 per cent of all Australia's certified seed potatoes: top-quality spuds that can be grown with a relatively low risk of pest and disease infiltration.

But, perhaps, what is most important to Mr Kadwell is his year-round commitment to responsible farming practices, which he said was heavily ingrained in the business' workplace culture.

"The philosophy behind our farming is concentrated on high production, but it is vital we offset that by having a farm that is, in the most part, sustainable, resilient and promotes healthy environmental conditions," Mr Kadwell said.

"This vision was realised – on a small scale – 30 years ago when I started noticing changes on the property, which I attributed to stock pressures on remnant vegetation areas. I knew that if we didn't do something to address the problem at the time, when we still had healthy trees, we would lose our seed bank and the potential to regenerate these areas naturally.

"Initially, the model we applied involved us fencing off particularly vulnerable areas in conservation, planting new trees and encouraging good vegetation cover, which we did with some success.

"Conserving the trees through planning conditions is helping us to re-establish

biodiversity across the whole farm, the advantages of which have become quite noticeable, especially over the past 10 years."

Crookwell's eco-farm

Mr Kadwell has since integrated a number of dedicated ecological zones on his property in an effort to encourage the recurrence of native plants and wildlife.

In March this year, more than 500 people made the trip to his property during the Crookwell Potato Festival to observe his "eco-farm" and seed potato growing operation, which also highlighted the changes in farm technology over the years.

"Thirty-two per cent of our farm is under conservation, an increase from 12 per cent over the past five years," Mr Kadwell said.

"By locking up more ground, we have actually lifted our production outputs."

Mr Kadwell said the dedicated ecological zones, which are locked away from stock and are not used for growing, have

been effective in combating common potato pests, ranging from aphids, grasshoppers and weeds.

He said the native plants and "biodiverse-balanced areas" have assisted in promoting beneficial insects and increased bird life, resulting in a reduced need for pesticides and chemicals on his potato crops.

"We no longer resort to spraying any thistles and weeds. Instead, we will let them grow and then mulch them into the ground so that we can get the organic material back into the soil to promote carbon levels.

"We have also made the switch from using all chemical-based granule fertilisers to manures and foliar fertilisers timed and applied prescriptively by regular sap testing. This, in turn, has improved microbial activity in the soil and is helping to keep our crops very healthy.

"However, one of the best things we have done is an Integrated Pest Management (IPM) course which gave us a good insight into the principles, strategies and tactics of plant disease management to

effectively control potato pests. Importantly, we learnt how to identify insects and separate the beneficial from the harmful. If the insects are not creating an 'economic loss', then we no longer intervene."

Natural benefits

Mr Kadwell said fencing off all remnant and regrowth native vegetation, including snow gum and peppermint gum, was "producing gains as simple as wind and frost protection".

"We are seeing more growth in our pastures and crops and better irrigation and water use efficiency, and the wind protection provided by the zones enables us to irrigate on days prior to a suspected frost event," he said.

"Another major plus is the return of native animals on the farm, such as kangaroos, echidnas and abundant bird life. Our wetlands area, in particular, is attracting a wide variety of bird life and the first platypus was spotted in a regenerated wetland a few months ago, which is proof that our water

quality is healthy and clean."

This focus on water quality is the second phase in Mr Kadwell's long-term conservation plan, which incorporates the use of hard hose irrigators and a 200-metre wide area outside the riverbank as an agricultural activity filter.

"We still have to use the area as an irrigation supply, but there's a dual benefit in that we can artificially lower the water table during the breeding season, a requirement of certain water birds through irrigation," Mr Kadwell said.

"These outcomes have given us great satisfaction and are proof that we can be highly productive and profitable while protecting the environment.

"But still we have a long way to go. Eventually, we aim to provide nesting islands and marshlands to protect our native species from predators, but that's in another day's work."



Wetlands have attracted a wide range of native bird life as well as a platypus.



Vulnerable areas of the property were fenced off and new trees were planted to encourage growth.



Vehicle and livestock corridors also feature in the property.

DAVID EAST

Building soil wealth



Western Australian lettuce grower David East knows a thing or two about how to make his plants happy and the answer, he says, lies in the soil.

It is why he turned to using caliente mustard as a biofumigant green manure in his rotation five years ago.

And he has never looked back, claiming the practice has been beneficial for the health and productivity of his crops.

Benefits of biofumigation

Biofumigation is the use of specialised green manure crops which are grown, mulched and incorporated into the soil before the planting of the next crop in order to suppress soil borne pests, diseases and weeds.

"I am extremely satisfied with the results," David says. Together with his wife, Lee and more recently his three sons, he has been growing baby leaf and contract lettuce in Manjimup over the warmer months for more than 16 years.

“The whole chemistry of the soil has benefited.”

"My lettuce looks healthier, the soil holds moisture better and I've seen a reduction in soil borne diseases and weeds, which has resulted in fewer seedling losses and less fungicide use in subsequent crops. The whole chemistry of the soil has benefited."

The East's production season begins with the first plantings of lettuce and baby leaf in late September and the final harvest is in late May.

"We sow the mustard seed in April-May

after the crop residues of the summer leaf program have been incorporated," he says.

"Because the caliente crop is deep rooted, a lot of the nutrients are brought up from deep in the soil profile and recycled, which reduces the need for pre-plant fertilisers for the caliente. Herbicides are not needed as caliente has a large canopy which blankets any weeds."

Sharing knowledge

In September 2015, David and Lee East hosted a field day on their Manjimup property as part of the Soil Wealth program.

David spoke to visiting growers and industry specialists about the benefits he had observed using the caliente and offered tips on implementing the practice.

Jointly run by Applied Horticultural Research and RM Consultancy Group, the program provides Australian growers with practical information and valuable resources on soil management to help them get the most out of their land and achieve long-term returns.

"We've hosted a number of demonstrations for this project since 2015, which gives us the chance to share our experience with other growers in the region," David says.

He explained that while biofumigation was a safe and effective way for growers to increase their soil fertility and combat soil borne pathogens, its benefits depended on local soil conditions and the type of crop grown.

"Caliente is not a silver bullet, but simply one part of your management system.

"Growers should consider what crops they want to grow, what diseases they want to mitigate and how it fits into their rotation."



Photographs by Jessica Liebrechts.

Summary:

- The Soil Wealth program (Project VG13076), is a levy-funded project that aims to highlight to growers the importance of soil in the productivity and efficiency of crop growth.
- David East has observed a number of benefits since using a crop cover of caliente mustard for green manure and biofumigation purposes into his cropping mix in Manjimup, Western Australia.
- These benefits include the suppression of soil borne diseases and weeds, an improvement in the soil's moisture holding capacity and a healthier, more fertile soil.
- The Soil Wealth program has been funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.



LEGACY OF THE LAND: ENVIRONMENTAL MANAGEMENT FOR THE NEXT GENERATION

Matt Ryan has fostered a love of the land into a rewarding career, running a mixed farming business with his wife Tricia in northern Tasmania. Matt speaks to AUSVEG Environment Coordinator Andrew Shaw about the changes he has witnessed over the years as a vegetable grower, embracing on- and off-farm challenges and the importance of sustainability.

Matt Ryan never particularly intended to pursue a career in vegetable production, but upon leaving agriculture college, he found his first full-time job as a field officer for vegetable producers Harvest Moon. In 1999, he and his wife Tricia started their own farm and have been growing ever since.

Now the mixed farm includes broiler (chicken) production, livestock, pyrethrum, poppies, vegetables including potatoes, onions, carrots and beans, for both processed and fresh markets and covers around 540 hectares of land around the major vegetable production region of north-west Tasmania. This is in addition to managing an agricultural contracting and transportation business which focuses on services to the vegetable industry.

“I do not come from a family farm – I was introduced to farming at an early age and wanted to pursue agriculture in general. It chose me and from there I extended to the vegetable industry,” Matt says.

“I really enjoy cropping and vegetable growing, which is why I have continued to pursue it. The thing about vegetables is there are lots of different dynamics and lots of different things happening all the time. As the season changes, so does your job.”

This mantra exemplifies an attitude of genuine appreciation for the career that Matt has developed. It has also led to work on behalf of the industry through various roles at the Tasmanian Farmers and Graziers Association (TFGA), where he is a director and vice chair of the organisation.

FACING CHALLENGES

Matt’s personality is one that relishes a challenge, and while he understands the nature of vegetable production will always be shifting, some changes are more welcome than others.

In particular, the past year in Tasmania provided difficult production conditions for growers across the state, including drought, prolonged wet conditions and periods of heavy rain and flooding.

“We went through the driest period we have had in my time, from August 2015 to January 2016, but the primary issue was the six inches of rain at the end of January when we were almost ready for harvest. It resulted in significant losses across many different crops,” Matt says.

“The damage from heavy rainfall and flooding during winter and spring has been significant, and that goes to show why it is important to have ground cover and produce growing in the ground all the time, because it just makes a big mess when you get a big rain. Large amounts of farmer’s topsoil in the region ended up being shifted into Bass Strait or the estuaries.”

Recovery has been facilitated in the region through a lot of hard work, and the ground stayed wet where cover cropping and remedial soil practices would normally be implemented. Topsoil has been physically carted onto some paddocks to repair the damage. This only strengthened Matt’s belief that caring for the land comes first.

“We are all users of the environment and we are only here for a visit, the whole lot of us. I have children and it is important that these resources are there in the future – we are acutely conscious of that,” he says.

“That process is ongoing in the back of your head all the time, particularly when there are floods. You think about how you don’t want to damage our land or our waterways and the effect that this has on our environment.”

APPRECIATING THE LAND

Many on-farm practices have developed and changed since Matt started growing in 2000. In establishing which practices are best for his business, the Tasmanian grower has prioritised his production requirements and emphasised a value to his time.

“GPS technology is the biggest thing that has changed. Investment in irrigation and irrigation technology gives you the best bang for your buck in terms of return on investment, improving your productivity and also improving your work-life balance and livelihood,” Matt says.

“Variable rate technology is not going to save you if it won’t stop raining, but it is going to save you on your water inputs, and you get better quality out of the ground in a normal, or dry season. There is the ability to tailor more water on the dry areas and less on the wet, and that makes a huge difference. The next step for the industry to adopt is variable rate fertiliser inputs.”

He describes the major production drivers as being the need to diversify, reduce risk profile and offset your requirements of the land. To achieve this, Matt uses inputs such as cover crops and chicken manure to balance out his soil profile.

“We use our own chicken litter on our farm, which has been quite beneficial for us. The soil that we grow on and the chicken litter from the poultry side of the operation complement each other, which is primarily used for potato production. We try and get cover on our ground after our crops to look after the soil and make sure we aren’t flogging the ground all the time,” he says.

“At the end of the day, as famers and growers, we are resources managers. Our business is to leave the environment as well as we can for the next generation because we have only got one of this

land. There isn’t any more soil, land and water resources being made – we are all acutely aware of that these days.”

While striving towards a better environment drives him personally, Matt understands the need for compliance is an external pressure to his business. As an EnviroVeg member, he believes accreditation is necessary as businesses are being incrementally more scrutinised.

“Compliance is driven down the supply chain, by retailers and consumers. The value of Australian vegetables is in their health benefits and because they are produced under great conditions. I think that we, as an industry, could do a better job of promoting that.”

A BRIGHT FUTURE

Despite the large and often complex challenges, Matt remains positive about the future of the Australian vegetable industry.

“There are exciting things happening in the industry at the moment. We can compete internationally with our products with the dollar at a more realistic level, and finding a home for product overseas means it stabilises the price in the domestic market so that’s got to be good.

“In general, agriculture and horticulture is a fantastic place to work and one of the best jobs or career paths anyone can choose. There are so many different places it can take you. The job is always changing, it’s never boring and you’re not often doing the same thing twice. We need to promote this choice to young people, and get them involved.”

R&D
Farm Productivity,
Resource Use &
Management

INFO
The EnviroVeg Program has been funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.

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EnviroVeg Horticulture Innovation Australia



Peninsula Fresh Organics owners Wayne and Natasha Shields.

Growing a sustainable model

BEGINNING WITH THREE ACRES IN 2009, PENINSULA FRESH ORGANICS HAS GROWN OVER THE YEARS TO COMPRISE 40 ACRES IN BAXTER, VICTORIA ON THE MORNINGTON PENINSULA AND 100 ACRES IN BARHAM, NEW SOUTH WALES NEAR THE MURRAY RIVER. WAYNE SHIELDS IS A FIFTH GENERATION MARKET GARDENER, CERTIFIED ORGANIC VEGETABLE GROWER AND INNOVATOR. HE SHARES WITH *VEGETABLES AUSTRALIA* THE SECRETS TO HIS SUCCESS.

Fifteen years ago, Wayne Shields was a conventional farmer. In recent years, however, he has found his niche as an organic grower offering year-round supplies of lettuce, leek, kale, cabbage and heirloom varieties. After expanding his business, Peninsula Fresh Organics, to a second farm in Barham, New South Wales on the Murray River, he has been able to extend these lines.

"I've found a lot of opportunities in the organic sector and there has been room for us to grow. With the expansion up into Barham, we are moving into the

bigger volumes of produce like the butternut pumpkin," Wayne says.

The foundation for the company's growth has been an ecosystem approach to farming. This approach is seen not just in the sustainable practices that are implemented, but also in the company's employment, development programs and community involvement.

"I have seen that when you are not damaging the environment, the environment helps you get through things. When other farmers near me are having an issue with a certain pest, I have my own

ecosystem helping me out."

Wayne perfects one business aspect before moving on to the next. His plans include installing solar power and drip irrigation practices for increased sustainability. Currently, his focus is on developing sustainable biofertilisers through the ReGenAg Program.

"There's a whole biofertiliser movement. There are courses – of which I am hosting a few – and you take the processes that apply to your business. I am getting the biology in the soil kick-started by learning about brewing my own biofertilisers and composts. I got a really

good result out of that – and it is only early days yet."

Community stewardship benefiting all soil

After completing the soil development course, Wayne noticed improvements to both his produce and his bottom line, and is now helping others to benefit from it.

"I thought it was fantastic and I got good, quick results – especially in the sandy soil of Barham – and cheap results too. Once you know the recipe, you do it yourself and it cost so





Photography by Luka Kauzlaric.

much less. For those looking to limit their inputs, there is some really good information out there.”

Peninsula Fresh Organics has hosted growers from across the country. The most recent course attracted growers from Western Australia, Queensland and Victoria, contributing to the development of a network for open communication among growers.

Peninsula Fresh Organics Land Management and Quality team member Lisa Brassington believes the ReGenAg Program has made a huge difference to Wayne's produce production as well as many others.

“ReGenAg is the theory of regenerating the soil on top. It's a smart way of doing an in-house green waste system. It teaches the biochemistry side to soil and has been a great way for growers to get a profile for different areas of soil performance in a single paddock and to understand what results you can achieve with crop rotations,” Lisa says.

“The upside for the

community is that farmers have a network, a 'biofertiliser phone-a-friend' from all over Australia that they can use.”

Lisa explains that the proof for the program is in their produce and the interest it has generated at the farm gate. The local Landcare network even organised an organic grower's group from across Western Port Victoria to visit the farm and see the effects of the program.

“This year's produce is saying, 'Thanks for feeding me – I've come on big and strong.' The growers will be able to see the effects of applying the methods of EnviroVeg and ReGenAg for themselves.”

Communicating strength

Effective communication is essential across the whole business operation at Peninsula Fresh Organics, but is of particular importance for the multicultural staff. With a component of Vietnamese speaking workers on-farm, Wayne had been searching for ways to communicate

complex operating instructions to these team members, who include farm managers. The recently released Vietnamese EnviroVeg Manual has been very useful in helping the workers to understand more complex instructions and farm management techniques.

Lisa appreciates the Vietnamese farmers' connection with farming the land and the importance of conceptualising EnviroVeg Best Environmental Management Practice theories with on-farm operations.

“In Vietnam they are very good at intensive horticultural farming; the farmers have natural land management skills but not always the technical horticultural understanding. The Vietnamese EnviroVeg Manual gives these growers the opportunity to understand the theory of horticulture, not just the practice,” she says.

“It might answer farming questions that they don't know how to ask.”

She believes the next level would be for the industry to have access to a common

smartphone translation tool for all areas of agribusiness.

“It would be great to have a multi-lingual/multi-crop app developed for farmers. Everyone has a smartphone in their pocket and it would also be especially great for communicating with international buyers.”

Looking ahead

Wayne recognises that supporting sustainable growers is important for the future of the industry.

“I think down the track there will be a bit of a meeting between organic and conventional. EnviroVeg is a good starting point – it takes people to a place they probably didn't think they could get to, with just a few simple changes to their practices.”



The EnviroVeg Program is funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.

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Peninsula Fresh Organics Land Management and Quality team member Lisa Brassington with Vietnamese growers.



BIOLOGICAL SOLUTION PROVES BENEFICIAL FOR GOURMET SALAD GROWER

A novel liquid biological solution aims to colonise plant roots and ameliorate soil resources to produce stronger plants that mature faster. Kevan Dobra from The Loose Leaf Lettuce Company explains how his crops have benefited from the application of this solution.

Like many growers, Kevan Dobra has had a healthy scepticism for biological products. That was until the Western Australian grower discovered one on a field trip to the United States and upon his return decided to try it out on his family’s property. He has since seen land become productive again with strong plants, which has also resulted in application savings and higher crop yields and quality.

In partnership with his parents, Barry and Maureen, Kevan operates The Loose Leaf Lettuce Company, which grows and processes fresh, gourmet salad vegetables.

The Loose Leaf Lettuce Company, located at Gingin, WA is one of the largest growers of lettuce, spinach and rocket in the state, while it also produces Asian green varieties, including kale.

Spinach crops are grown over about 24 days from direct seeding to harvest, while the lettuce is produced over seven to eight weeks. The crops are irrigated twice a day using fixed irrigation and significant overhead irrigation, and they are also fertilised three times a week.

FIELD TRIP FINDINGS

Kevan was on a field trip to the United States viewing lettuce varieties in the Salinas Valley in California when he heard about a biological product during a visit to a Bayer manufacturing facility.

Serenade® Prime contains viable spores of the highly active QST 713 strain of beneficial bacteria *Bacillus subtilis*. After germination, these beneficial bacteria live on plant root surfaces and in the soil zone around the root systems (rhizosphere), where they can develop mutually beneficial relationships with plants under suitable conditions.

When interactions between the bacteria, plants and soil are balanced, both the plants and bacterial populations function at a higher level, allowing nutrients and water to become more available.

In short cycle crops, the product is designed to be used early as an inoculating agent while in perennial crops it is designed to reinvigorate the soil/root/microbe relationship at critical growth times.

TIMING IS KEY

At The Loose Leaf Lettuce Company, dolomite is applied at one tonne per acre in preparation for crops. In spinach, the liquid biological solution is applied using a boom spray just after seedling emergence at seven litres per hectare, followed by a similar application in a further seven days before harvesting a week later. Each application has been followed by five millimetres of irrigation.

Kevan said the second application of Serenade® Prime would be delayed during the cooler months, when the growing period is extended by three weeks. In the lettuce crops, they wait for plant roots to become a decent size before applications in weeks two and four prior to harvesting in weeks seven to eight.

“The crops and the quality are exceptional – and there’s no withholding period, so we can harvest immediately,” Kevan said.

“In the spinach, the roots are whiter, healthier and they are going deeper – and this will be better for the roots to get calcium, particularly when things are slower in winter.

“Plants are absorbing nutrients quicker and we are not putting calcium through the water, as we would normally do in summer.

“Water here is very good (with a Mount Franklin site nearby) and every week we apply 100-120 litres per hectare of calcium and boron, so we are saving 500 litres per hectare over the whole crop. We are also seeing less burn in lettuce.”

INFO

For more information, please visit bayer.com.au. Serenade® is a Registered Trademark of the Bayer Group.



VICTORIAN GROWER COMMITTED TO SUSTAINABILITY

As a sixth generation vegetable grower, production and business sustainability have always been part of Rick Butler's farming legacy. This dedication has allowed Rick's Victorian growing operation, Butler Market Gardens, to engage in a range of key components to improve its environmental practices.

Butler Market Gardens in Victoria is a well-established, multi-generational farming business with a rich heritage and deep commitment to sustainability, the environment and protecting valuable agricultural resources for future generations.

Butler Market Gardens' Chief Executive Officer Rick Butler said the business recognises its soil as a valuable and enduring asset.

"Therefore we make it a priority to not only maintain, but improve soil health and general soil structure, ensuring that we are putting back more than our crops are taking out," Rick said.

To reflect this, the Heatherton-based business has pursued environmental projects which include a five-year partnership with certified composter Enviromix.

IMPROVED PRACTICES

Butler Market Gardens uses Enviromix's 'Dig-it-in' mulch, which it incorporates into the soil every four months, and Rick is pleased with the results shown so far.

been able to proceed with the use of its vegetable green waste for composting at this stage.

"We are hopeful that in the future this will be an option that we can consider," he said.

PROVIDING SOLUTIONS

Rick detailed several benefits that a compost solution could provide to vegetable growing operations. These include:

- An improvement in soil structure.
- Replacement of organic matter.
- Promotion of beneficial soil organism populations.
- Increased water retention.
- Helping to enhance plant health to resist disease and pest pressure.
- Reduction of use of chemical fertilisers and harmful residues and side effects.

Rick said that Butler Market Gardens' decision to commit to a partnership with Enviromix is expected to pay dividends well

...since regular application of the mulch, our soil tests are showing increased levels of organic carbon and potassium, as well as better structure, water retention and nutrient retention.

"The benefits have been very good. Soil tests taken in 2014 showed low organic matter and other elements, yet since regular application of the mulch, our soil tests are showing increased levels of organic carbon and potassium, as well as better structure, water retention and nutrient retention," he said.

"Cation exchange capacity (CEC) values have also risen, enabling plants to better utilise available nutrients. Overall, this mulch is providing us with strong benefits and is working well in our program."

Rick said that unfortunately, due to Environment Protection Authority (EPA) restrictions in the area, his business has not

into the future, including an improvement in overall yields of between five to 10 per cent.

"The key to growing good quality vegetables starts with healthy soil, so focusing on soil management through using these products is a great start."

INFO

For more information, please visit butlermarketgardens.com.au or enviromix.com.au.



Stingless bee carrying pollen returning to its hive.



Blow flies, like the Australian brown blow fly, pollinate crops such as carrots.

The role of honey bees and wild pollinators in vegetable production



INSECT POLLINATION IS A VITAL COMPONENT OF VEGETABLE PRODUCTION AND SEED VEGETABLE PRODUCTION. IN THIS ARTICLE, PLANT & FOOD RESEARCH EXPLAINS THE ROLE OF HONEY BEES AND FLIES AS POLLINATORS, AND PROVIDES AN OVERVIEW OF AN UPCOMING FIVE-YEAR RESEARCH PROJECT THAT WILL FOCUS ON UNMANAGED INSECT SPECIES IN VEGETABLE CROP POLLINATION.

Insect pollination is not only important for the production of vegetables such as pumpkins, courgettes and cucumbers, but is often crucial for vegetable seed production.

Honey bees are often used to pollinate these crops, but recent research indicates that the presence of unmanaged pollinators – such as other bee species and flies – can improve yields beyond what honey bees can achieve alone.

This is because honey bees may be more attracted to the nectar and pollen of non-crop plants flowering at the same time as the crop plant. Secondly, honey bee movements between flowers and trees requiring cross pollination may be less frequent than those of other insects (floral constancy). Thirdly, under cold cloudy conditions, honey bees are more reluctant to forage than other insect pollinators.

Upcoming research project

In Australia, the roles of unmanaged insect species in vegetable crop pollination are still poorly understood, limiting the ability for growers to use them to increase yields. Given

this challenge, a new five-year program funded by Horticulture Innovation Australia with co-investment from Plant & Food Research aims to understand the role of different pollinators, including honey bees, in Australian crops.

Researchers will liaise with industry groups, including the vegetable industry, to determine the highest priority crops where yields can be improved through better pollinator management. Focused research to identify the most efficient pollinating species will also form the basis for the development of new pollinator management strategies for growers.

Based on limited existing research, following is a list of the likely key contributing pollinators within Australian vegetable crops, from Plant & Food Research's perspective.

Honey bees

Honey bees are the only pollinators that can be easily moved en masse into flowering fields, making them the most flexible and widely used. Feral (unmanaged) honey bees can also provide significant pollination, but if Varroa mite (*Varroa destructor*) arrives as most experts predict, it is likely

to decimate populations. (More about honey bee management and use in crop pollination can be found at far.org.nz.)

Australia has over 1,000 native bee species. Some nest in cavities, others in the soil. Some are solitary, while others are social.

Although many species are likely to contribute to crop pollination, research has focused on two bees. Stingless bees (particularly *Tetragonula carbonaria*) are sometimes used in warmer regions, but they are reluctant to forage at temperatures below 18 degrees Celsius. Blue banded bees (*Amegilla* sp.) play a useful role and can forage in cooler conditions. (Information on Australian bees can be found at aussiebee.com.au.)

Fly pollinators

Flies can be the most important pollinators under certain

weather conditions, locations or crop types. They can be particularly beneficial for pollination of carrot and onion hybrid seed crops.

While some flies can be problematic to other primary industries (some blow flies cause sheep flystrike), other species provide multiple benefits. For example, a number of hover fly (*Syrphidae*) and bristle fly (*Tachinidae*) species have adult flies that pollinate, while larvae attack pest aphids and caterpillars. Blow flies, such as the Australian brown blow fly, pollinate crops such as carrot.

Plant & Food Research is also very interested in understanding crop growers' thoughts and experiences of current crop pollination requirements and strategies. This is important for future research goals specifically to address grower needs. To provide your thoughts in a short online survey, please visit pollinationsurvey.com.



For more information, please contact Brad Howlett from Plant & Food Research at brad.howlett@plantandfood.co.nz.

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Horticulture
Innovation
Australia



Boosting productivity with vermiculture

WORMS CAN POTENTIALLY IMPROVE THE COMMERCIAL AND ENVIRONMENTAL SUSTAINABILITY OF VEGETABLE PRODUCERS. HOWEVER, THE MAGNITUDE OF THESE BENEFITS IS NOT WELL QUANTIFIED, AND GROWERS INTERESTED IN USING VERMICULTURE NEED INFORMATION ABOUT HOW TO OPTIMISE BENEFITS THROUGH PRACTICE CHANGE.

A new research project will be conducted across a range of vegetable farms to assess the practices and conditions that result in productivity improvements through increased earthworm activity and/or use of vermi-products.

Horticulture Innovation Australia (Hort Innovation) has commissioned Blue Environment and SESL Australia to undertake a three-year project, entitled *Optimising the benefits of vermiculture in commercial-scale vegetable growing*. This project will increase vegetable grower awareness and knowledge about using earthworms to improve productivity, consult growers currently using or interested in using vermiculture on their farms, and establish research and demonstration sites in major vegetable producing areas in Australia.

Agronomic and economic assessments of the productivity impacts of different vermiculture practices will be undertaken. Field days to demonstrate the potential benefits of vermiculture in vegetable production will also be conducted.

As well as being a good indicator of a healthy soil, earthworms have been shown to improve soils and plant growth. Earthworms have been described as 'ecosystem engineers', changing soils to promote the growth of plants, which in turn provide the organic matter that worms need to thrive. In this way worms build soil health and depth over time.

Potential benefits

It has been reported that increased earthworm activity results in improved soil structure, drainage and aeration. On some soils, roots will grow along old worm burrows because they are less dense, more nutrient-rich and better aerated. This results in deeper and healthier root mass.

Earthworms convert nutrients in soil and plant matter to more concentrated and plant available forms. Each earthworm can produce over 300 times its body weight in nutrient-rich 'cast' (or poo) per year. Worm casts can stimulate beneficial soil microbes and this activity

helps to make nutrients available to plants.

Worm casts also contain enzymes and hormone-like chemicals that can stimulate root and plant growth. Earthworms move organic matter down the soil profile and build the depth, water and nutrient-holding capacity of soils. Some species of earthworm also consume and kill pathogens and pests including various bacteria, fungi, nematodes and insect eggs. Earthworms do not eat living plant matter, so they do not damage plants or roots.

Identifying worms

The project will mainly focus on how growers can create conditions where naturally present earthworms can thrive and work the soil. There are over 700 species of earthworm in Australia, but only about 20 (mostly introduced, 'agronomic' earthworm species) are commonly found on farms. There may be native and other species present and working on farms, and the project will seek to identify useful worms in different vegetable growing areas.

Practices that can promote earthworm numbers and activity include:

- **Building soil organic matter.** Worms feed on decomposing organic matter and soil microorganisms that grow on organic matter. This can be achieved through the use of cover crops, composts and management of organic residues.
- **Reducing and timing tillage to reduce destruction of worms and burrows.** Tillage can reduce worm numbers by 90 per cent and it takes at least 90 days for worms to double their numbers.
- **Managing soil pH.** Worms thrive at near-neutral conditions (pH 6.5-7), can tolerate conditions between pH 5-8, but will not survive more acidic or alkaline conditions.
- **Reconsidering and timing the use of chemicals that can impact on worm numbers.** Nematicides and soil fumigation will decimate worm populations and some insecticides and fungicides, as well as copper-based products, can impact heavily on worms. Most common herbicides have less impact



and may even help worm numbers by creating a stock of decomposing organic matter.

- **Soil moisture.** Managing soil moisture and organic matter to boost worm breeding during autumn, winter and spring, and managing moisture over summer can improve survival rates. If practical, deliberately dry beds before heavier tillage – worms will migrate down the soil profile when it is dry, increasing the survival rate during tillage.
- **Worm 'refuges'.** Maintaining

worm 'refuges' between permanent beds where organic matter, tillage, moisture and chemical use practices are designed to boost worm numbers. Transplanting worm 'blocks' taken from worm-rich areas re-establish and boost worm populations.

Grower interest

Many of the practices that increase worm activity have other soil health and productivity benefits.

Vermi-products such as

vermicasts and 'teas' or extracts made from vermicasts can have soil and plant health benefits, and the potential to use these in different growing systems

will be investigated.

If growers are interested, trials of the use of these products and on-site 'worm farms' will be considered.



Blue Environment is interested in talking to growers using, or interested in using, earthworms and vermi-products to boost productivity, as well as growers who are interested in hosting field and demonstration trials. For more information, please contact Bill Grant on 0407 882 070 or bill.grant@blueenvironment.com.au.

Optimising the benefits of vermiculture in commercial-scale vegetable growing has been funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.

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Beneficial bacteria: An avenue to unlock soil wealth

MANY VEGETABLE PRODUCERS IN AUSTRALIA HAVE RECOGNISED THE VALUE OF USING BENEFICIAL INSECTS THROUGH INTEGRATED PEST MANAGEMENT TO PRODUCE SUSTAINABLE CROPS, BUT IT DOESN'T STOP THERE. *VEGETABLES AUSTRALIA* INVESTIGATES NEW RESEARCH ON BENEFICIAL BACTERIA AND HOW THE FIELD OF BIOLOGICS IS BEING USED TO ACHIEVE GREATER ACCESS TO SOIL RESOURCES AND SOIL HEALTH.

The vegetable industry in Australia has seen many developments and changes that have shaped how vegetables are produced. Ploughing, irrigation and advances in chemicals and pest management have all shaped how vegetable producers operate today.

The next big shift could be the development of biologics, which are products derived from living organisms to enhance plant productivity.

Current research in biologics include a focus on beneficial bacterial or fungal microorganisms as well as biochemicals such as plant extracts, which have resulted in the development of a number of new products overseas.

The benefits of these products vary, from combating sucking pests including whiteflies and controlling parasitic nematodes to working as a biological fungicide, and these products are increasingly becoming available for use in Australia.

Industry R&D

After seven years of isolating and testing around 20,000 different microorganisms, Bayer has developed the biologic product Serenade® Prime, based on the highly active QST 713 strain of the soil bacteria *Bacillus subtilis*. This strain stood out for a number of reasons, according to Bayer Agronomic Development of Biologics Director Denise Manker.

"It works because it is a good root coloniser. Plants allocate about 30 per cent of their

energy into making efforts to attract beneficial microbes. We are supplying the best possible microbe into that root system so that it can colonise and help the plant better access soil resources," she said.

This strain is very adaptable – it colonises and benefits a range of crops early in the crop cycle, forming a mutually beneficial relationship between the soil and plant roots. The bacteria enables better nutrient exchange between the soil and the plant roots, and the plant provides a food source for the bacterial colonies in the form of root exudates.

"It colonises plants when they are in the growing stage and increases nutrient uptake by a range of methods, including adjusting the soil pH and attracting phosphorus and iron," Ms Manker said.

The endospores can sense growing roots from up to 13 centimetres through the soil matrix, which stimulates the endospores to germinate. They then grow multiple flagella (small tails) and can "swim" through soil towards the roots where they colonise the surfaces of young roots and root hairs. This occurs very rapidly (usually within two days).

Biological agents in action

Vegetable growing operation Kalfresh – winner of the AUSVEG Innovative Marketing award at the 2016 National Horticulture Convention – has been trialling rhizobacteria in conjunction with controlled

traffic farming, cover cropping and Integrated Pest Management techniques at its Soil Wealth demonstration site at Kalbar, Queensland.

Kalfresh Agronomist Andrew Johnston explained that the benefits have been seen across the whole production business.

"For the beans there has been a better weight and the carrots have grown a better quality. There has been a broad level of benefits – increased yield that works hand in hand with cover cropping, improved soil structure which, in turn, reduces the costs of working the soil and holding onto moisture," he explained.

Mr Johnston views this as the future for horticulture production in Australia.

"This is the way the industry is moving. If you use more chemicals at the start then you will need more chemicals throughout the crop's life. If you go down a softer route you need less chemistry, and if you can reduce your input through the whole crop's life and get a better result at the end, that is a win-win situation."



For more information, please visit bayer.com.au.

The EnviroVeg Program has been funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.

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Using water to combat difficult growing conditions

THE INCREASING DEMAND FOR FOOD PLACES A HIGH PRIORITY ON SUSTAINABLE FARMING PRACTICES. *VEGETABLES AUSTRALIA* SPOKE WITH JAN LUNDQVIST, SENIOR SCIENTIFIC ADVISER AT THE STOCKHOLM INTERNATIONAL WATER INSTITUTE (SIWI) ABOUT HOW TO MAKE THE MOST OF AVAILABLE WATER RESOURCES.

As the global population expands and farmers face extreme fluctuations in growing conditions, fresh water continues to be a precious commodity in agriculture. While the Global Agriculture Report of 2008 found that the world's available water will be enough for a growing population, this will only be the case if we use it efficiently and make better use of rainwater and soil moisture.

"Almost three quarters of our freshwater resources today are used in agriculture," Stockholm International Water Institute (SIWI) Senior Scientific Adviser Jan Lundqvist said.

"A good 60 per cent (of global crop cultivation) comes from rain-fed agriculture where the need for water is covered exclusively by precipitation."

In order to harvest the same amount of agricultural produce in 2080 as today, 30 per cent more water will be needed in Africa and 70 per cent more in south-east Asia, given a projected rise in temperature of four degrees Celsius.

In Australia, the issue of prolonged periods of drought only exacerbates the need

for sustainable water use. The sustainable use of water will play a key part in the development of the Australian agricultural sector.

Intelligent water usage

Green water is the water that is available to plants through the soil, including soil holding capacity and rainfall.

"The amount of 'green water' is much bigger than the volume of water supplied for irrigation from reservoirs and pumped from the ground," Professor Lundqvist said.

"Irrigation water – so-called 'blue water' – can be allocated to specific locations at desired times. With global warming, precipitation patterns will be more stochastic, so there will be increased uncertainty of timing, amount of rainfall and soil moisture. A better use of rainfall is crucial but it requires arrangements to capture and retain sporadic rainfall as soil moisture.

"In irrigated systems, it is crucial to have a good relationship and mutual trust between farmers and people

who control water provision. In rain-fed systems, the challenges are different; it is more of a combined soil, landscape and water management task because land management is also rain water management.

"Rainwater harvesting methods include building ponds and tanks, barriers to reduce surface runoff, mulching for enhanced water retention capacity and low or no till agriculture. So growing the 'right' crops is essential."

Tolerant crop varieties

The water absorption capacity and ideal cultivation density of a crop relate to how efficiently water stored in the soil can be used, with a greater water retention capacity ensuring that a crop will survive a period of drought.

Using the 'right' crop variety can go a long way to tackling difficult growing conditions in a more efficient way. For example, using temperate crops (such as brassicas) in the winter months and opportunistic crops in the summer can mean that crops are more likely to thrive.

Protecting resources from pollution

Water is not just used in crop irrigation. Cleaning facilities also produce wastewater that could be recycled. For example, Bayer has developed a biological system for sustainable disposal of crop protection effluent called Phytobac®. The system uses a waterproof pit filled with substrate and straw which provides a habitat for the microorganisms to degrade crop protection residues.

The clean washwater can then return to the water cycle, having eliminated potential pollution and making more water available for use.



For more information, please visit siwi.org.

The EnviroVeg Program has been funded by Horticulture Innovation Australia Limited using the National Vegetable Levy and funds from the Australian Government.

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