

What is a cover crop worth?

Cover crops in Australian vegetable systems

Integrated
Crop Protection
PROTECTING CROPS



Soil Wealth
NURTURING CROPS

This fact sheet outlines the economic considerations when using cover crops in vegetable production systems. It is based on lessons learned from several Soil Wealth – ICP demonstration sites, during the period 2014 to 2016.

Key messages:

- You have to be clear about the purpose of using cover crops in your system; it influences the way you may judge costs and benefits and the timing of these.
- **Overall benefits depend on each situation** including previous crop, crop sequence, soil condition, soil fertility, fertiliser management, disease pressure, yield and packout; they can also vary over time. Therefore, you need to consider the costs and benefits for your own farm in the short and long term.
- **To figure out what works for you on your farm and a specific purpose**, talk to others who have used cover crops for a similar purpose / situation; trial cover crops or include a test strip if possible.
- **In the short term cover crops can be profitable.** The economic benefits from potential increased marketable yield will depend on market specs and prices, and how your produce is priced e.g. per kg or per item. If crop quality and packout are improved, you may save on post-harvest and handling costs.
- **Consider the longer term benefits** such as improved soil health, better water and nutrient holding capacity, less disease pressure and reduced erosion which are more difficult to quantify – but are important.
- Improved soil condition and **resilience will reduce risks** such as impacts of drought, floods and pests and diseases or nutrient imbalances. Water infiltration, drainage and holding capacity will be better in a well-structured soil compared to a compacted one. This will mean that you can access paddocks more quickly after a heavy rainfall without causing damage to the soil and/or beds.
- **A well-structured soil will require less tillage.** This can mean less passes are required or smaller sized tractors can be utilised because less power / draft is required due to reduced soil resistance.
- **Monitor soil nitrogen (N) to determine if nitrogen inputs need to be adjusted.** Following legume cover crops, N fertiliser rates may need to be decreased. N benefits for the next cash crop will depend on the cover crop species, conditions (soil temperature, moisture), and timing relative to crop N demand of the next crop. Some crop residues can tie up soil N as they decompose. Therefore, N dynamics need to be considered when selecting cover crops and managing crop nutrition so that you can realise the full economic benefits of the cover crop.
- Cover crops can be used as a non-host plant for **soil-borne diseases**. Cover crops can also increase soil microbial activity and diversity, which helps to suppress soilborne diseases in cash crops. Under high disease pressure, cover crops will not provide short-term disease suppression – but can provide preventive and longer term benefits.
- **Biofumigation is the use of specialised cover crops**, which are grown, mulched and incorporated into the soil prior to cropping. High biomass, especially roots, can provide the traditional benefits of green manure crops, and if done right, naturally occurring compounds from the biofumigant plants can suppress soil-borne pests, diseases and weeds. Refer to the resources on the SW-ICP website (www.soilwealth.com.au) for more information about biofumigants.

“Practices like cover cropping, using compost and using reduced tillage can increase or maintain soil organic matter. This builds long term resilience. In the long term you can’t add that out of a bag. There is no substitute for long term resilience.”

Marc Hinderager, Agronomist.

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- **Selecting the right cover crop for the situation** and purpose, will maximise the economic benefits e.g. ryegrass is effective for building soil structure; biofumigants can be effective for suppressing weeds and diseases.
- **Consider how to transition from the cover crop to the cash crop.** Consider when it will need to be macerated, sprayed off or mulched and how you will manage residues. Your machinery may need to be adjusted to plant through trash.
- **Consider any risks** e.g. which cover crop species could host pests and diseases.
- **The nature and extent of economic benefits will vary depending on what the most important reasons to use a cover crop are on your farm** – and how that is matched with the cover crop species selected as well as its management.

There is usually an economic benefit in the short term, but the full economic benefits of cover cropping can take several seasons.

Cover crop benefits

Benefits of cover crops can include:

- Improved soil health, which in turn provides improved water storage and infiltration capacity
- Improved soil structure which can reduce tillage costs (through reduced number of passes required or reduced power required for tillage)
- Reduced soil erosion
- Improved nutrient cycling (nutrients captured for use by the next crop) especially nitrogen (and therefore potential decrease in fertiliser inputs)
- Suppression of weeds, pests and diseases (and therefore reduced chemical input costs – so long as you adjust your chemical inputs)
- Increase in quality / pack-out percentage
- Yield increase (potentially; not always).

Disadvantages of using cover crops, especially in the trial phase can include:

- Insect or slug pressure
- Clubroot if brassica cover crops are used in brassica production

- Not being able to get rid of the cover crop in time for planting due to weather
- The need for new machinery or adjustments
- Additional costs for cover crop including: seed, sowing, inputs (irrigation, fertiliser), termination of the cover crop, extra time for management
- Opportunity cost (decreased income if it replaces a cash crop)
- Risk that there is a decrease in marketable yield or quality.



Figure 1: Forcett demo site - mulching and spraying early enough to allow sufficient time for the cover crop to break down before preparing beds for the following cash crop.

Top, mulching a cover crop; Below, cover crop breaking down.

Tip: Consider timing of cover crops, how to transition to cash crop and how to deal with stubble. One option, if it fits the cropping schedule, can be to spray the cover crop off early and allow it to decompose without the need for cultivation.

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What have we learnt from the SW-ICP demo sites?

The following table shows some of the main benefits and costs of cover crops. As mentioned above, the overall benefits depend on each situation. The benefits and costs at one site does not necessarily show what is achievable at other sites.

Table 1: Potential benefits and costs of using cover crops

	POTENTIAL BENEFITS/ ADVANTAGES OF COVER CROPS	POTENTIAL COSTS/ DISADVANTAGES OF COVER CROPS	CHANGES REQUIRED AND THINGS TO CONSIDER WHEN USING COVER CROPS	WHAT DATA (OR ESTIMATES) TO KEEP FOR EACH PADDOCK AND CROP
Soil condition, resilience, risk management	Y	-		Soil condition scores, observations, photographs
Yield	Y	Y	There can be yield benefits but not always Select the right cover crop for the situation and manage it well	Gross and marketable yield
Quality (packout, shelf life, post-harvest costs)	Y	Y	If quality is increased there can be increased income and/or decreased post-harvest handling costs	Post-harvest costs including labour by crop/paddock % packout or grading data
Pest, disease and weed management costs	Y	Y	Monitor pests and diseases Consider an Integrated Crop Protection approach Adjust inputs if required Consider biofumigant cover crops	Pest, disease and weed pressure Costs of management
Tillage costs (for cash crop)	Y	-	Consider if softer tillage equipment can be used, or less passes or smaller tractors	Number of passes and type of equipment
Nutrients (for cash crop)	Y	Y	Adjust fertiliser inputs especially consider N fertiliser	Monitor soil fertility especially N Amount of fertiliser used
Water holding capacity (for cash crop)	Y	-	Adjust irrigation scheduling	Monitor soil moisture
Opportunity costs (if cover crop replaces cash crop)	-	Y	Consider which cover crops fit your cropping schedule and rotation Consider frequency of cover crops e.g. annually or every 2-3 years Consider any trends in cash crop marketable yield, quality, inputs, and returns	Long term records of cash crop marketable yields, quality and inputs
Cost of cover crop management	-	Y	Talk to others who have used cover crops for a similar situation	Record cover crop costs including termination costs

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Bowen, North Queensland

Cover crops, compost and beneficial bacteria (QST 713) have been trialled at this site. The aim is to improve soil health, weed and disease control and profitability. Compost combined with cover crops improved capsicum shelf-life, in addition to increased yields.



Figure 2: Post-harvest assessments

The following table summarises the yield and net economic result.

Table 2: Capsicum yield and economic results, Bowen, Qld, July 2016

COMBINED HARVESTS				
	MEAN NUMBER FRUIT PER PLANT	AVERAGE FRUIT WEIGHT (G)	APPROX YIELD IN T/HA	ECONOMIC BENEFIT OF SOIL WEALTH PRACTICE \$/HA (OVER CONVENTIONAL)
Conventional	9.40	254	34.0	-
Compost	9.87	272	36.4	\$5,360.00
Compost + Cover crop	10.17	278	37.1	\$7,200.00
Compost + Cover crop + Beneficial Bacteria (strain QST 713)	10.20	286	38.1	\$9,495.00

The benefits from cover crops alone are difficult to assess as it was combined with other treatments. Nonetheless, there appears to be an additional benefit from the cover crop compared to compost alone.

Tip: When assessing the benefits of cover crops (or other practices), in addition to any yield benefits, consider the benefits from improved packout %, crop quality and shelf life.



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Bathurst, New South Wales

Demonstrations at this site included cover crops as well as tillage (conventional and no-till). Early establishment of the pumpkins was a problem in the no-till permanent beds due to soil insect attack by symphylids causing seedlings to die. Cultivation in the tilled plots helped to control the symphylids. Another factor was that the cover crop was not sprayed out early enough and hence provided a “green bridge” for the symphylids through to the crop.

The grower also felt that he did not have the equipment to deal with trash left over from the cover crop in permanent beds.



Figure 3: Cover crops provided good weed management. Cover crop on right, fallow control on left (weeds)

Cowra, New South Wales

Several cover crops were demonstrated including legume and non-legume species. There was a substantial yield benefit in the following cash crop when it followed the legume cover crops. This, plus the soil analysis data, indicates that the yield benefit was mainly due to nitrogen. However, the economic benefit of nitrogen from legumes will only be realised if nitrogen fertilisers are adjusted accordingly i.e. saving money on fertiliser.

Tip: If using legume cover crops, monitor soil nitrogen and adjust fertiliser rates for the next crop as required.

Koo Wee Rup, Victoria

Leeks were grown following cover crops, and were harvested late September 2015. Overall the gross margin was similar to the control. There were additional costs for sowing the cover crop. However, cost savings were achieved with the cover crop through reduced post-harvest labour. The main results for the leek crop can be summarised as follows:

- Yield - although earlier in the growing season leeks in the cover crop plots were larger than the control, the final yield was similar for the cover crop and the control.
- Pack-out – the final pack-out percentage was similar for both. However, with cover crops more leeks had healthy, strong white roots and had leaves that peeled back easily and neatly – this meant that trimming and cleaning was much easier and faster with less harvested product going to waste (Figure 3). There was a modest saving on post-harvest labour costs.
- Quality – the leeks with a cover crop were better quality. While no price premium was received for this, better quality usually means that the customer is happy and repeat sales are more likely.



Figure 4: Leeks from control (left) and following a cover crop (right). Leek quality was substantially better following the cover crop with less disease, better colour and strong health roots.

Improved crop quality can mean reduced post-harvest costs e.g. less labour required for preparing or grading produce. Improved quality means that the customer is happy and repeat sales are more likely.

“The leek crop harvested in 2016 was one of the best we’ve ever seen”, Adam Schreurs said.

Adam is now using rye corn at the start of a leek and double spinach rotation. “The biggest thing we’ve noticed is about a 35% increase in boxes of large leeks.” Usually,



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there is a ratio of small, medium and large leeks of about 30:60:10, whereas in the demonstration site bays this has shifted to 10:50:40. This has also been coupled with an earlier harvest of about 2 weeks, and reduced disease incidence across the board. This makes life in the processing and packing shed much easier.

“The soil has also come back to life and where we want it to be, look at all the worms.” he remarked.

Adam also added “we’ve almost accidentally moved to a minimum till system with the rye corn, as the seed is just power harrowed in. The difference in soil structure in these beds compared to the others is amazing.”

Manjimup, Western Australia

Benefits observed at Manjimup were as follows.

Weed control:

- Caliente™ gave good control of the brassica weeds, particularly wild radish
- It did not work very well to suppress other weeds such as doublegee and clover after incorporation
- There was a weed suppression affect from the very dense canopy of the caliente while it was growing, which helps to smother out weeds.

Improved soil condition, reduced erosion and improved water infiltration:

- The Caliente™ held the soil together and helped to prevent wash aways when heavy rainfall occurred
- Rainfall tends to infiltrate more easily into the soil, rather than running off the top of the soil
- The caliente has opened up the ground and made the soil more friable
- The soil is easier to work when preparing for planting crops
- Less tractor passes are required when preparing the ground for cropping after growing Caliente™.

At Manjimup a biofumigant cover crop was grown mainly for disease suppression. However, the grower noticed other benefits of reduced requirement for tillage and reduced erosion in heavy rainfall.

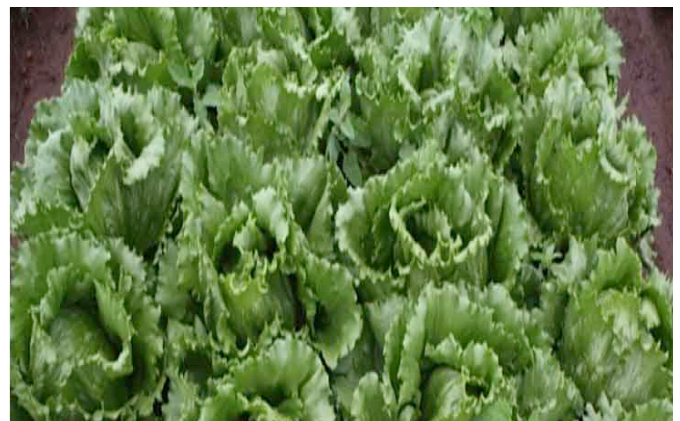


Figure 5: Lettuce from control (top) and following Caliente™ (middle). Lettuce yield and quality was substantially better, following Caliente™. Caliente™ improved soil structure (bottom).



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The cost of cover crops

Each cover crop has its own set of unique benefits and costs. Table 3 shows the expected seed cost of a range of common cover crops. Most cover crops will require some cultivation and irrigation, and a soil test will determine if fertiliser is required. In fact, deep rooted cover crops can recover nutrients from deep within your soil, recycling your lost fertiliser. A pricier option such as Caliente 199™ should be treated with more care to reap the full benefits of the cover crop. Finally, you must also consider the opportunity cost of planting a cash crop, which is the profit of selling a cash crop instead of growing a cover crop, however, your soil needs a break sometime and a cover crop is healthier than bare fallow.

Table 3: Seed cost and characteristic of some common cover crops.

Cultivation, irrigation and fertiliser requirements are unique to each scenario so these costs are not considered here.

	Tillage radish™ (Daikon radish)	RootMax™ (Lolium rigidum)	Sorghum (Sorghum bicolor)	Rye corn (Secale cereale)	Morgan Field Peas (Pisum sativum)	Caliente 199™ (Brassica juncea)
Cost of seed (\$/ha)	\$50 - \$70	\$65	\$100 - \$130	\$144	\$140 - \$150	\$210 - \$250
Fertiliser required	not essential	not essential	recommened	not essential	not essential	recommened
Cultivation	2 passes	2 passes	2 passes	2 passes	2 passes	2 passes
Builds organic matter	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓✓
Reduces erosion	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Recovers nutrients	✓✓✓	✓✓✓	✓✓	✓✓	✓	✓✓✓
Fixes nitrogen	✗	✗	✗	✗	✓✓✓	✗
Biofumigant	✓	✗	✗	✗	✗	✓✓✓
Soil Compaction	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Broadleaf weed control	✓✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓
Grass weed control	✓✓✓	✓	✓✓	✓	✓✓✓	✓✓✓
Specialised equipment?	✗	✗	✗	✗	✗	✓

The economic loss of bare fallow is represented by the loss of organic matter to the atmosphere and the erosion of topsoil. This could be calculated by the cost of compost required to replace lost organic matter, or the topsoil required to compensate for erosion. Planting any variation of ground cover will slow or even reverse the loss of organic matter and control the erosion of bare fallow. However, the cost of irrigation should be also considered.