

Soil and plant health benefits from using compost

A long-term case study on Baldivis Farms

Integrated
Crop Protection

PROTECTING CROPS



Soil Wealth

NURTURING CROPS

At a glance

Owners: Sam Calameri, Charlie Blogna and Joe Blogna

Location: Baldivis, Western Australia

Property size: 40 hectares

Crops: Carrots, cauliflower, potatoes (all in-field), hydroponic lettuce (in a glasshouse)

Soil type: Spearwood sand

Overview

Baldivis Farms is located on the Swan Coastal Plain, about 50 km south of Perth. The soil type at Baldivis Farms is a Spearwood sand which is characterised by yellow or brown sand in the top 30 cm and it commonly occurs over limestone at depth. The soil pH is neutral to slightly alkaline. The sandy soil has limited water and nutrient holding capacity. Sam Calameri has been using compost on Baldivis Farms for the past 10 years and has seen benefits in his carrot, cauliflower and potato crops.

Sam's decision to trial compost was prompted by his concern for the condition of the soil. "We had a more intense cropping program, growing crops all year round as we needed to maximise our returns from the same area of land. I knew we were pushing our ground to the maximum and our carrot yield was starting to decline" said Sam. Sam was attracted to compost by the potential benefits of improved soil structure and water holding capacity on the very sandy soil.

Sam set up a trial area for compost, where he could compare a compost treated growing area with an untreated area side by side. A high quality fully matured compost has been applied at a rate of 20 m³ per hectare to every crop grown in the trial area. This equates to about a 2 mm layer of compost being applied per crop. Two crops are grown in the area each year, giving an application rate of 40 m³ per hectare per year. For each

crop, Sam forms up the planting beds first, applies fertiliser and any other products, then applies the compost using a Nufab multi-spreader. The compost is lightly raked into the ground using harrows and then the beds are reformed.

Key benefits of using compost at Baldivis Farms

- Organic matter in the soil has doubled
- Improved soil structure
- No fumigant used on composted areas
- Reduction in fertiliser use by 10%
- Increase in yield of carrots by 30%
- Increase in yield in potatoes
- Reduction in sandblasting of young seedlings
- More uniform crops in cauliflower, carrot and potatoes
- Growing beds are more stable and don't erode
- Easier to drive tractors on compost treated areas

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Improving crop quality

The first crop grown in the compost trial area was cauliflower. This crop had increased yield, was more even in growth and had less yellow curds due to sun exposure compared to the non-compost control area. “These benefits were enough for me to keep applying compost before each crop. The improved uniformity of growth in the cauliflower was especially notable when I incorporated the compost in a windrowed strip prior to transplanting the cauliflower [rather than broadcasting]” said Sam.



Figure 1. Carrots grown in composted treated soil (left) were larger at 10 weeks after seeding, compared to carrots grown in non-composted soil (right). Photo supplied by Deb Archdeacon, Agronomica

Sam has since grown carrots and potatoes in rotation in the compost trial area, moving away from cauliflower due to market conditions. The carrots grown using compost had larger, less brittle tops and were more uniform in size. Sam noted an increase in the carrot yield of 30% in the crop planted in January 2016, which he thought was due to more even germination of the seed in compost treated ground and better early establishment of the carrots (Figure 1). The less brittle tops made it easier to harvest the carrots without damaging them or leaving some behind. The Brix reading in the carrots was higher in the composted area (8 compared to 6.7 in the non-composted area), the higher brix helps to extend storage life of the carrots and makes them taste sweeter. Sam noticed an increase in potato yield in the composted area, with more uniformly sized potatoes. The potatoes growing in the composted area had better early establishment than the non-composted potato crop (Figure 2). Sam is planning to grow cauliflower again and will use a windrowed compost placement system for this crop.

A key benefit of using compost is that pre-formed beds are more stable. In non-compost beds, the shoulders of the bed often erode during heavy rainfall, exposing the carrots or potatoes to the sun (Figure 3). This results

in greening and increases crop waste. The more stable shoulders also reduce losses during harvest because carrots do not fall over when the beds disintegrate along the edges. “If planting an onion crop I would double the rate of compost to 40 m³ per hectare, to stop the beds collapsing and the loss of onions from the edge of the bed” said Sam. “Using compost holds the soil together better and helps to prevent sand blasting of seedlings in strong winds, which can be a major cause of yield loss”.



Figure 2a, 2b. Potatoes planted in soil containing 20 m³ compost (left) had better early establishment compared to potatoes grown in non-composted soil (right). No fumigant was used in the composted area.

Photo supplied by Deb Archdeacon, Agronomica

Sam has been able to reduce his fertiliser rate and eliminate fumigant application in the compost area. “In the compost treated crops I have not used the fumigants metham sodium or Telone® [1,3 dichloropropene] before a crop. I have also reduced the fertiliser rate by 10%. I reduced the fertiliser rate slowly, over several crops, as the amount of compost in the soil increased with each application” said Sam. “It noticed at harvest that carrots growing in the compost had a ‘carrot smell’ to them, which wasn’t obvious in the non-compost crop”. Compost helps to retain nutrients from fertiliser applications in [the] plant’s root zone, reducing leaching especially in sandy soils.”



Figure 3a, 3b. The shoulders of non-composted beds (right) collapsed after heavy rainfall. The composted beds (left) did not collapse. Photo supplied by Justin Wolfgang, C-WISE.



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If fumigant is used, it should be done before the compost is applied, as the fumigant would kill any beneficial micro-organisms in the compost, reducing its effectiveness.

Improving soil quality

Sam noticed it is easier to drive the tractor through the composted bays. “When driving the tractor on the soft sand, it feels like there is a build-up of sand on the tyres. In the compost treated areas, you don’t get that build up and the tractor seemed to run more freely” said Sam.

Sam has noticed some major changes to the soil and water holding capacity by applying compost for several years. He first started noticing soil and water benefits after a couple of years. “The organic matter in the soil has doubled, the soil structure has improved and the soil pH and water electrical conductivity (EC) has stabilised. I assume there is increased water retention in the compost treated plots, although due to my irrigation layout which is fixed, this is difficult to measure” said Sam. “The compost has changed the dynamics of the soil with a change in

colour and feel, as the compost treated soil is not soft and doesn’t collapse as easily as the non-treated soil. The soil now looks like a really good growing soil.”



Figure 4. Compost application at Baldvis Farms.
Photo supplied by Sam Calameri, Baldvis Farms.

Want to try compost?

Things to think about are:

- What is the reason for using compost?
 - Is it to increase organic matter in the soil?
 - Is it to help prevent bed collapse?
 - Is it to add nutrients to the soil?
 - Is it to increase the water and nutrient holding capacity of the soil?
 - Is it a combination of these reasons?
- Can you consistently produce compost on-farm to a high quality, meeting local environmental regulations or should you buy it from a reputable supplier?
- Do you need certified organic compost?

What compost is to be used for can affect the type of compost needed. It is important to let your supplier know why and how you want to use compost, so they can assist you to select the right product and application rates for your needs.

Sam recommends growers give compost a go but be aware that compost is a long-term treatment. “You have to build your soils up. Many growers are used to fertilisers with a quick action but compost doesn’t work like that at all. Expect some benefits after the first couple of years but you have to apply compost consistently, before every crop. There is no benefit in applying a large amount of compost all at once and then not doing it for a few years.”

Thinking of using compost - things to consider

The rate of compost to be applied can vary depending upon the crop and the purpose for using compost. “It can vary from 5 m³ per hectare in a broad acre situation to 100 m³ per hectare in highly intensive cropping, especially where the planting beds need to stay formed and not collapse”, says Justin Wolfgang from C-WISE who supply compost to Baldvis Farms. “It is important that growers work with their compost supplier to find out the best type and rate of compost to apply. This can be done through trial applications of compost at different rates, taking into account the type of crop, the quality of the compost, the soil condition/texture and the purpose for which compost is being applied. A dedicated compost spreader is useful to get an accurate and even application rate when handling bulk compost.” Focus on getting the highest possible carbon and humified substances in the product.



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Ask for a composition analysis and look at the amount of carbon and nutrients. Check the relative amount of carbon to nitrogen (C:N ratio), which should be less than 20:1, to prevent the nitrogen from fertiliser being used by the compost instead of plants. Look for any components which would cause a negative effect on your crop, such as heavy metals, pesticide residues and inert contaminants such as metal, glass and plastic. Compost can contain useful amounts of copper and zinc for plant growth, allowing fertiliser programs to be adjusted. Be aware there may be a build-up of copper and zinc after repeated applications of compost, which can be detrimental to plant growth.

Consider the maturity level of the compost and whether it suits your needs. Mature compost doesn't have an unpleasant odour but has an 'earthy' smell. Less mature compost stimulates soil flora quickly and is useful for fast growing crops however the compost doesn't last very long in the soil. Less mature compost uses nitrogen as it continues to mature and available nitrogen for the crop needs to be closely monitored. A mixture between mature and less mature composts may be required for some crops. All compost contains varying amounts of beneficial bacteria and fungi. Some types of compost can help the proliferation of beneficial fungi such as vascular arbuscular mycorrhizae (VAM).

Questions to ask a supplier of compost:

- What is the maturity of the compost?
- What is the suggested application rate for your crop and soil type?
- What is the quality of the compost?
- What does the compost contain?
 - Ask for an analysis of what's in the compost
 - Check for the presence of undesirable components, such as heavy metals, pesticide residues and inert contaminants such as plastic, glass and metal.
- Is the compost plant and human pathogen and weed free?
- Is there anything in the compost that might impact on food safety programs?



Figure 5. Harvesting carrots grown in compost treated soil at Baldvis Farms. Photo supplied by C-WISE.

You should ask about the temperature and method by which the compost was made, to ensure pathogenic microorganisms (plant, and human pathogens) and weeds seeds are destroyed.

When using compost for the first time, set up a trial area to compare the effects of using compost against your usual growing program. The non-composted area should be close by, with the fertiliser and irrigation programs in both areas, initially being kept the same. Reduce the amount of fertiliser you apply in stages. Don't make irrigation and fertiliser changes at the same time. Doing them separately allows you to compare the differences more easily. Don't make large changes suddenly.



Figure 6. Harvesting carrots grown in compost treated soil at Baldvis Farms. Photo supplied by C-WISE.

Soil and plant health benefits from using compost

The value of compost

What is the value of compost when applied to an intensive vegetable growing farm? It costs about \$84 per m³ for compost to be delivered to Baldvis Farms. At an application rate of 20 m³ per hectare, this costs \$1,680 per hectare. The fumigants, metham sodium or Telone[®] were not applied to the composted area. Not using Telone[®] saved \$1,640 per hectare and not using metham sodium saved \$920 per hectare. The compost supplies some nutrients to the crop, which has allowed Sam to reduce the amount of fertiliser applied by 10%. Table 1 shows the value of the major nutrients that are in compost, based on a typical analysis of the compost used on Baldvis Farms. There is additional value gained from the micronutrients that are also contained in the compost.

Table 1 - Value of nutrients based on a typical analysis of compost used at Baldvis Farms. Compost is applied at 20m³/ha.

NUTRIENT	NUTRIENT APPLIED (KG/HA)	NUTRIENT AVAILABLE TO THE CROP FROM THE COMPOST (%)	FERTILISER EQUIVALENT IN 20M ³ OF COMPOST (KG/HA)	VALUE (\$/HA)
Nitrogen (N)	128	10	28 kg urea	\$16
Phosphorus (P)	24	40	109 kg superphosphate	\$51
Potassium (K)	64	80	138 kg potassium nitrate	\$251
Calcium (Ca)	210	20	221 kg calcium nitrate	\$146
Magnesium (Mg)	12	20	25 kg magnesium sulphate	\$13
Total				\$477

Composted beds hold together, with no slippage of the sides of the beds. There was less greening on carrots as they were not exposed to the sun and they were easier to harvest as the tops were less brittle. Sam noticed an increase in the yield in the carrots of about 30% in the composted area.

Not using fumigant, improving fertiliser use efficiency, adding carbon to the soil and improvement in crop yield and quality all contributed to off-setting the cost of the compost. Additional benefits, which are difficult to value such as improved environmental and social sustainability also need to be considered.

A final thought

Compost should be used to support plant growth, with it being one component of the overall production system. "Since using compost, I have had better yield and quality, improved crop uniformity, the soil organic matter has doubled and I have made a saving on fumigation and fertiliser" says Sam. "The main challenge on the farm is producing high quality crops and using compost is contributing to improved quality".

Acknowledgment

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