compost for soils

Compost in citrus

Compost in Citrus - can it make a difference?

Soil amendments, including composted green organics, are making a difference in many agricultural and horticultural operations - including the citrus industry. Recent research conducted at SARDI (Dr Peter Crisp and Greg Baker) and the University of South Australia (Dr Sarah Wheeler) has highlighted several key benefits of using compost in citrus production.

Compost and yield

Applying compost can have substantial yield benefits. SARDI trials in Navel oranges in Loxton, SA demonstrated that yield can increase by 60% when compost is applied. A range of soil amendments were applied at varying rates and yield was measured over two seasons (Table1).

Increased yield was achieved through increases in fruit size as well as fruit density - on average, fruit increased by 5-7mm. This gives growers about an extra $100 per tonne ($4,000/ha) on fruit for high value markets. A similar study in Valencia oranges achieved similar if not slightly better results.

Yield benefits of soil amendments last well beyond the first year and monitoring is continuing to evaluate the persistence of increased yield after the initial application.

Increases in fruit size and density are consistently achieved with compost

Navel Oranges -Loxton North % increase in yield compared to no treatment		
Treatment	**2007**	**2008**
Animal manure 40 m^3ha^{-1}	5.0	28.8
Grape marc 200 m^3ha^{-1}	25.5	51.2
Compost 40 m^3ha^{-1}	11.7	16.8
Compost 120 m^3ha^{-1}	16.9	43.4
Compost 200 m^3ha^{-1}	25.7	62.9

Table 1: The average percentage increase in Navel orange fruit yield recorded for five soil amendment treatments in 2007 and 2008 (compared to the untreated control).

Compost and pest management

One of the major pests in citrus production, particularly in the Riverland and Sunraysia regions is Kelly's citrus thrips (KCT), *Pezothrips kellyanus*.

KCT feed on developing fruit causing damage which often reduces fruit quality and in some cases can make fruit unsaleable. The most common method to control KCT is application of organophosphate insecticides but KCT are developing insecticide resistance. These insecticides can also kill beneficial insects within the orchard, disrupting integrated pest management programs (IPM).

Predatory mites have been identified as a biological control agent of KCT pupae in the soil and, when these mites are in high numbers, KCT emergence from the soil can be reduced by more than 50%.

SARDI research has found that predatory mite numbers increase, and KCT emergence from the soil decreases, when composted green organics is applied to citrus.

In the first year of compost application, KCT adult emergence was reduced by 50%. In the second year after application, KCT emergence had reduced by 90% compared to trees without compost. This reduction represents a significant contribution to KCT management and prevention of fruit damage.

Not all composted materials are created equal when it comes to KCT control. Composted grape marc and composted dairy organics both increased the numbers of arthropods (insects and allied forms like mites and spiders) found in the soil, but there was no significant reduction in KCT emergence.

Composted green organics applied to citrus can play an important role in a KCT IPM program.

Composted green organics can significantly reduce KCT emergence for at least 2 years

Compost and Water Conservation

Applying composted green organics to citrus trees can also significantly increase moisture levels in the soil.

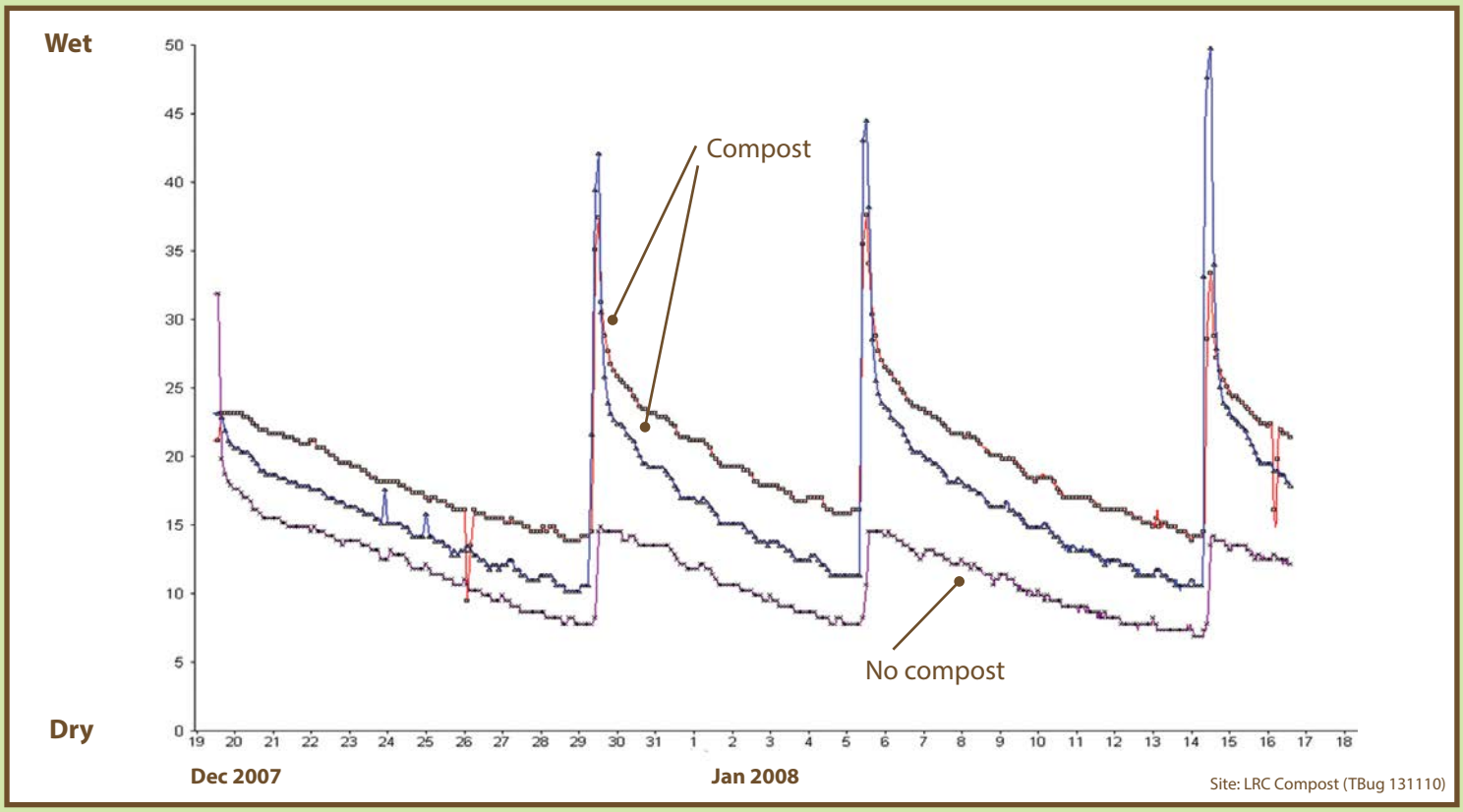

Fig 1: Sample data of soil moisture at a depth of 10-15 cm under Valencia trees at Loxton Research Centre (SA) from control trees without soil amendments or trees treated with 200 m^3ha^{-1} composted green organics.

Applying soil amendments can increase soil moisture levels in the top 25 cm of the soil - this can reduce the demand for irrigation without impacting on yield or tree health. Soil moisture monitoring is still underway at Loxton (SA) with sensors added at different soil depths for more detailed measurements of the effect of amendments. Stay tuned for the next round of results!

See the difference……

Fig 2: Valencia orange trees at Loxton Research Centre, October 2007.
Left to right; Untreated control, Grape Marc 200 m^3ha^{-1}, Compost 200 m^3ha^{-1}.

Compost and nutrients

It is well known that compost can supply vital nutrients to the soil after application - particularly nitrogen, phosphorus and potassium.

Soil sampling in citrus orchards highlighted significantly higher nitrogen levels where soil amendments had been applied compared to no application. This increase could be a result of the nitrogen present in the soil amendments, reduced leaching of nitrogen through the soil profile or increased microbial activity in the soil (through bacteria that fix nitrogen). More research is needed to determine the exact cause of the increased nitrogen levels. Regardless of the nitrogen source, the good news is that application of soil amendments could reduce the need for fertiliser applications such as urea, saving significant amounts of time and money.

Compost application can significantly increase the amount of nutrients in your soil

Soil carbon plays a vital role in soil health and fertility. Increasing soil carbon levels helps to improve root and plant growth and leads to healthier, more productive plants. Soil amendments provide a great source of soil carbon and can add up to 44 tonnes of carbon per hectare when applied at 200 m^3ha^{-1}. SARDI trials in citrus have also demonstrated that composted green organics can increase soil carbon beyond the level that can be explained just by the carbon content of compost. Composted green organics added to citrus trees at 200 m^3ha^{-1} provided around 40 t/ha but after 28 months soil carbon levels had increased to 100 t/ha. This means that carbon is being stored or accumulated in the soil. An increase in stored carbon may also provide additional commercial opportunities (as well as improved plant growth) for individual growers and the citrus industry if carbon trading is introduced and this type of carbon storage is included.

Getting bang for your buck - cost benefit analysis

Application of soil amendments in citrus orchards can be expensive, even though it may only need to be applied every 3 - 5 years. This initial investment can be a barrier for many growers, but rigorous cost-benefit analyses have shown it is well worthwhile (Table 2).

All amendments used in SARDI citrus trials (composted green organics, grape marc, animal manure) showed a positive return on the initial investment. Benefits varied between sites, for example the 120 m^3 ha^{-1} composted green organics application returned the lowest benefit of 1.9 ($1.90 for every $1.00 spent) on Valencia oranges at Loxton Research Centre, but the same treatment returned a 2.81 benefit in Washington Navel oranges at Loxton North.

An application of 40 m^3 ha^{-1} of composted green organics in Loxton North gave the highest benefit at 5.38. This means that for every dollar invested around $5.00 is returned to the grower!!

	Benefit Cost Ratio	Net Profit value /5 years /ha $
Compost 40	5.38	16,471
Compost 120	2.81	18,270
Compost 200	3.16	22,180
Mark 200	3.11	18,461
Animal 40	4.24	13,347

Table 2: Benefit cost ratios of trial applications for Navel citrus at Loxton North

All amendments used in SARDI citrus trials (composted green organics, grape marc, animal manure) showed a positive return on the initial investment.

Growers can expect between $1.90 and ~$5.40 for every dollar they invest in compost.

Low applications of animal manure and composted green organics gave the largest financial returns but high levels of compost resulted in greater overall farm and environmental benefits - including improved soil and water quality, leaf and fruit quality and decreased thrips presence.

The benefit cost figures in Table 2 are a conservative estimate as they do not include the potential water savings associated with compost use, reduction in thrips presence and associated chemical control savings or improvements in fruit quality. When all of these factors are taken into consideration compost applied at 200m^3 ha^{-1} is the most sustainable option with the highest overall net benefits.

References

Crisp, P., S. Wheeler and Baker G. (2009). Synthesis of a citrus thrips IPM system with production and environmental benefits. Horticulture Australia Limited Final Report No CT06007. South Australian Research and Development Institute (Sustainable Systems) Adelaide

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