

Making organic vineyards sustainable: the novel Amisfield approach

An inventive approach to vine nutrition and weed control has been implemented in Central Otago, New Zealand, promising improved vineyard economics and sustainability in drip-irrigated organic vineyards particularly, writes international viticultural consultant **Richard Smart**.

Introduction

A new approach to viticulture has been developed at Amisfield, in Central Otago, New Zealand, which can improve the sustainability of drip-irrigated organic vineyards worldwide. In fact, these techniques will likely also find application in sustainable and conventional vineyards as well as they are based on current concepts of economically sustainable production. These ideas are quite novel, hence the headline reference to sustainability, normally considered an alternative to organic production. But this new approach at Amisfield does lead to better vineyard economics within a more sustainable environment.

Amisfield is a 90-hectare vineyard in Central Otago planted in 2000. The owners of Amisfield decided to manage the vineyard organically in 2013 and will achieve certification by 2021.

The challenge of viticulture in Central Otago

Central Otago is cool in summer but quite sunny. The region around Amisfield is quite arid, with only 360mm of annual rainfall of which 240mm falls in the October to April growing season. Drip irrigation is widely practised, with around 200mm per season normally applied.

The soils of the region are generally light textured, often sandy loam and contain significant quantities of stones

and gravel. These soils, therefore, have low water-holding capacity, low nutrient content and low organic matter, as there is little native vegetation in this arid climate. The predominant soil type in the Amisfield property is known as Waenga and has a native organic matter content of 4.6%.

The combination of the cool, dry climate and low retention soils presents problems for conventional viticulture which are exacerbated by the use of organic principles. Deficiencies of many nutrients are common, especially N, P, K, S and Ca. Low levels of yeast available nitrogen (YAN) are also very common, especially with organic vineyards.

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The further challenges of organic viticulture

The challenges of organic viticulture are not unique to Central Otago, but the environment there makes organic viticulture more difficult. Weed control under an organic regime is always problematic in drip irrigated vineyards. Mid-row cultivation and/or mowing can control competing weeds and is easy in drier climates like Central Otago. However, under-vine drip irrigation encourages weed growth, and the presence of trunks and trellis posts compromises mechanical weed control by cultivation, especially with vigorous perennial weeds. This problem is often overcome in conventional viticulture with herbicides.

A second challenge is the ban on 'chemical' fertilisers, especially nitrogen. A common appearance in organic vineyards in New Zealand (and elsewhere) is yellow nitrogen-deficient vines, often with reduced vigour. Animal manure and compost has low N content and is therefore expensive to transport

and spread and is often reliant on nearby livestock farming. This nutrient supply problem is exacerbated on lighter-textured soils, especially those with low organic matter as in Central Otago. Other nutrients can also be difficult to economically provide in 'organic' form.

The relatively dry growing season facilitates fungal disease control although there are issues with adequate wound protection to overcome grapevine trunk diseases with non-chemical products.

Development of the Amisfield approach

This has been a team approach, although South African-born Andre Lategan, Amisfield's vineyard manager, has been a major contributor. Andre was trained in viticulture at Elsenburg College and, after working in local Cape vineyards, moved to Central Otago in 2001 where he has since been managing Amisfield.

I recall Andre's anxiety about the conversion to organics during a consulting visit in 2013, and his principal concerns were for nutrition and weed

control. My suggestion was to use geotextile fabrics for under-vine weed control, but Andre's inventive mind had considered an alternative and probably simpler approach that has led to the

AT A GLANCE

- Weed control under an organic regime is problematic in drip irrigated vineyards
- The ban on 'chemical' fertilisers in organically-managed vineyards is also problematic, with nitrogen-deficiency common.
- Amisfield ceased watering under vine in favour of the mid row where weeds are easier to control.
- The drip system was also buried in the mid row to allow weed control by mowing rather than tillage.
- A source of nitrogen was subsequently grown in the mid row to produce much-needed organic matter.

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Amisfield system described here. And this was a very good example of lateral thinking — figuratively — by moving the irrigation system laterally. He reasoned that weed control would be much easier if he stopped watering under vine, so why not irrigate the mid row, where weeds were easier to control? Why not?

Interestingly, Andre's idea of mid-row irrigation takes me back many years to the very early period of global drip irrigation development in the late 1960s, when I studied this very new technique in Griffith, Australia. At this time there was more drip irrigation in the Hunter Valley on vineyards than anywhere else in the world! I recall several scientists and farmers worried about under-vine irrigation because of weed control issues, but the more widespread use of herbicides eventually solved that problem. So early suggestions on **mid-row irrigation** were not followed up.

Andre further reasoned, why not bury the drip system to allow weed control by mowing rather than by tillage, which was another of Andre's concerns in these fragile soils? But his idea wasn't to bury the drip system deep; just at 10cm to avoid any implement damage. Andre's logic here was that this would encourage the greater lateral spread of water and,



Figure 1. A photograph taken in May 2018 of Pinot Noir on 3309C rootstock planted in 2008, showing that both larger and fine root growth is concentrated in the berm underneath the drip line under conventional irrigation. Some major roots are painted white.

hence, vine roots. There is currently some commercial interest in buried drip systems mid row, but this is a different approach to that followed here.

Do vines suffer with mid-row irrigation?

This is the first question that will come to mind for the grapegrower. Are not all the roots in the berm underneath the vine occupying a better soil environment, made **moister by irrigation** and **cooler because of canopy shade**? The answer

is yes, more or less. Figure 1 shows clearly the within-berm concentration of large and fine roots with conventional irrigation at Amisfield.

However, we know that roots will grow in wet soil, and that they are encouraged to grow in the mid row by occasional winter-spring-autumn rainfall and inhibited by summer drought. Andre tested his ideas beginning in 2010 by installing second-hand drippers in the midrow of a 1ha planting of Pinot Noir on 3309 rootstock. For five years

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maintained both the under-vine and mid-row irrigation systems, dividing water application between the two, and then in 2016 he stopped the under-vine irrigation altogether from the beginning of the season.

The result was surprising. There was only a minor setback in the early growth of the vines previously watered with under-vine irrigation, and no effect was noticeable by the end of the season. For the last two seasons yield was maintained at 7t/ha with well-ripened Pinot Noir grapes. Andre now believes that vines will adjust to mid-row irrigation by developing a root framework to the middle of the row, and a zone of higher feeder root density under the mid-row drippers. Figure 2 shows roots growing to the row centre and the growth of fine vine feeder roots below the mid-row dripper tube.

So, why not irrigate legumes mid row to provide nitrogen?

This was Andre's second 'lightbulb' moment. He asked, why not now grow a source of nitrogen in the mid row and produce some much-needed organic



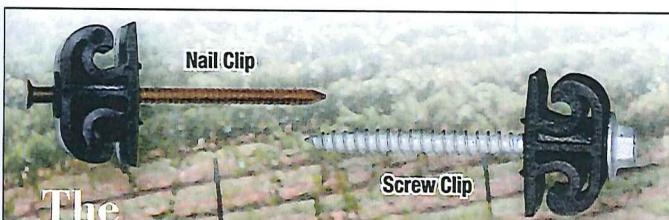
Figure 2. Lateral growth of a main root away from the berm towards the mid-line drip row. The root branches and fine roots are evident at each inline dripper. Some roots are painted white. Photo taken May 2018 of Pinot Noir on 3309C rootstock planted 2008.

matter? Clover seeds were hand spread in an 80cm wide band over the mid-row dripper line in 2016 which were lightly 'spiked' and rolled in.

Perennial clover types were chosen over annuals saving yearly establishment and soil disturbance. Figure 3 shows a sward of red clover. Red, white, crimson and subterranean clovers and lucerne are now

being evaluated. The legume growth was prolific, occurring in warmer summer months with adequate water supply.

Irrigated legumes in pastures in the South Island of New Zealand will produce up to around 3000kg/ha of dry matter and fix around 100kg N/ha. For a strip of vigorous legumes occupying 40% of the vineyard area we might expect



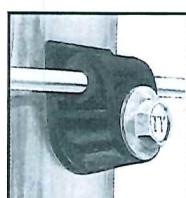
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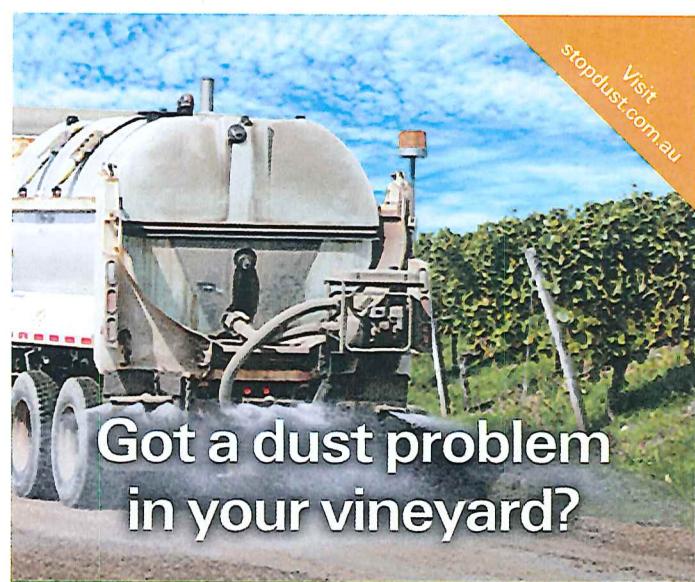
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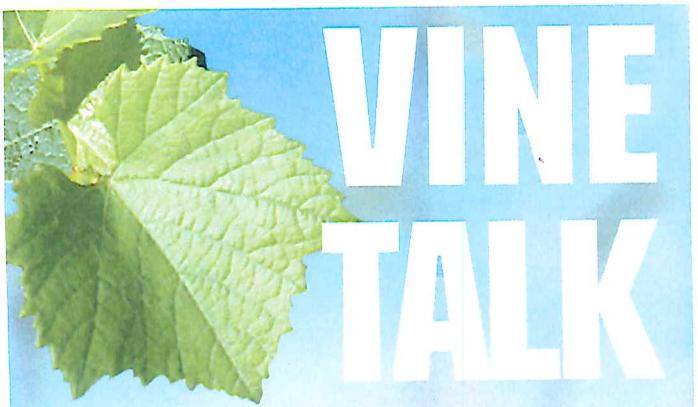


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Build IPM into your vine program

In the July Vine Talk, I recommended using the dormancy period as a great opportunity to get amongst your vines and identify what pests you have and where they are hiding. Grapevine scale, Mealybugs and mites are among the many pests you are likely to encounter. This period of dormancy is where your insect control strategy for the coming season starts.

If you are on top of this, you may also have applied a targeted dormant spray and employed pruning techniques that have further reduced pest numbers. Infested vine material should also have been removed from the vineyard or destroyed.

Grape growers that have done these things are well prepared!

Even so, green growth, moisture and warm conditions can cause pest populations to escalate quickly, so we need to be conscious of what's important for the coming weeks.

Insect pests are typically opportunists. They grow and reproduce quickly when conditions are right, which can sometimes lead to an explosion in pest populations. However, it can take a little longer for the beneficial species to multiply and help control these pests. During this lag-time, it's important not to have a knee jerk reaction when you see insects in your vines. Before you reach for that insecticide you need to ask the question, 'what impact will this product have on beneficial species', and if so, 'what are the longer-term implications for my vineyard'? An understanding of the IPM friendly-nature of the crop protection product you intend to use is important. With IPM, the idea is to selectively target insect pests and control the pest population sufficiently, while minimising harm to beneficial species. These beneficial insects (otherwise known as natural enemies) can help keep pest numbers below a threshold where spraying would be required.

Your local agronomist/viticulturist should be able to guide you in making well informed decisions about the best products to use and how to apply them when pest thresholds are reached. With the 2018-19 vintage approaching, an exciting new product has been released for mite control in wine grapes. Along with offering control of a broad range of other pests, this product is relatively soft on beneficial species and is IPM friendly. Growers should contact their reseller for more details.



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Figure 3. A red clover sward, planted in 2016. Photo taken December 2017.

1200kg/ha of dry matter and 40kg N/ha. Prior to converting to organics, Andre found that 10kg/ha/year of N gave adequate canopy growth and YAN values of up to 300mg/L. The N requirements of vineyards are commonly considered at around 10-25kg N/ha/year depending on yield and crop removal.

The mid row legume sward has also produced substantial amounts of organic matter. Measurements were made in spring 2018 at 0-5cm soil depth to compare soil organic matter under an eight-year-old lucerne clover sward to an adjacent mid row without a sward using conventional under-vine irrigation. Organic matter levels were 41% higher at 6.2% than for the mid row with no sward at 4.4%; there was also 1.2% roots and litter waiting to break down under the sward compared with 0.1% in the mid row with no sward. This is a substantial gain in soil organic matter in eight years.

By simple modifications to the mower, some or all of the legume foliage can be retained, and the cuttings may be spread as desired over more or less of the soil surface.

Installing the Amisfield system

Andre has the assistance of retired farmer Bert Sim who has brought exceptional metal working skills to the project. Bert has developed a simple device to allow mid row irrigation to be installed. The 'cleaver' roller shown in Figure 4 is a simple towed implement, made from a metal drum (filled with concrete) which can be pulled (and lifted) by a tractor. A similar implement, the 'spiker', was developed for use pre and post legume seeding. A conventional mower with two cutting blades was modified to trim the clover with a 'mohawk' cut where foliage growth needed to be reduced.

Installing the Amisfield system on new plantings

The target root zone for irrigation with new vine plantings is limited. This time is also an opportunity to begin training roots laterally from the beginning of a vineyard's life. During the first year the dripper line is laid about 30-50cm to one side of the vine row, close enough to ensure that the wetted zone will extend to the young vine roots.



Figure 4. Andre Lategan (left) and Bert Sim beside the cleaver attachment

During the second growing season the drippers might be put in a temporary shallow trench using the cleaver, say at 0.8m away from the vine row. The advantage of the shallow trench is that the dripper line can be easily removed for the beginning of the third season to the row centre. These distance suggestions are tentative, and are under trial at Amisfield. Wet soil conditions in early spring will encourage lateral root spread, as will heavier-than-usual irrigation applications.

Discussion

The Amisfield organic system represents a new concept in organic viticulture, suited to drip irrigated vineyards especially with light textured soils in regions with low summer rainfall.

There are two principal benefits of the approach. The first is that under-vine weed control is facilitated by reducing weed amount and growth due to competition from the established vine root system. Andre finds that only three passes are now required per year compared with the previous six using under-vine tillage.

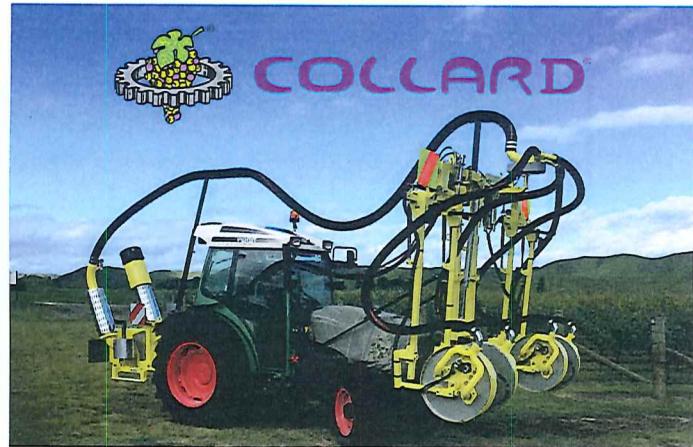
The second benefit is that rather than some irrigation water being wasted on weeds, it is now used to 'grow' nitrogen supply to the vines, using solar energy and the rhizobia bacteria of the legumes. The resulting summer growing sward is easy to manage by mowing, and there will be valuable organic matter addition to the soil from the legume sward.

There have been no root blockages of drippers noticed at Amisfield, and dripper line ends can be easily accessed for periodic cleaning. This approach also utilises more of the vineyard soil volume, much more so than with conventional drip irrigated organic viticulture where vines and weeds compete for water and nutrients under the vine row.

I can anticipate sustainable vineyards also adopting this approach for the benefits of reduced herbicide use, improving soil organic matter and a free source of nitrogen fertiliser.

Richard Smart can be contacted via email: vinedoctor@smartvit.com.au.

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