Soil Enhancement versus Maintenance of Yield

Case Study: Viticulture

Soil enhancement processes have long been plagued by early-term yield losses as lower nutrient application and changes in land management practices are adopted. Prior studies have shown that low microbial counts and low microbial diversity are a feature of depleted soils and in particular of intensively farmed regions which have a strong reliance on applied nutrient. There is evidence to suggest that continued reliance on high rates of synthetic fertiliser prevents regeneration of the microbial elements which are critical to the in-soil processing of these same nutrients. This approach has fostered a cycle of increasing need for more nutrient in order to maintain yields. In an attempt to address this nexus, many landholders are seeking soil enhancement products which aim to help rebuild microbial diversity and biomass in soils. However, in most instances, farmers have been faced with accepting several seasons of lower yield or leaving land fallow altogether in order to promote microbial recovery in the soil.

This situation creates a commercial barrier for entry for most soil enhancement products, including those which involve the re-cycling or re-application of organic matter as a stimulant or a catalyst for in-soil biomass development.

In 2005 a solution was developed in North Queensland whereby highly adapted sets of organisms were pre-grown on conventional fertilisers allowing a reduction of the environmental shock load faced by soil organisms when concentrated nutrients are applied to the soil. These formulations were then specifically adapted to allow the processing of key nutrients (N, P and Ca) and it was found that the introduction of formulations containing these key sets of organisms were able to supply a much faster development of soil biomass than had previously been possible. In addition, the sensitivity to concentrated nutrient was reduced, allowing farmers to manage reductions in the application of fertiliser over time rather than removing chemical inputs altogether in the early years of transition.

A simultaneous improvement in soil biomass and diversity of microbial development while in transition to lower fertiliser application and the use of organic inputs without the attendant yield losses provided an attractive solution for those landholders wanting to move to a platform of improved soil. Further impetus has been added to the discussion with the growing need for soil structure management (to prevent erosion and wind-blown losses) and for moisture retention. It has long been observed that soils which contain higher levels of humus – the result of microbial diversity and higher levels of microbial biomass – are better structured and retain water and nutrients longer in the zones where plants need them.

In recent times this discussion has become even more pertinent given the focus on re-deployment of Soil Carbon reservoirs which occur naturally as a result of increased biomass development. It became clear in 2005 that the process of adapted microbial re-deployment was, by proxy, a process which rapidly sequestered atmospheric Carbon.

In this study, a prominent farmer in the Riverina area of Australia sought to make the transition to lower fertiliser input and improved soil. The objective was to maintain yield by managing the input of both organic (soil enhancement) products and conventional nutrients such that improvements in soil health were achieved without yield decrease.

Property Details

Land Owner: Ken Hughes

Land Size: 800 ha including 2.8 ha of vineyards

Land Usage: Shiraz, Tempranillo and Chardonnay grapes

Fertiliser Used: MicroGrowth (a fermented soil inoculant aimed at early phosphorous processing) and MicroNutrient (a bio fertiliser containing 7%N, 1%P and 4%K from conventional sources)

Dilution Rates: MicroGrowth 1:100 (water) and MicroNutrient 1:10 (water)

Nutrient Application Rates 2006 Crop:

Urea	**50 kg per ha**
Phosphate	**70 kg per ha**

Note: Microsoil produces VRM biofertilisers.

Nutrient Application Rates 2007 & 2008 Crop:

MicroGrowth	**3 Litres per ha**
MicroNutrient	**200 Litres per ha**

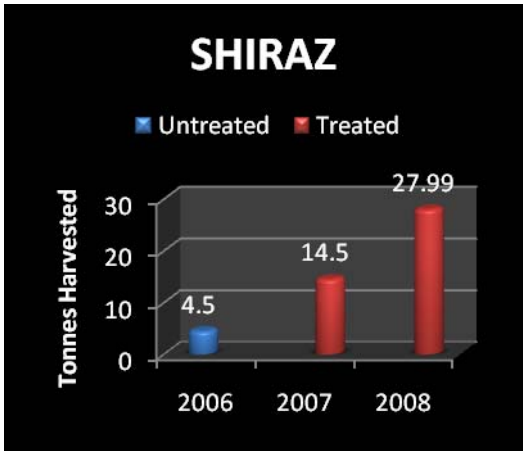


Method: Over the course of the 2007 and 2008 growing seasons 2.8ha of grapes were tested to measure the production level and sugar concentration (Baume) achieved following adoption of a lower nutrient (fertiliser) regimen combined with selected soil enhancement products. Products were applied to grapes at three intervals from June onwards. Each of the products was diluted and applied through a *Hardi* boom spray rig as per the application rates listed above. Normal irrigation of the grapes continued throughout the years.

Yield Data

Grape	Year	Baume %	% change	Tonnes	% change
Shiraz	2006 (untreated)	14.0	-	4.50	-
Shiraz	2007 (treated)	14.1	+0.7	14.50	+222
Shiraz	2008 (treated)	13.5	- 4.5	27.99	+93
Tempranillo	2006 (no crop)	nil	nil	nil	nil
Tempranillo	2007 (treated)	14.3	-	0.61	-
Tempranillo	2008 (treated)	13.5	-5.6	2.27	+272
Chardonnay	2006 (untreated)	13.5	-	0.32	-
Chardonnay	2007 (treated)	14.8	+9.6	0.65	+103
Chardonnay	2008 (treated)	14.0	-5.4	0.92	+41.54

Note: 2006 crop yield was affected by hail.



Organic Carbon Measurements

Year	Organic Matter %	% change	Total Organic Carbon %
1998	0.3	-	0.18*
2005	0.93	+210	0.55*
2008	4.23	+355	2.42

Note: The vineyard was irrigated each year.

*Calculated Values.

Outcomes

Overall Grape production increased by 15.42 tonnes or by 98% between the 2007 and 2008 seasons upon adoption of lower nutrient regime coupled with soil enhancement. The Baume (sugar concentration) was maintained at approximately the same levels as achieved in previous years – in this case 13.7%.

Baume is a key element in yield determination for this farmer. Historically on this farm – as in most viticulture—an increase in volume of production will invariably mean a significantly lower sugar concentration in the fruit. In this case, significant increases in volume production were achieved without the attendant drop in sugar concentration. This result means that the farmer has been able to increase yield during the transition to a lower nutrient application without yield loss. Additionally the farmer has stated that improved flavour, aroma and texture compounds have been evident in the wines.

Improvements in soil structure and friability have been noted, together with much advanced water management. This mirrors an increasing pool of organic carbon measured in the soil over the period. Further measurement of these factors is anticipated for following seasons.