THE USE OF AN INNOVATIVE MICROBIAL TECHNOLOGY (EM) FOR ENHANCING VINEYARD PRODUCTION AND RECYCLING WASTE FROM THE WINERY BACK TO THE LAND

Daly, M.J.(1) and Arnst, B. (2)
(1) New Zealand Nature Farming Society, 146 Halswell Rd. Christchurch 8003, nznfs@paradise.net.nz
(2) Seresin Estate, PO Box 859, Blenheim, bart@seresin.co.nz

Abstract
Effective micorganisms (EM) is a technology now widespread around the globe and known for its versatility and effectiveness under a wide range of environmental situations (Higa, 2002). Originally developed for enhancing the soil and promoting growing conditions for food crops, it has also gained a reputation as a very effective tool in waste management.

The technology has been promoted within New Zealand by a non-profit organisation called the New Zealand Nature Farming Society (NZNFS). EM technology is being used as a tool in many agricultural growing systems in NZ.

This paper will describe how one of these examples, Seresin Estate, a well-known 145 ha vineyard and olive grove in the Marlborough Region, uses this technology. The management of Seresin estate could be described as a "hand tended" approach under Organic and Biodynamic principles. EM technology was first used about 4 years ago, and is now fully integrated into a number of management operations throughout the property.

This paper will describe as a case study the integration of EM technology on the Estate. References will be made to published data on the likely impact of each operation. In particular the paper will focus on the technique of recycling the grape waste back to the vineyard as a compost and will present data from a trial conducted on the property to compare the relative differences between compost made using EM, verses a control and the subsequent impact on plant growth.. In addition the technique of treating winery wastewater will be covered and data presented to indicate odour control and pH stabilization differences.

Introduction

What is EM technology?
EM, short for effective microorganisms, is a complex combination of microorganisms that can be found in nature and the food processing industry. This technology was developed in the 1980s, by a Japanese Professor Dr Teruo Higa. These microbes have been cultured in a special combination and developed as a technology for improving soils and plant growing conditions. In 20 years EM technology has developed into a global technology, and is recognised as a powerful and effective tool both in agriculture and horticulture for crop and animal production systems. EM technology is used in over 140 countries around the world, and has been used in NZ for 9 years. The main focus in New Zealand has been both in Agriculture and waste management. This paper will describe how prominent and successful Vinyard and Olive Grove, Seresin Estate in Marlborough, have introduced EM into its management.

What is in EM?
This product is a mixed combination of 3 main families of microorganisms. These are Yeasts, Lactic acid bacteria, photosynthetic bacteria and fungi (Daly & Stewart, 1999). These micro-organisms are completely natural and all are found in the environment, with many found also in food processing applications, (eg Lactic acid bacteria in Yoghurt).

How does EM work?
The key to the success of EM is not the microbes working in isolation from each other…but the combination and synergistic effect when they are used together. This is what makes EM so effective. The diverse combination of microbes in EM also gives it adaptability. And this is why it works in such a broad range of

conditions. The leading roles of each family of microbes will change as the environment applied into is changed. EM causes a fermentation process when applied to organic matter rather than a putrefying process. EM will compete with and displace, through competitive exclusion other microbes such as pathogenic microbes, some of which cause disease (eg. “Damping off” disease).

Seresin began using EM technology around 4 years ago, initially as a soil and plant application, then latterly as a compost additive and for wastewater treatment. This technology is now well integrated into management applications at Seresin and is considered an important multiple facet technology in the Holistic approach used on this property. Although the property has significant Olive plantings, the focus in this paper will be on the vineyard.

Seresin Estate

Seresin Estate is a well-known 145 ha vineyard in the Marlborough Region, owned by the well-known New Zealand film Cinematographer, Michael Seresin.

Michael has placed great emphasis on creating a vineyard that works in Harmony with Nature, taking advantage of the natural contours and landforms to produce unique quality wines and extra virgin olive oils. The Vineyard encompasses some distinctive landscapes, and waterways that are enhanced by native plantings. The management uses a “hand tended” approach under Organic and Biodynamic principles, and has been using EM technology for 4 years.

Table 1. Seresin Vineyard and Olive Grove 2005, statistics

Size:	114 ha in Grapes
Established	1992
Organic Certification	May 2000
Latitude	41^0
Altitude:	100m above sea level.
Rainfall	650mm evenly distributed through year
Temperature range	Summer average 27°C, Winter average 13°C. (high sunshine 2448 hrs/yr
Soils (Kear et al. 1967)	2 distinct types, Waimakarriri alluvial loam well drained (45-75cm depth), Renwick stony alluvium loam, high % rock fragments, recent glacial formed.
Vineyard Production	600 tonnes expanding to 1000 tonnes
• varieties	Sauvignon Blanc, Chardonnay, Pinot Gris, Riesling, Pinot Noir
Olive Grove Production	15 tonnes expanding to 30 tonnes
• varieties	Frantoio, Lecchino, Minerva, Pendalino (All Tuscan)
Olive growing plantings	5000+

How is EM being used around the vineyard?

When EM is supplied, it is a living product, but stable at a pH off 3.5 (The natural lactic acid brine preserves and stabilises the product until used.

The product can be used directly by diluting with water adding a sugar source (molasses) and applying to the soil or plants or compost. However a more cost effective method is to activate and expand the product. This is done by making a solution containing 5% EM and 5% molasses. This solution is kept warm 30 degrees C for 7 days. In that time the microbial brew increases populations many times over and fully activates the microbes. This in effect, turns 1 litre of EM into 20 litres of activated EM (EM-A). Making a very cost effective product (cost = 60 cents per litre).

This EM-A is then diluted with water and applied in the following operations;

Adding to fertilisers

- EM-A is added to foliar fertilisers such as seaweed at 2 litres per ha.

Understorey management

- When the understorey is mown and prunings mulched. EM-A is applied to the fresh cut mulch at 10-20 litres per ha EM-A

Compost making

- In the compost making process. EM-A is added to the compost at 1-2 lites/cubic metre of compost

Vine health

- EM-A is applied at 1% concentration as a foliar spray to enhance vine health and assist in disease control

Waste water treatment

- EM-A is added to the waste water system to control smells and make the system work more efficiently. The water is then recycled onto amenity planted areas for irrigation.

How does Seresin justify the use of EM?

The justification for using EM has come firstly from published data both within NZ and overseas, showing positives results from using EM. Secondly, from our own experience and observations with using EM over a period of several years.

There are numerous results that show EM can increase crop yields (Daly, 1996. Sangakkara & Higa, 2000) and can improve soil quality (Sangakkara & Higa, 2000. Hussain, *et al.* 2000)

EM has been shown to enhance fertiliser efficacy when combined together at application (Xu, 2000,Hussain, *et al.* 2000)

EM is used as a foliar application to improve vine health and reduce disease incidence (Robotic *et al*. 2001)

The justification for using EM in compost making has been based on our own trial to make two types of compost, one made with EM and one without EM, then an independent analyis of the samples. These results, which have been published, previously (Daly, 2004) are presented in the next section.

Compost Trial at Seresin

A common waste product at Vineyards is the Grape pomace (skins seeds and bunch stems). This waste product is being turned into valuable compost.

To test the effectiveness of EM in the compost making process. Two separate compost batches were made in 2003.

Around 50 cubic metres of each compost type was made. Both treatments had the same base ingredients. 50% grape pomace, 25% wood chips, and 25% paper waste, a small quantity of rock phosphate and elemental sulphur was also added.

1) The EM compost received 1 litre of EM-A/cubic metre, applied to the ingredients as they were mixed. The compost was rolled down, then immediately covered with a black plastic sheet and left to ferment.
2) The standard compost was left uncovered and turned regularly as normal practice for aerobic compost.

After 12 weeks both composts were sampled and sent away for independent analysis and growth comparisons. There was a significant visual difference between the 2 compost treatments. With the EM treated compost looking more fully composted.

Results from Independent Growth Tests conducted by the Biological Husbandry Unit at Lincoln University were reported as follows;

Glasshouse Experiment Compost comparison (From internal report by Don Pearson, Lincoln University)

"On 23/09/03 a standard seed raising mix was made up in three batches and bulked together. This mix was made up of the following ingredients sieved through a 6mm sieve, three parts composted bark, 1 part steam sterilised soil and 1 part pumice. Samples from composts A (EM compost) and B (standard compost) passed through a 6mm sieve and added as 10% of the final blend to the respective treatments. The control treatment C contained just the blend, with no added compost."

"Composts were placed in Flight 60 cell trays. One half of each tray i.e. 30 cells, were planted with one radish seed of the cultivar 'French Breakfast' and the other 30 cells with one seed each of 'green crop' mustard. On 17/10/03 the plants were harvested. Tops only for mustard were harvested level with the potting mix. For radish, tops were abscised at the top of the hypocotyl with 'roots' being the material below this point after the removal of the fine roots. Fresh weight was recorded immediately on harvesting, as was the number of plants present (total of 12 possible). Data was analysed using ANOVA on Minitab and means separated where appropriate using Fischer's protected LSD."

Results Compost comparison Glasshouse expt.

Table 2. A comparison of EM compost; Influence of grape compost amendment on Mustard and Radish components; number, fresh weight means (plants/tray and g/plant) as a function of treatment

Compost	Number		Top fwt		Root fwt
(description)	Mustard	Radish	Mustard	Radish	Radish
A. (EM grape- compost)	9.8	11.4 ab	0.65 a	0.68 a	0.753 a
B. (Standard grape-compost)	10.2	11.6 a	0.55 b	0.54 b	0.471 b
C. (No compost)	10.8	10.4 b	0.54 b	0.65 ab	0.524 b
Significance	ns	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.1$

"The EM grape-compost produced significantly higher fresh weights for both mustard and radish than the standard grape compost in the seed raising experiments." Table 2.

Field Experiment Compost comparison

"On 3/10/04 composts A and B were applied volumetrically at rates of approximately 40 tonne per hectare to 5 plots each of approximately 0.75m^2. A third control treatment of no compost application was applied. After application the treatments were lightly cultivated. Lettuce cultivar "Triumph" was planted at 5 plants per plot and 25cm spacings to assess the effect of the treatments on yield. Lettuces were harvested on 10/12/03 and the total number surviving and total yield were measured. From this the mean weight of plants at harvest was derived. Data was analysed using ANOVA on Minitab and means separated where appropriate using Fischer's protected LSD"

Results Compost comparison Field expt.
"Compost A proved more effective than Compost B though both composts performed the same as the nil control." Table 4.

Table 4. A comparison of EM compost; Influence of grape compost soil amendment on yield characteristics of lettuce variety 'Triumph (g/plant)

Compost	Number	Mean weight
A. (EM grape- compost)	4.4	0.58 a
B. (Standard grape- compost)	4.0	0.43 b
C. (No compost)	3.8	0.49 ab
Significance	ns	$p < 0.05$

"On the whole Compost A performed the best with a clear win against Compost B and control in mustard fresh and dry weights, a win against Compost B in radish tops fresh weight, a combined win with control against Compost B in radish tops dry weight, and a win against compost B for field grown lettuces."

"Previous experiments have demonstrated the efficacy of EM Bokashi, particularly in pot trials, but not with a direct comparison with aerobic compost from the same materials. This experiment demonstrates the efficacy of the EM inoculated compost over the 'non EM' product. It is also interesting to note that there is much less loss of carbon during the EM process than the aerobic process. So, as products were applied at the same rate, the EM treated product not only increased plant growth more than the 'non EM' product but also allowed the initial residue to be spread over a larger area."
As can be seen by the above report on the compost performance, the addition of EM to the composting process produced much higher quality compost at Seresin. In addition with this technique, the speed of composting is greater, allowing quicker turnaround times and more repetitions of compost throughout the year. Because the compost is covered there is less leaching (rainfall effect removed), and the energy used to compost is less because there is no turning with machinery. Overall a much better technique than the standard composting method.

Treating Winery processing waste water

Although Seresin is using EM in its waste treatment system to improve smell and function, we have not collected any data on this process. However, at another vineyard (Canterbury Wine House), we have been using EM to control smell and improve the function without the use of chemical, and will present data from there.

The Winery had a smell problem associated with irrigating its treated and processed wastewater. The processed water is used for irrigation onto the feature gardens in front of the main reception and restaurant areas of this Vineyard. This smell problem was not good for business!

The wastewater from the winery contained a number of winemaking chemicals and sediment and residues from cleaning out ferment tanks and barrels. The process for treating this acidic wastewater, was through a biological multi-tank system with aeration in the process. Caustic soda was added to raise the pH.

Table 5. Comparison between Caustic soda and EM for pH adjustment, smell, costs, and benefits (Canterbury House Winery 2004)

The System has 6 tanks with controlled flow and aeration in tank 5		
Statistics	Caustic Soda treatment (original process)	EM treatment (new process)
pH initial of waste water (lees)	3-4	3-4
pH final of processed water for irrigation	6-8	6-7
dose	nr	50 litres per week
Cost/month	$200	$100-$150
Volume water treated	7000-9000 litres/day	

The Winery Manager at Canterbury House is extremely happy with the results to date, they have reported excellent odour control and growth improvements are evident in the gardens where the water is applied.

The outcomes from treating the waste water at Canterbury House are very positive and similar benefits can be assumed for Seresin Estate.

Summary

To summarize, EM is being used on Seresin in four main activities;

1) Soil and plant health
2) Fertilizer efficacy
3) Compost making
4) Waste water treatment

This diversity of activity of EM makes it a very unique product and important technology on this property.

EM is just one of many tools used at Seresin estate, however our research and others has shown this technology to be very effective in many areas of management in and around the vineyard, making it a valuable innovative technology.

References

Daly, M.J. 1996: Effective micro-organisms (EM) in broadacre organic vegetable production on New Zealand farms. *Proceedings 11th IFOAM Conference 1996*, Copenhagen, Denmark.

Daly, M.J. Stewart, D.P.C. 1999. Influence of “effective microorganisms” (EM) on vegetable production and carbon mineralization - A preliminary investigation. Journal of Sustainable Agriculture Vol.14 (2/3).

Daly, Mike. 2004. An Overview of EM technology in New Zealand. Proceedings of the EM European Conference 2004, held at cultural centre de Meervaart Amsterdam,18-20 September 2004 inpress.

Hussain, Tahir., Jilani, G., Haq, N.A., Anjum, S., Zia, M.H., 2000. Effect of EM application on Soil properties. Proceedings 13th International IFOAM Scientific Conference, Basel, Switzerland 2000. p267.

Higa, T. 2002. Kyusei Nature Farming and Environmental Management Through Effective microorganisms – The Past, Present and Future. In: U.R. Sangakarra, and Y.D.A. Senanayake (eds.), Proceedings of the 7th International Conference . Kyusei Nature Farming .published by APNAN; Thailand, pp56-60.

V. Robotic, R. Bosancic and M. Mojic, 2001. Control of Vine Powdery Mildew by the use of EM Preparations. www.emtech.org/data/pdf/891msvesnarobotic.pdf

Sangakkara, U.R. and Higa, T. (2000): Kyusei Nature Farming and Effective Microorganisms for enhanced sustainable production in organic systems. Proceedings 13th International IFOAM Scientific Conference, Basel, Switzerland 2000 p268.

Xu, Hui-lian. 2000. Effects of a Microbial Innoculant and Organic Fertilisers on the Growth , Photosynthesis and Yield of Sweet Corn. Journal of Crop Production Vol 3, No1(#5) 2000 pp183-214