Increasing vineyard profits and sustainability

In an era of declining resources, US-based vineyard consultant Kelly Mulville writes of his experience to develop viticulture methods that eliminate the need for mechanical or hand cultivation, mowing, tillage and suckering while simultaneously improving soil health (sequestering carbon), increasing biodiversity and reducing irrigation needs.

On-site studies of viticultural practices on four continents made it apparent that production of winegrapes, conventionally and organically, appear almost completely dependent on fossil fuel and the machinery associated with its use. The former abundance of inexpensive energy had made this approach an economic no-brainer – for a while.

With the reality of perpetually declining fossil fuels and corresponding increases in virtually every aspect of mechanised farming, the creation of a more economically viable and ecologically sustainable model of grapegrowing is imperative.

For a number of years I have been aware of the problems associated with fossil fuel-based viticulture and have experimented with a variety of design concepts, recently developing and trialling a model that increases profitability, as well as providing a more ecologically and socially sound approach to grapegrowing. Initial results from this practical trial demonstrate that it is possible to eliminate the need for mechanical or hand cultivation, mowing, tillage and suckering while simultaneously improving soil health (sequestering carbon), increasing biodiversity, and reducing irrigation needs.

Before my involvement in viticulture I was fascinated by the dramatic improvements in land health myself and other land managers were achieving by holistic management (Savory and Butterfield 1999). Primarily this was due to carefully planned grazing management of livestock.

Coming into winegrowing with this background in livestock grazing and a decent understanding of ecosystem processes, I was frustrated by the lost opportunity and what I perceived as ecological absurdity of many contemporary viticultural management practices, including various "sustainable" approaches. Nutrient and water cycles were systematically debilitated by standard tillage, cultivation, and weed control practices. The technological approach was not only costly and damaging to the environment, but it perpetuated the reliance on off-farm inputs of energy, machinery and fertility. I believed a holistic approach to viticulture using planned grazing of sheep held the best potential to move towards true sustainability.

The current scenario

Grazing sheep (and other livestock) in vineyards is not a new idea. Likely many vineyards throughout history were grazed, as some are now, each winter during the dormant season. Once vines start budding out, sheep are removed as they have a voracious fondness for grape leaves (perhaps the apparent similarity between ovine and vine or vino has etymological roots?).

This routine of winter grazing works especially well in Mediterranean climates as the wet winters encourage native vegetation, weeds or cover crops to grow under and between vine rows allowing forage for livestock to graze while the vines are dormant. Inopportunely, when temperatures warm and grape vines start to leaf out, growth rates of cover crops or weeds increase but sheep must be removed – just when their services are most needed. In winegrowing regions with summer rainfall, the ability to graze throughout the summer has been almost impossible. This is clearly a major design flaw from the perspective of using grazing as a tool. Then again, vineyards are designed for tractors not sheep.

Therefore, the key to maximising the effectiveness of sheep as a management tool in vineyards would be through creating the opportunity for grazing to occur any time of the year, most importantly during spring and early summer.

Basis for a trial

The concept behind conducting a trial was to determine if a relatively simple and inexpensive electrified deterrent system could effectively allow various breeds and sizes of sheep to graze the vineyard floor and browse vine suckers while preventing damage to the canopy and fruit. Creating such a system would open management options to take advantage of locally available stock and possible cooperative

ventures with regional sheep producers. An effective deterrent system could allow management and control of livestock to achieve beneficial levels of grazing, browsing and animal impact whenever and wherever needed.

The trial was conducted on a 0.2 hectare vineyard in the Alexander Valley, of Northern California, during the winter, spring and early summer of 2009. Once the deterrent system was in place and tested, four medium-sized adult sheep were introduced and monitored for six months - three during which the vines were leafed out. Electrified net fencing was utilised to create small paddocks within the vineyard maintaining stock density at an equivalent of 79 sheep per hectare for most of the trial period.

The system proved effective in deterring vine and fruit grazing even when sheep were deprived of food to "stress test" for effectiveness. Following are the benefits realised from this trial:

- Eliminated the need for any mechanical cultivation, tillage or mowing both between rows and under the vines as this task was accomplished through simple grazing moves. This corresponded to 4-8 fewer tractors passes per row/per year and all forage consumed was converted to fertility in the vineyard.
- Eliminated the need for hand-suckering of the vine trunks as sheep browsing performed this task. Twenty hours of labour saved per year/per acre and suckers are converted to manure.
- Sheep consumed all canopy lateral and leaf thinnings (removed by hand and placed on ground). Converted this material into manure and eliminated need for disking into soil.
- Reduced irrigation use by 90% compared to neighbouring vineyard (conventionally managed – same clones, rootstock and soil). This amounted to approximately 189 litres less water per vine used on the trial plot: 208 litres per vine on the conventional side, 19 litres per vine on the grazed side. The year of the trial (in 2009) and the previous year were both drought years.
- Reduced on-site irrigation use by 80% from the previous year (2008) during which the vineyard was managed biodynamically and organically. Sheep were grazed from January until the end of March during the non-trial year.
- Increased yield (over previous year) by 1397 kilograms/hectare.
- Based on recent tastings, wine quality from fruit harvested during the extended season grazing trial is exceptional.
- Provided on-site fertility in the form of high-quality dung and urine, eliminating the need to haul in compost or other fertilizers.
- The electrified deterrent system proved adaptable and effective in the trial vineyard VSP trellising system. With modifications

The grazed trial vineyard (A) compared with a neighbouring vineyard that is not grazed (B). Sheep performed all suckering and vineyard floor vegetation management while providing on-site fertility.

this approach would likely prove viable with other trellising methods. Training vines higher or using small sheep breeds are also options for grazing vineyards without using a deterrent system. Smaller breeds may be difficult or costly to obtain and have been known to climb on each other in order to reach foliage. The deterrent system allows vineyards to be safely grazed by numerous breeds and sizes of sheep and possibly small cattle.

- Provided a saleable, edible product that is self-replicating, powered by current solar energy and pairs well with red wine – show me a tractor that can match those features.

The potential ramifications of reducing fossil fuel-based tractors and machinery in vineyards and replacing those practices with the tool of planned grazing of livestock offers a multitude of real and potential benefits.

One of the most dramatic results was the substantial decrease in water use. Weeds and cover crops, which can require considerable mechanisation to control, become a resource to be harvested, adding value to both the animal and the soil. The ecological dynamics of the vineyard change when grazing replaces mowing and cultivation. Beneficial insects residing in the vineyard floor foliage would likely survive even high-density grazing better than the mechanical alternative. Fuel reliance, pollution and their associated economic, social and ecological costs are reduced. Soil health and the potential for improved carbon sequestration are increased without the need for hauling fertilisers from off-site.

Additionally, numerous cooperative opportunities open up between sheep producers and grapegrowers for sharing of resources, trading services and marketing. Options to develop additional income-producing enterprises, (while maintaining/improving wine quality) such as lambs, meat and wool become available from the vineyard as well.

Sheep graze in the vineyard in Medlock Ames Vineyard near Healdsburg California. *Photo: Elaine Patarini.*

Changing management to save

Getting more specific with the economic benefits is a little tricky as effectively utilising sheep in vineyards opens up many variables. Costs for installation of an electrified deterrent system are dependent upon row width, row length, trellis type, off-set support spacing, total vineyard size, and hardware preferences. The possibilities for stocking sheep on a vineyard are limited primarily by creativity, and can run the gamut from being a costly expense to a profitable venture.

For comparative purposes, let's use a hypothetical example of a 10ha, square vineyard with rows spaced 2.4m apart using a VSP trellis system. Electrified deterrent system cost would be about $US4238 per hectare (this can vary considerably depending on trellis and materials) with an expected life of 18 years. For simplicity, all costs are assumed to remain the same throughout the life of the system and interest, opportunity costs, etc., are not included (all figures are in US dollars which at the time of writing are equal to the Australian dollar). There are numerous factors that could change these numbers including stocking rate (which is directly related to forage volume, rate of growth, size of sheep, etc.), rental or purchase price of sheep, processing costs, regional price variations for lamb meat, etc.

VINE TALK

Most growers appreciate the importance of having an effective fungicide resistance management strategy. However, when it comes to herbicides, the importance of resistance management is sometimes overlooked. Given that vintage is mostly behind us it is timely to be considering your weed management strategy and as with most vineyard operations this should be an integrated approach.

I would like to present the latest information on glyphosate-resistance and sustainable glyphosate use courtesy of Dr. Chris Preston and the Glyphosate Sustainability Working Group so that the importance of adopting an Integrated Weed Management (IWM) programme is front of mind when considering your options. The first documented case of glyphosate-resistance in Australia was a population of annual ryegrass (Lolium rigidum) or ARG in Victoria in 1996. There are now 133 populations of resistant ARG across Vic, NSW, SA and WA, 33 along fence lines and 17 in vineyards. In addition, since 2007, resistance has been confirmed in populations of awnless barnyard grass (18), liverseed grass (3), windmill grass (1) and fleabane (8).

The good news is that all of these have occurred where glyphosate (Group M) has been used for 15 years or more and with little or no alternative control methods. Reducing your reliance on glyphosate and implementing effective IWM can be achieved by following these key points:

- Use herbicides with alternate modes of action including pre-emergent herbicides
- Use a double knock strategy where a glyphosate application is followed by tillage or the full label rate of SPRAY.SEED (Group L)
- Adopt physical control practices ie tillage, mowing, grazing, mulching
- Prevent any possible herbicide resistant weeds from setting seed
- Maintain low weeds numbers
- Ensure good vineyard hygiene especially considering stock and machinery
- Utilise cover crops to compete with weeds

Where herbicides are used it's important to understand what will achieve the best results possible given the product being used and the conditions in which it is being applied. Knockdowns will be more effective and require a lower rate when targeting small weeds. Remember weeds may appear small and still have an established root system if they have been cut, grazed or sprayed previously so it is best to pull some up and check. Pre-emergent herbicides work best with bare soil and the right rainfall or irrigation conditions.

Note that these IWM techniques will be more or less suitable in different vineyards and it's important to understand what will and won't work given your particular situation.

More detailed information can be found online:

Preston, C. (2010) Australian Glyphosate Resistance Register. Australian Glyphosate Sustainability Working Group. www.glyphosateresistance.org.au

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Cost savings comparisons were determined based on UC Cooperative Extension Sample Costs to Produce Organic Wine Grapes (Cabernet Sauvignon) North Coast Region (2005). Calculated savings per hectare were as follows: $112 – hand suckering, $116 – weeding, $62 – mowing/disking, $68 – fertilising, and $33 – irrigation, for a total of $391 ($966/hectare).

1. 100 sheep rented for five months at $.55/sheep/day = $8250 or $825/ha. Cost savings of $966/ha over organic practices = $150 savings/ha/year. Yearly cost of deterrent system is $237/ha. Total cost = $87/ha/year or $870 for entire vineyard.
2. 100 sheep purchased at the start of grazing season and sold for the same price at the end (or 100 sheep borrowed for duration). Cost savings of $966/ha less $237 cost of deterrent system = savings of $729ha/year or $7290 for entire vineyard.
3. 100 sheep purchased at the start of grazing season ($130 each), harvested, processed ($100) and sold direct ($15.44/kilo X 22.7 lb. carcass= $350) = $120/sheep income X 100 sheep = $12,000 total income or $1200 income/ha year. Subtracting cost of deterrent system ($237) gives a total per ha income of $963. Combined with cost savings of $966 this comes to a $1929 per ha ($19290 overall) advantage over standard organic practices.

Note that none of the above strategies involves running a breeding/lambing operation. Sheep could be on the vineyard for as little as half a year and still provide maximum benefits – eliminating the possibility of needing to find off-vineyard forage.

Establishing a breeding vineyard flock can also be a profitable option (potentially higher than the third option above) but requires a deeper level of management and possibly an off-vineyard source of forage for part of the year.

Moving forward

Ultimately, I think we are just scratching the surface of design and management possibilities available through a more holistic practice of grape farming. Research has shown that grazed grasses have much higher resistance to leaf hopper damage than the same species when it is mowed. The possibility of similar beneficial effects occurring from browsing of grapevines is worth investigating. Properly implemented grazing has been shown to be one of the most effective means of increasing soil carbon levels. (Agricultural Research Service website)

Given there is approximately eight million hectares of winegrapes throughout the world, the cumulative effect of increasing soil carbon by 1-2% over the next 10 years offers tremendous potential for carbon sequestration while simultaneously reducing farming costs – even if management changes occurred on just a portion of that total acreage.

We have entered an era of continually increasing prices and scarcity of almost every resource used in growing grapes: fossil fuel, water and fertilisers being the major elements among those. Creatively utilising current solar income through grazing animals such as sheep in a holistically-based management practice offers hope that there will still be good quality, affordable wine being sustainably produced for our kids to enjoy (when they are adults, of course).

Kelly Mulville does vineyard consulting and design work throughout North America and internationally. His focus is in creating innovative, resilient and holistically sound farming practices that achieve the triple bottom line criteria of being ecologically, economically and socially sound. In 2008 and 2009 the grazing trial discussed in this article was conducted at The Ranch on Soda Rock located near Healdsburg California. Check out Kelly's blog at: http://grazingvineyards.blogspot.com/

Reference

Holistic Management by Allan Savory with Jody Butterfield. Island Press, 1999
http://www.ars.usda.gov/research/publications/publications.htm?seq_no_115=237228