

Understanding the Undervine

Last year, OWINZ commissioned Dr Charles Merfield, director of the Future Farming Centre at Lincoln, to help us write our undervine weeding manual. He gave us more scientific background than we were able to include in the final technical manual – so we'll be excerpting choice segments in the OWINZ newsletter for our members to ponder.

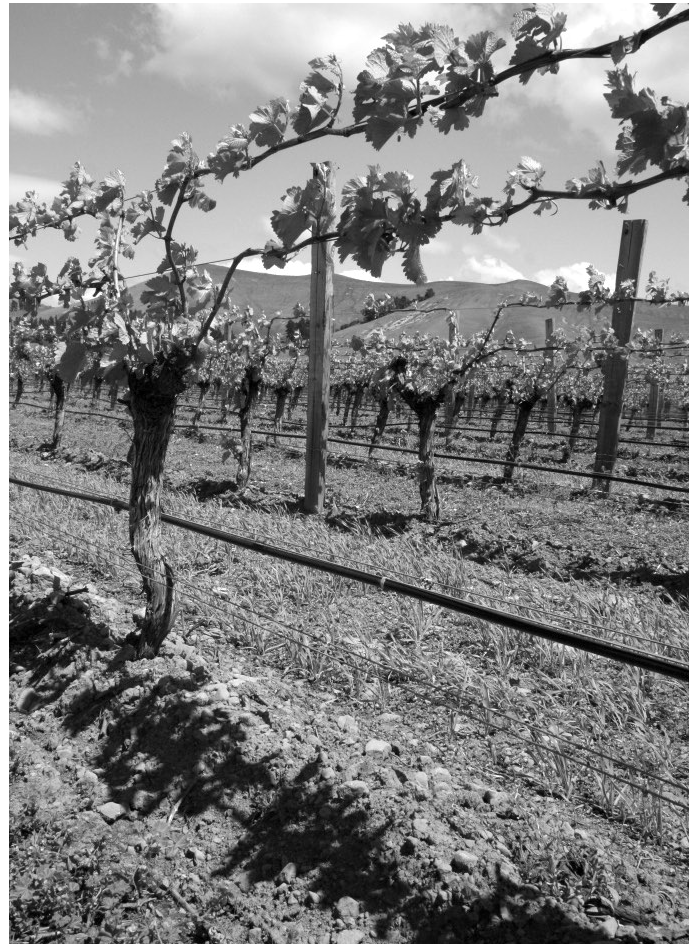
This first excerpt addresses basic questions of how we see weeds, and also resonates with the work of some of our international speakers at this year's conference, who are experimenting with undervine cover crops.

Reappraising 'just how things are done'

Within non-organic viticulture, the use of herbicides to maintain a vegetation-free undervine has become almost universal in the half a century since herbicides became widely available. This practice is not restricted to viticulture, with nearly every perennial tree, vine and bush production system adopting the practice, even extending it to a completely vegetation-free soil surface. The reason for the dominance of this approach is that all plants compete with each other for light, and soil nutrients and water. Eliminating under-crop vegetation can therefore reduce competition with the crop, with potential increases in yield, and other benefits such as reduced water and nutrient requirements.

Such was the initial success of removing vegetation from the undervine, that after generations of use, the practice became simply 'just how things are done' and it became inconceivable that things could be done another way, or that there was even another way of doing it in the past. And, to some extent, organic agriculture followed the same trend of eliminating undervine vegetation, except using non-chemical techniques, such as cultivation. However, like many initially successful novel practices, upon herbicide becoming dominant, an increasing number of problems became apparent, such as soil compaction, inactive soil biology and herbicide-resistant weeds.

In light of evolving industry aims, such as increasing



the amount of organic and biodynamic viticulture and improving the sustainability of all winegrowing, it is considered timely to reappraise the 'just how things are done' of undervine and vineyard floor management, to re-evaluate practices and re-examine the agronomy to find better and more sustainable practices and make them the new 'just how things are done.'

A weed by any other name

The advent of the herbicide era around the 1950s and the dramatic simplification and ease of weed control that they permitted resulted in an equally dramatic shift in farmer, grower and societal perceptions of weeds. Quite simply, plants that had previously been of no concern, were redefined as weeds simply because it was now possible to easily kill them. For example, clover seed was considered mandatory in lawn seed mixtures prior to the 1940s, and their quality was judged on the percentage of clover; but the advent of selective herbicides that could kill dicots

among grasses, rapidly caused the elimination of clover from lawn seed mixtures and from lawns, which was previously impossible at a practical level.

Agriculture and society are now starting another paradigm shift in attitude to weeds. The concept that any given plant species is, and will always be a weed, is evolving. The emerging view is that there are three 'classes' of plants in agri / horticultural systems:

- Crop;
- Non-crop plants;
- Weeds.

Weeds, as a class of plants, are therefore shifting from a definition of 'everything else than the crop' to a definition where they must be creating 'real and actual harm' in any given situation to be deemed a weed. The real and actual harm, therefore, has to be clearly defined – i.e. economic loss, a physical hazard or poisoning stock.

It is only under the emerging paradigm, rather than the old 'once a weed, always a weed' perspective, that plants can be a weed in one situation but a valuable resource in another. A good example of this is soursop / Bermuda buttercup (*Oxalis pes-caprae*). In Australian pastoral systems this plant is clearly a weed, as it is toxic to stock and out-competes pasture; while in vineyards, it can make for an excellent undervine living mulch, as it is winter-active and smothers out other plants, but dies back and

becomes dormant in spring, so it does not compete with vines during their active growth period. The key part of the new weed paradigm is therefore that non-crop plants, i.e., plants that are not weeds, do not need to be eliminated. Indeed, even plants that are weeds only need to be managed to the point that they no longer cause real and actual harm, rather than always being exterminated.

It must be noted that due to the biology of weeds, particularly the longevity of the weed seed bank in the soil, and the prolific reproductive abilities of annual weeds, a long-term perspective has to be taken, as a few unproblematic non-crop plants can in just two to three years become so numerous, that just by sheer numbers they do cause real problems. But, within this caveat, weeds only need to be managed and controlled to the point of eliminating harm, not eliminating all the weed plants all of the time.

Aesthetics: the right 'look'

A less commonly discussed aspect of the traditional herbicided undervine is how it has become accepted as the 'right' way for a vineyard to look. This is not restricted to viticulture; many other agri/horticultural sectors also have broadly accepted views on things such as herbicide strips under fencelines and along roadway edges. Often under organic and non-chemical weed management, it is neither practical or desirable to achieve the same



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'manicured' look to a vineyard. This somewhat more 'rugged' look can cause consternation both for vineyard managers and also colleagues viewing the vineyard.

Vineyard aesthetics are clearly a matter of taste. What is tasteful now, however, has not always been that way. Going back in time, the current bare earth and mown mid-row would have been considered rather sterile, compared to what had gone before. What is now increasingly clear is that aesthetics needs to take a backseat to sustainability issues such as soil protection and biodiversity, such that achieving the traditional manicured vineyard look ought to become an increasing sign of a badly –not a well managed – vineyard. So, for example, having a few weeds around vines and posts and a longer mid-row sward, as long as it is not negatively effecting production, should not be considered a sign of failure, rather a sign of success.

Roots

Vine roots respond and can adapt to vineyard soil conditions. As described above, compaction can prevent them accessing the mid-row. Where undervine cultivation is used, this can result in the vines 'moving' their feeder roots below the depth of cultivation, while the opposite can occur when biological / organic surface mulches are used where the feeder roots will grow into the mulch. The upper extent of this adaptability is not well established, but, within woody perennials the flexibility can be

considerable, for example in agroforestry systems the trees can 'move' their roots downwards by a meter below the root zone of the annual crops grown between them.

That vines (and other perennial woody crops) have shallow feeder roots is why, despite their size they can suffer significant competition from comparatively tiny annual and particularly grass weeds. A classic example of this was demonstrated in a high cane blueberry crop (high cane = 1.5 m tall plants) infested either with Californian thistle (*Cirsium arvense*) and couch / twitch grass (*Elymus repens*): despite the thistle growing up through the bushes and competing for light, it had no effect on the crop, and conversely, while the grass was well overtopped by the bushes, it caused a 20% reduction in height and an even bigger yield loss. This was because the root system of Californian thistle grows at depth, typically 20 cm or more, and only sends shoots up through the berry feeder roots without competing with them, while the grass, with its highly competitive and shallow fibrous feeder roots competed very strongly with the blueberries, causing the large growth and yield reductions.

This illustrates the potential for undervine cover crops that have root systems that do not compete with the vine roots and therefore provide all the benefits of cover crops (e.g., soil protection, weed suppression) without reducing vine productivity. However, hardly any research has been done in this area, so little rigorous data exists.

Mycorrhizal fungi and cultivation

There is often considerable interest in mycorrhizal fungi among organic producers and researchers, going all the way back to the beginnings of organic agriculture with Sir Albert Howard writing about the newly discovered symbiosis back in the 1920s. Mycorrhizal science has expanded dramatically since then. However, there is still much to be learnt, as researching these fungi is often difficult, as they refuse to grow in culture, with many only growing on their hosts, and studying soil biology is also exceptionally difficult.

From what is known, it is clear that mycorrhizal fungi can have a profound effect on plant growth and pest and disease protection, but it is equally clear that the effects can become insignificant, especially in agri/horticultural systems where soil properties are manipulated for the benefit of the crop plant. For grapes it is clear that mycorrhizae are important for both nutrient uptake and suppression of some diseases.

Fortunately, encouraging mycorrhizae is pretty simple, as a range of other plants share mycorrhizae with grapes, so simply having a range of other species in the vineyard floor, and not necessarily the undervine,

will ensure an association – or to put it another way, it is pretty hard to stop vines establishing a mycorrhizal association. The main way to reduce associations is to over-fertilise, especially with nitrogen and phosphorus, as easy availability of these nutrients makes it less economic for plants in general to support mycorrhizae, so they will expel them and then take up such nutrients directly. Therefore mycorrhizal associations tend to be strongest on lower fertility soils.

The second most effective way of reducing mycorrhizae is cultivation, as this breaks up the fine hyphae, so if you are wanting to maximise mycorrhizae, then avoiding soil disturbance is key, e.g. mow cover crops instead of cultivating them in. Having said that, the hyphae re-establish pretty quickly, and unless you are cultivating on a very frequent basis, and cultivating the entire vineyard floor, the impacts are unlikely to be large. Even then, the direct effects of cultivation on vine roots is likely to have a much larger effect; if, with regular cultivation, the vine's feeder roots 'move' down the soil profile, then the mycorrhizae fungi will simply follow them down, and avoid the cultivation zone.

– Charles Merfield