



What is the future of the herbicide strip?

The ubiquitous herbicide strip is facing increasing challenges. Foremost in most growers' minds is the banning of individual herbicides, particularly glyphosate. At the end of last year (2023) the European Union (EU) reapproved glyphosate until December 2033. Had the EU not reapproved it then there would have been a cascade effect where growers supplying the EU would not be allowed to use it either. Despite dodging a bullet on glyphosate, older herbicides continue to be banned. However, herbicide resistance is probably a much bigger risk.

Charles Merfield

Due to a five-year Ministry of Business, Innovation & Employment (MBIE) funded project on herbicide resistance the number of known resistant weeds in New Zealand has increased massively, with over 30 species resistant to herbicides from eight different modes of action.

On arable farms over 40 percent were found with cases of resistance, and on vineyards nationally one-third have glyphosate resistant ryegrass, and in Marlborough it's over 50 percent. Herbicide resistance is therefore widespread

in New Zealand, so while sectors such as pipfruit and stonefruit have not been assessed, if they were, it is highly likely that resistance would be found to be widespread.

And don't think new herbicide chemistry is coming to the rescue. The last mode of action discovered was the ALS (acetolactate synthase) inhibiting herbicides in 1983. Forty years ago! The problem is now both the cost (getting a new pesticide of any kind to market is going to set you back over a billion dollars), and finding a chemical that is both effective and safe, which is pretty much incompatible.



Electrical weed management (EWM) seems to be living up to its theoretical potential to be a partial replacement for glyphosate. Photo courtesy of Zasso Group AG

The likelihood of new modes of action coming to market, especially in New Zealand with our very small market and drawn-out regulatory approval process, is as close to zero as you can get.

The only option is to redesign the orchard or vineyard system to become hostile to herbicide resistant weeds. This requires a whole system approach, which was how farming was done prior to the development of pesticides. Pesticides and mineral fertilisers allowed us to compartmentalise and simplify production systems. Weed management could be conducted separately from pest management and nutrient management for example. With fungicides and insecticides facing the same difficulties as herbicides with resistance and limited new chemistry, plus the increasing external challenges such as extreme weather, labour shortages and so on, there is a need to rethink production systems for multiple reasons. And the name for that redesign is 'agroecology', the science and practice of sustainable food systems.

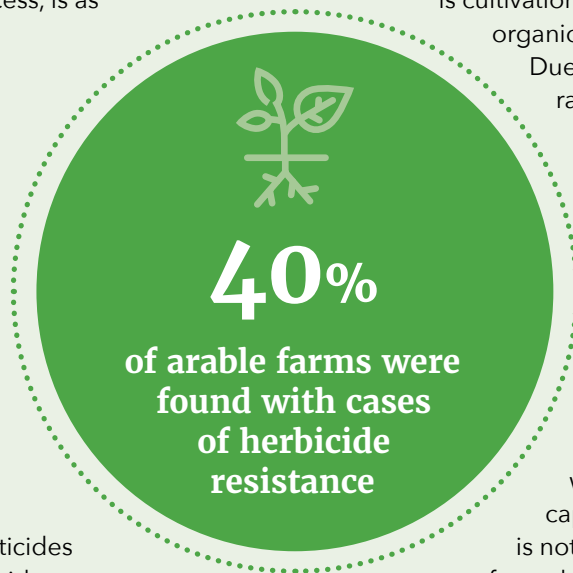
The first step is to remember the primary purpose of the herbicide strip: to reduce competition from other plants, principally grasses, to increase yield. Prior to herbicides

most orchards and vineyards had complete pasture cover – and were often grazed. The first alternative to herbicides is cultivation – as has been developed in organic systems over the last half century.

Due to organics there is now a vast range of types and manufacturers of mechanical weeding systems. However, mechanical weeding is almost certainly worse than herbicides from nearly all angles.

Herbicides create a hard, capped soil, while mechanical weeding loosens the soil, making it at high risk of washing away in the next big rain event, or even just blowing away in the wind. Considering soil is the primary capital asset of a grower, loosening it is not only careless, it is the foundation of your business being lost forever. That says nothing about the damage to waterways and other environments receiving the soil.

Then there is soil health. A healthy soil will grow much better crops. But both herbicide and cultivation strips are literally killing soil life and health. There has been a massive revolution in our understanding of soil biology, the formation of organic matter and the drivers of soil health. It is not organic inputs to the soil such as leaf litter and compost that drive soil health, it is exudates of simple





There has been a massive revolution in our understanding of soil biology and the impact of both chemical and mechanical weed management

organic compounds like sugars from living plant roots that directly feed soil microbes and create around 80 percent of the organic matter, and thus drive soil health. The greatest damage done by both chemical and mechanical weed management is that they reduce the diversity and biomass of plants, i.e., their core objective causes the most harm. This is why the soil in the herbicide strip is so hard compared to the pasture in the alleyway – it is dying due to a lack of plant root exudates.

The agroecological answer is intercropping – the science and practice of growing multiple plant species together for many beneficial outcomes – beneficial both to the business environment and wider environment. In the case of perennial crops the main intercropping approach is ‘living mulches’. These are service crops (i.e., non-cash crops) grown where the herbicide or cultivation strip would be. These crops suppress ‘true weeds’ (i.e., plants that cause harm), while providing other benefits such as protecting the soil from wind, rain and sun, and producing root exudates to feed soil biology. They also increase both soil and above-ground biodiversity, the loss of which is a far greater risk to humanity than the climate crisis. They can boost beneficial insects that attack crop pests, and improve pollination. Leguminous living mulch will fix atmospheric nitrogen, reducing the need for nitrogen fertilisers. A great example of this is the A Lighter Touch ‘Biodiverse planting in perennial crops’ project where 20 species of service crops were planted across the floor of citrus orchards.

The big challenge with intercropping is finding plants that will play nicely together. Unfortunately due to the dominance of herbicides for the last 80 years, both scientific and practical experience is limited. The above-ground interactions of plants, e.g. for light, their below-ground competition for nutrients and water and the chemical communications (allelopathy) among plants and also with other soil organisms is really complex and very poorly researched and understood. Intercropping compatibility is also likely to be affected by factors such as soil texture, climate, production objectives etc. Individual growers undertaking their own on vineyard or orchard trials is therefore going to be the main way forward.

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The high voltage (5000-15,000 V) heats the water in weeds to boiling point so they explode from the inside out. Photo courtesy of Zasso Group AG

Another issue with living mulches is that the plant community will change over time. A clover living mulch will be invaded by grasses, which with their fine, shallow, fibrous root systems are highly competitive with the shallow feeder roots of woody crops. This is where mainstream growers have a big advantage over organic - they have the herbicide toolbox, so could use a grass selective herbicide every few years to clear the grasses out. And mechanical weeders could be used to do a more aggressive reset. So while intercropping is the ideal to aim for, don't be too precious, if you need to kill off the living mulch for a particular reason then the sky ain't going to fall on your head if you kill it off for a few months. What is really bad is continuous bare earth, this simply has to stop.

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EWM uses high voltage (5000-15,000 V) to heat the water in weeds to boiling point so they explode from the inside out

One thing that is becoming increasingly popular is growing annual cover crops (a form of service crop) such as ryecorn and vetch in the alleyways, instead of pasture, with the

aim of improving soil health. Unfortunately this is totally the wrong thing to do. This is because of the soil organic matter cycle. Annual cover crops don't produce anywhere near as much root exudates as perennial pasture plants. So while a cover crop may produce a lot of above ground biomass, it feeds soil biology poorly and when turned into soil organic matter it decomposes in a few years, compared with the organic matter from exudates lasting centuries to millennia. By far the best thing in the alleyways is a diverse pasture, ideally eight or more species of grasses, legumes and forbs. And leaving the mower in the shed. We are a very tidy bunch of Kiwis when it comes to mowing the orchard or vineyard. This neat and tidy look is incompatible with a safe future. The pasture needs to be left as long as possible to get the most benefit from it, e.g., soil health and biocontrol. And not mowing all the time is the easiest way to save money, increase profit and reduce your carbon accounting costs. Just stop it!

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The agroecological answer is intercropping - the science and practice of growing multiple plant species together



Another newish tool is electrical weed management (EWM). First patented at the end of the 1800s, over two centuries later commercial machines have finally been produced. EWM uses high voltage (5000-15,000 V) to heat the water in weeds to boiling point so they explode from the inside out, which is very satisfying. Even more satisfying is that the electricity is applied to the foliage but returns via the roots, traversing the hypocotyl, which means that in many plants it has a systemic kill. Just like glyphosate... With independent research now being done, it looks like EWM is living up to its theoretical potential to be a partial replacement for glyphosate. This is with potentially lower lifecycle energy use than herbicides. It is however, still a cutting-edge technology so its full potential and costs and benefits are still being worked out. There are five companies globally selling electrical weeders: zasso.com, rootwave.com, theweedzapper.com and crop.zone. Both Zasso and RootWave have perennial crop weeders, and it would be hugely valuable to get their machines into New Zealand so they can be put through their paces and checked out. The Australians have already done this for a Zasso weeder so we need to keep up with the neighbours!

In summary, the herbicide/cultivation strip is dead (double meaning intended). The future is agroecology using intercropped living mulches. New tools such as electrical weeding will further facilitate the phase-out of herbicides. Organics proves it is entirely possible to farm without herbicides. A future without herbicides in perennial crops is therefore entirely achievable. At that point lack of new chemistry and herbicide resistance will be a non-issue. ●

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