Alternative weed control measures for vineyards

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Key messages

- A combination of chemical, mechanical, biological and cultural practices could provide more effective long-term weed control than continually using only one method
- The timing of any spray application in relation to plant life cycle, air temperature and humidity is critical to achieving the best results
- A cover crop in the midrow or undervine area can help suppress weeds
- Strategic tillage will suppress weed germination
- Monitor weed populations and prevent weeds from setting seed
- Use label rates and rotate between herbicide groups to reduce resistance developing in weed populations.

Introduction

Managing undervine weeds is an intensive ongoing task and the ease of using glyphosate products is fast becoming a tool that may become obsolete in conventional vineyards. Additionally, if your vineyard is certified organic, you need to consider non-chemical options available to effectively control weeds.

With these limitations in mind, the Greater NSW/ACT regional program (funded by Wine Australia) facilitated three demonstration trials to be established in Mudgee, Orange and Hilltops during 2018–19 to evaluate alternative weed control measures in undervine areas of both conventional (Hilltops) and organic vineyards (Orange and Mudgee) compared to current practices at each site.

Methods

Commencing at budburst in early spring, the following treatments were applied within adjacent rows and along single rows within the same panel areas across each site:

1. **Flame**: applied using a handheld Butane gas weed wand until leaves, stems and crown structures were completely burnt off (Orange site only due to fire restrictions).
2. **Steam**: applied using an SW2800 unit with water set at 120 °C and 20 psi pressure, travelling at 1 km/h with a 30 L/min water output rate using 17 L/h of diesel. Hilltops received two steam treatments, one in November and another 4 weeks later in December, whereas Orange and Mudgee received 3 treatments 4 weeks apart in early October, November and December at the aforementioned rates.
3. Active constituent 790 g/L **acetic acid** (Contact Organics FarmSafe™) applied at a 1:20 ratio of formulation or 50 mL/L and Organics FarmSafe™ Boost at a 1:40 ratio or 25 mL/L with a water rate of 600 L/ha to run-off for complete coverage.
4. Active constituent 224 g/L **sodium chloride** (Nontox®) applied as a pre-mixed solution at a water rate of 600 L/ha to run-off for complete coverage.
5. Active constituent 680 g/L **pine oil** (Bioweed™) applied at a rate of 100 mL/L in a water rate of 600 L/ha to run-off for complete coverage.
6. Active constituent 525 g/L **nonanoic acid** (Slasher®) applied at a rate of 70 mL/L with a water rate of 900 L/ha to run-off for complete coverage.
7. **Recycled mulch** (Australian Native Landscapes AS4454-2012) applied as an 80/20 blend of coarse mulch and compost at a rate of 153 m^3/ha (banded 60 cm width x 7.5 cm depth undervine). The mulch was applied to previously cultivated soil in Orange, and pre-sprayed (with Slasher®) grass surfaces in Mudgee. At Hilltops, the mulch was applied to both pre-sprayed (see Hilltops current practice below) and non-sprayed areas.
8. **Straw**: applied as banded 60 cm widths x ~5–7 cm depth undervine (applied at Hilltops site only on both pre-sprayed and non-sprayed areas).

All sprays were applied using a 60 psi pressurised 15 L backpack with a solid cone nozzle set to coarse.

Weed populations and diversity varied at each site, but all included selections of annual and perennial grasses and broadleaf weed species. The most problematic weeds at Orange and Mudgee were grass species including paspalum (*Paspalum dilatatum*), perennial ryegrass (*Lolium perenne*), ribwort plantain (*Plantago lanceolate*), Scotch thistle (*Onopordum acanthium*) and couch (*Cynodon dactylon*) whereas at Hilltops, wild oats (*Avena fatua*), mallow (*Malva neglecta*) and Paterson's curse (*Echium plantagineum*) were dominant.

Current weed control practices at each site were as follows:

Mudgee: grazing sheep between harvest and budburst with midrow slashing when required. No specific undervine practices throughout the growing season, with weed management relying on high temperatures and dry conditions to suppress weed growth during summer.

Orange: grazing sheep between harvest and budburst with undervine cultivation around budburst to allow ryegrass to outcompete broadleaf weeds and grow toward cordon height. A second cultivation occurred at flowering to provide a cover of decaying material to suppress weeds during summer. Herbicide (Slasher®) was used to spot spray blackberries undervines where necessary.

Hilltops: undervine herbicide spraying in early October with a mixture of 570 g/L glyphosate (Roundup ULTRA® MAX) at 1.9 L/ha plus 45 mL of 400 g/L carfentrazone-ethyl (Hammer®) and 350 g/L soyal phospholipids, 350 g/L propionic acid (SP700 surfactant) at 1 L/ha in 200 L/ha water rate. This was applied again on 1 January, with the addition of 500 g of ammonium sulphate. This combination is used to attain superior weed kill, less drift, and pH buffering under adverse environmental conditions.

The effectiveness of treatments against the current practice at each site can be observed in the normalised difference vegetation index (NDVI) scores recorded in January 2019. NDVI was measured using GreenSeeker™ technology to determine the amount of living or dead vegetative matter.

Soils were collected at a 10 cm depth from the Orange and Hilltops sites before and after treatments to determine if any of the applied treatments changed soil parameters.

Results and discussion

Due to fire restrictions and drought conditions, the flame treatment could only be applied at Orange. While this method does offer some control, it can be problematic and might not be a practical option.

All non-selective contact desiccant sprays (treatments 3, 4, 5 and 6) affected broadleaf weeds within hours of spraying (Figure 55), although a delayed response occurred with grass species (Figure 56). Within seven days, the desiccant sprayed areas looked like a typical herbicide treated bare undervine area (Figure 57). However, weed control was short-lived, with weeds re-emerging through decayed material and new weeds growing on bare soil in all desiccant treatments.

Figure 55. Broadleaf weeds within one hour of treatment.

As desiccant labels suggest, they are designed to control young broadleaf weeds and suppress established and perennial weed populations, therefore the timing of applications is paramount. This was evident at the Orange site where a single desiccant spray later in spring (November) was more effective than two separate applications in early spring (October). This suggests that environmental conditions such as increased temperature and rainfall might have influenced weed control with the later spray.

Steam treatments resulted in minimal visual effects directly after application, but provided good weed suppression at the Orange and Hilltops sites (Figure 58) where weed management previously involved cultivation or spraying. However, this technology requires further work to suit vineyard operations if the undervine area is not clean initially. While steam is effective, the labour costs to cover large areas may render this application prohibitive as it took 3.5 hours using 5,940 L water and 56.1 L of diesel to cover one hectare.

Figure 56. Grass species showed a delayed response to desiccant sprays and complete clump kill was difficult to achieve with one application at the label rate.

Figure 57. One week after spraying with acetic acid showing a complete kill of undervine weeds.

Mulch was one of the better performing treatments at Orange, with NDVI suggesting reduced vegetation regrowing after treatment (Figure 59). Applying straw, both sprayed and unsprayed, resulted in the lowest NDVI scores at Hilltops (Figure 60). None of the treatments seemed to be effective at Mudgee (Figure 61), with all treatments scoring slightly higher NDVI readings than current practice, despite the visual effects in the weeks after treatment.

The costs involved with some of these treatments could mean that using alternative methods to manage weeds might not be economically viable (Table 13), therefore the efficacy of each treatment and its duration must be considered. A combination of chemical, mechanical, biological and cultural practices might be more effective in the long term, rather than the continual use of only one method to control weeds.

Various soil chemistry parameters were influenced by the treatments (Table 14). Applying pine oil changed the soil from alkaline to acidic, while applying mulch increased calcium and potassium.

Figure 58. Steam treated undervine area at Hilltops, highlighting the treatment zone with weeds growing outside the edge of the treatment toward the midrow.

Table 13. Cost of products when applied at label rates used in the trial.

Input	Input cost	Cost/ha (input only)
224 g/L sodium chloride (Nontox®)	$240/20 L	$238
525 g/L nonanoic acid (Slasher®)	$286/20 L	$298
680 g/L pine oil (Bioweed™)	$330/15 L	$436
790 g/L acetic acid (Contact Organics™)	$220/20 L	$163
Flame	$15.95	$579
Mulch	$33/m³ delivered	$5,049 (~$1,683/ha/yr)
Steam SW2800	$39,600/unit	~$87.00 water and diesel
Straw	$70/4 x 4 round bale delivered	$3,500 (~$1,166/ha/yr)

Table 14. Soil chemistry parameters with different treatments to manage weeds.

Site	Analysis	Units	Treatment	Before treatment	After treatment
Orange	Sodium (Na)	(mg/kg)	Sodium chloride	11.2 very low	220 high
	pH ($CaCl_2$)	pH unit	Pine oil	7.54 slightly alkaline	6.2 slightly acid
	Potassium (K)	(mg/kg)	Mulch	299	538
	Calcium (Ca)	(mg/kg)	Mulch	2,480	6,230
	eCEC	(cmol(+)/kg)	Mulch	14.5 moderate	34.3 high
Young	Sodium (Na)	(mg/kg)	Straw	30.4 very low	298 high
	Sodium (Na)	(mg/kg)	Nonanoic acid	30.4 very low	269 high
	pH ($CaCl_2$)	pH unit	Nonanoic acid	7.15 neutral	6.44 slight acidity
	Potassium (K)	(mg/kg)	Mulch	187	560
	Potassium (K)	(mg/kg)	Straw	187	566
	Sulfur (S)	(mg/kg)	Straw	7.8	65

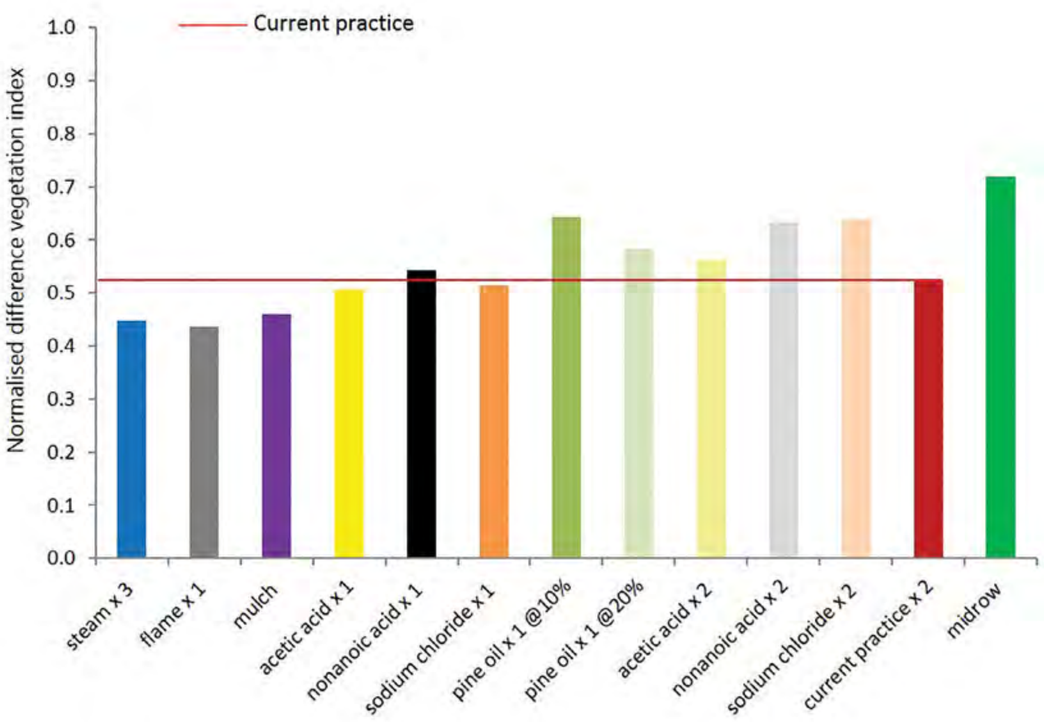

Figure 59. NDVI differences at the Orange site on 10 January 2019.

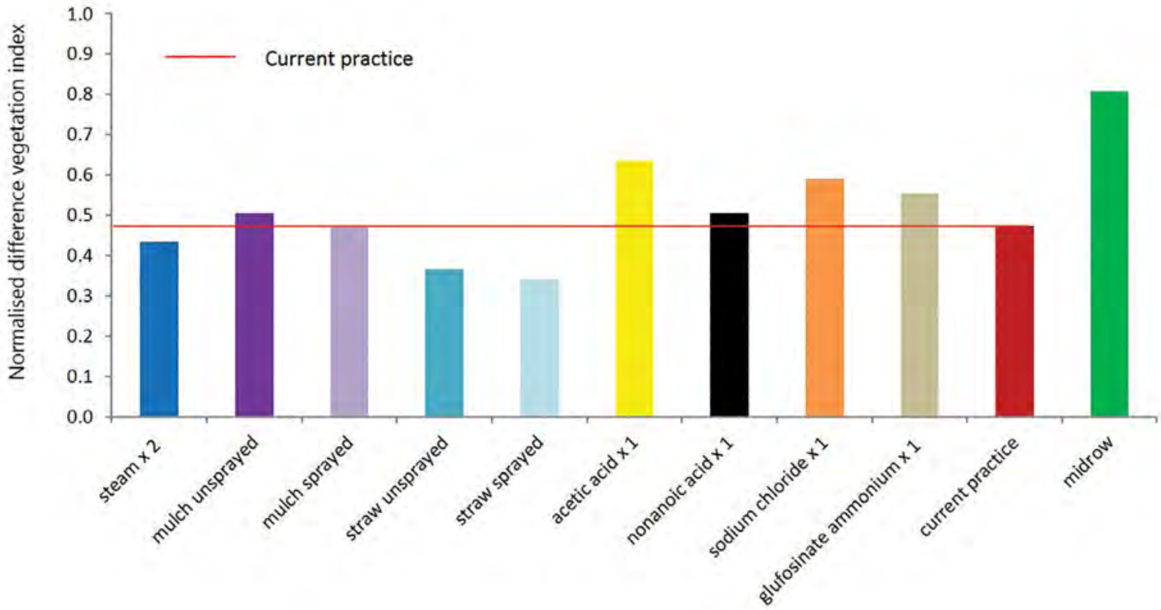

Figure 60. NDVI differences at the Hilltops site on 17 January 2019.

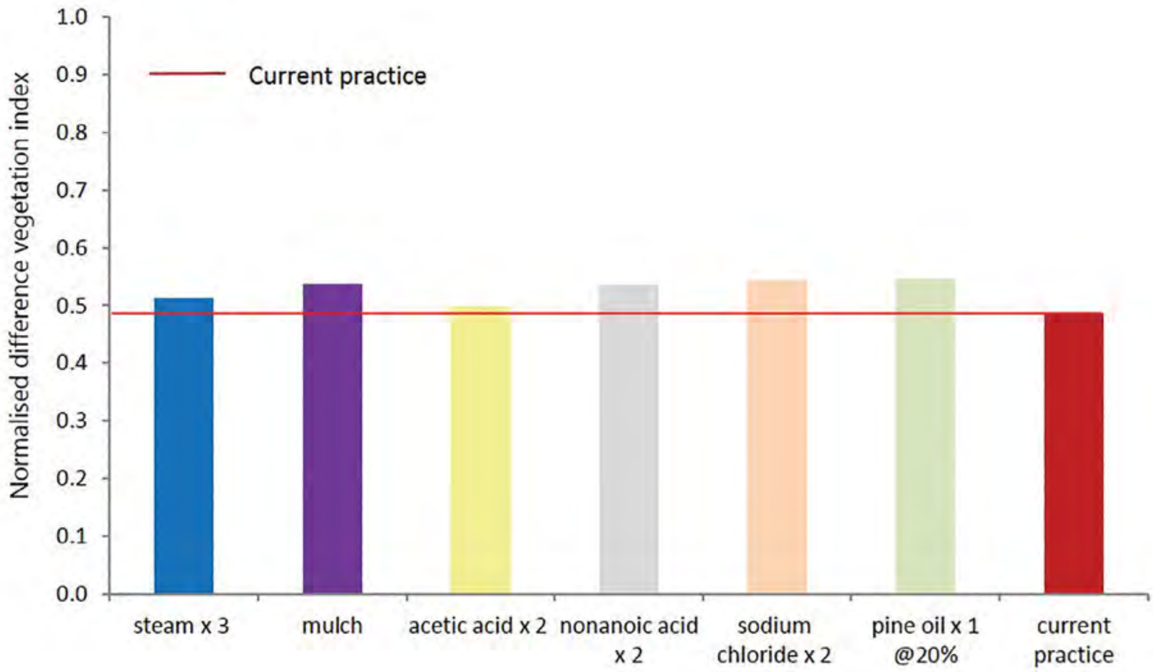

Figure 61. NDVI differences at the Mudgee site on 14 January 2019.

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Further information

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