Cover crops and weed suppression

Mr Chris Penold and Dr Cassandra Collins
The University of Adelaide

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Introduction

One of the primary reasons for growing cover crops in vineyards is for weed suppression. The correct species of cover crop growing in a suitable environment can be very effective at out-competing other plants. However, before an appropriate cover crop can be selected, it is necessary to determine what is a weed in the vineyard. A weed can be defined as 'a plant growing out of place' or 'a plant whose value has not yet been discovered' or, in the production context, 'any plant that has an adverse impact on the crop yield and/or quality'.

What is a weed?

A classic example of problems in defining a weed is soursob (*Oxalis pes-caprae*), a plant introduced from South Africa which has now naturalised throughout the cropping zone of South Australia. It emerges in autumn from bulbs that may be up to 600 mm deep, with up to 3000 plants/m^2, providing strong competition for other plants. In spring, it senesces with the onset of warm weather, without the need for herbicides or mechanical control. Is this a weed in the vineyard? It does not compete with the vine for moisture or nutrients, as it grows when the vine is dormant and it competes with other less desirable plants. It was brought to Australia as an ornamental plant, so it also looks attractive. However, aside from providing soil cover and amenity over winter, it does little to improve soil properties and, due to its lack of lignified tissue, provides no soil cover over the spring–autumn period. It is therefore a weed when trying to replace it with another cover crop. However, many growers now recognise its value and are making use of the plant's virtues in the vine row while continuing to grow cover crops in the mid-row (Figure 1).

Figure 1: Soursob growing undervine during winter suppresses the growth of other plants. (Photo courtesy Joch Bosworth)

Many situations exist where the resident plant species may be deemed to be either weeds or desirable soil cover, depending on the perception of the individual. For example, in the Riverland of South Australia, turnip weed (*Brassica tournefortii*) grows very well from the soil seed bank and competes successfully with many other species. Recognising the benefits of this plant as a provider of soil cover allows it to play a valuable role in the vineyard, and rolling in spring keeps it looking neat over the summer/autumn period while maintaining mulch on the soil surface.

Another example comes from a large vineyard in the Murray Valley, where the resident vegetation mix of saltbushes and native grasses was maintained as soil cover. Aside from performing this important role, its capacity to provide habitat for beneficial insects also negated the need for light brown apple moth control in years of outbreaks (P Sells 2005, pers. comm.).

Suppressing weeds with cover crops

Where weed suppression through competition from a sown cover crop is required, cereal crops work very well. At a Riverland site where turnip weed was the principal concern, cereals were much more effective in restricting its growth than both grain and pasture legumes (Figure 3). Field trials investigating non-chemical weed control strategies, conducted from 2001 to 2003, found that cereals competed strongly during winter/early spring until they were terminated. Barley was particularly effective in reducing the growth of wireweed (*Polygonum aviculare*), and this effect persisted through into the summer months. It is likely that this impact on wireweed could be partly attributed to the allelochemicals it contains (Kremer & Ben-Hammouda 2009).

Figure 2: A healthy, vigorous barley cover crop will compete strongly with most weed species.

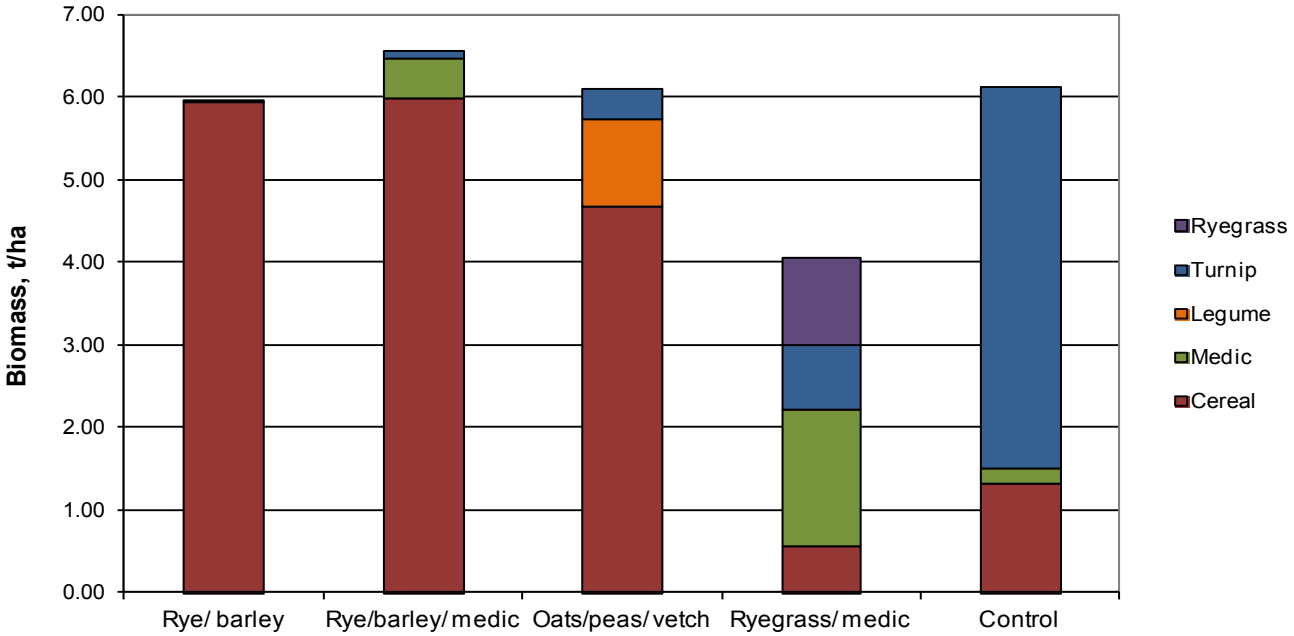

Figure 3: A mix of cereal rye and barley effectively suppressed turnip in this trial at Kingston-on-Murray, South Australia, 2001.

Many weed species common to the Australian winegrowing regions are also found in South Africa. Johan Fourie (Fourie *et al*. 2006) found oats to be more effective than rye and faba beans in providing competition, a result that supports the findings shown in Figure 3.

Richard Porter (1999) conducted trials throughout southeastern Australia to determine the suitability of a wide range of plant species to vineyard cover cropping. In a trial at Langhorne Creek, fodder radish displayed superior weed (capeweed and soursob) suppression compared with ryecorn, faba beans and especially medics. Another trial at Yenda in the Murrumbidgee Irrigation Area investigated the summer weed control capacity of cover crops. A range of annuals (oats, oilseed mustard, faba bean, sub clover and medics) and perennials (white clover, ryegrass and cocksfoot) were mown in spring and assessed for their capacity to suppress summer weed (wireweed; common sowthistle, *Sonchus oleraceus*; pigweed, *Portulaca oleracea*; and fleabane, *Conyza* spp.) populations in January. By providing competition for moisture, the perennial ryegrass was very effective in suppressing weeds, the cocksfoot less so, while the white clover was very ineffective. The annuals, with a maximum dry matter residue in January of only 2300 kg/ha, had not produced enough biomass to generate mulch. Mowing rather than rolling the cover crops would have enhanced the rate of breakdown of the residue, further negating its mulching value. To provide an effective mulch over the spring/summer period, it is necessary to generate in the vicinity of 5 tonne/ha of annual ryegrass or 8 tonne/ha of vetch (Porter 1999). Such yields are more readily achieved with a mix of legumes and grasses (Teasdale 2003), which also generates a mulch that is more effective at excluding light from the soil surface, thus removing this stimulus for germination, which is required by some weed species (Teasdale 2003).

In their first year, annual and perennial grasses and annual legumes (medics and clovers or beans and peas) compete poorly with most weeds. However, with regenerating annuals such as sub clovers and medics, or grasses that are allowed to set seed in their first year, the increased plant population in following years can provide considerable competition to emerging weeds (Porter 1998).

The growth of perennial grass and ground cover species can also be a very useful non-chemical weed management tool where they are used as living mulches (Teasdale 2003). Perennial native grass species such as wallaby grass (*Danthonia* spp.) have also shown strong competitiveness against wireweed and caltrop (*Tribulus terrestris*). Figure 4 shows the difference in dry matter production between an area where wireweed was growing on bare soil and one where wallaby grass was growing, which completely prevented the growth of wireweed during spring and summer. Also an effective weed suppressant, which is best suited to the dry inland vineyards, is prostrate or creeping saltbush (*Atriplex semibacatta*). In a trial at Loxton in the South Australian Riverland, growth of the saltbush overwhelmed caltrop, as shown by the dry matter production of caltrop with and without saltbush (Figure 5).

Buckwheat is another summer-active species traditionally used for weed suppression. It is now also recognised for its provision of food sources to beneficial invertebrates during the summer period (Barnes et al. 2008; Gurr et al. 2004; Jacometti et al. 2007), but the environments to which it is suited are limited to cool climates with soils of good water-holding capacity.

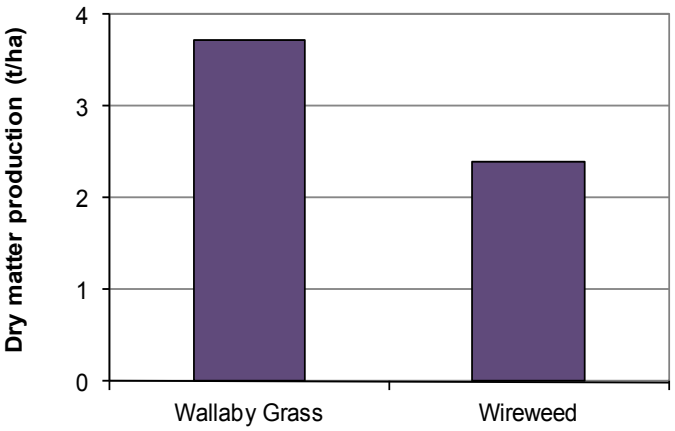

Figure 4: Wallaby grass in a dry-grown vineyard in the Coonawarra region of South Australia suppressed wireweed growth completely, while wireweed with no wallaby grass (right-hand column of graph) grew without competition.

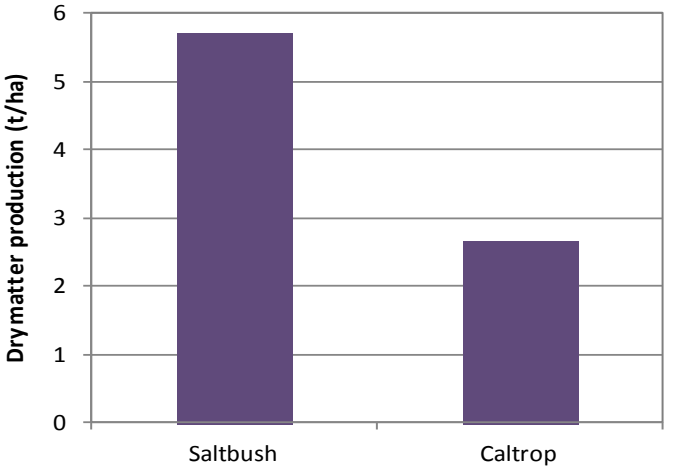

Figure 5: At a Loxton, South Australia, trial site, saltbush completely excluded nearly 3 tonne/ha of caltrop, which grew in the absence of saltbush.

Sheep grazing

Until recently, sheep and vineyards have seemed incompatible, whether due to the damage sheep might do to the vines, soil or irrigation infrastructure, or to the additional management that they require. While none of these issues have changed, the recognition that sheep can be very useful tools in containing growth on the vineyard floor over the winter/early spring period has reignited interest in their value (Madge 2010).

Vineyards with adjacent grazing land have the opportunity to move sheep onto the vineyard over the winter/early spring period. This can be either as a low-input weed management tool or, if serious productivity is required, pastures can be sown in the mid-rows and grazed strategically, with the sheep removed at budburst. In some cases, they may be reintroduced as a labour-saving leaf plucking and sucker removal system, as occurs in New Zealand vineyards.

A report commissioned in New Zealand by Merino Inc. (Jermyn 2009) found there were nett benefits to both the farmer and the viticulturist of grazing sheep over the winter

Figure 6: Sheep grazing over the winter period is now recognised as an inexpensive non-chemical weed control practice.

period. Benefits to the vineyard were reduced compaction generated through tractor traffic for mowing, and a subsequent reduction in the carbon footprint, although this is yet to be quantified. While some damage to infrastructure is possible, this is seen as being manageable. Growers favour using merinos, as they tend to be less destructive than the British breeds, and have greater respect for fences. Some producers are favouring miniature Southdown (Babydoll) sheep, which, due to their small stature, may be left in the vineyard all year without damage to the vine. Another option that has been developed recently uses electrified 'hot' wires as outriggers at cordon height; these are very effective in deterring sheep from accessing the vine canopy, while still allowing them to maintain the vineyard floor and water shoots (Mulville 2012).

In financial terms, vineyard grazing is deemed to save both sheep farmer and vineyard owner about $100–150/ha, creating useful synergies between the two groups of primary producers (Jermyn 2009). There are, however, concerns from food standards authorities that sheep export markets may be jeopardised if any non-compliant pesticides on the vine leaves are ingested by sheep (New Zealand Food Safety Authority 2010). Interim guidelines have been produced to ensure that no sheep enter the food chain with detectable levels of unacceptable chemicals in their tissues.

Management for weed control

As highlighted earlier, cover crops can be used to reduce the populations of most weed species in the vineyard, but some species (e.g. couch grass) will defy such efforts, making intervention with more dramatic measures necessary.

To use cover crops for weed suppression, it is necessary to:

- select a competitive species known to grow well in the required environment
- plant into soil that is free of actively growing weeds

- where possible, direct-drill seed into the soil. This will prevent the disturbance of the seed bank and reduce the severity of another flush of weed germination
- be aware of the cover crop's nutritional requirements for healthy growth, and compare these with the soil nutrient status. Where cover crops have been grown in the past and fertilised at the time of sowing, adequate nutrients for healthy cover crop growth will probably still be available. If not, apply fertiliser to the drill row with the seed so that weeds between the rows are not also receiving fertiliser
- following germination, monitor growth
- prevent weed seed set in-crop by using selective herbicides if crop competition is inadequate. Following termination of the cover crop, follow-up mowing, grazing or broad-spectrum herbicides may be required if summer weeds are a concern.

Unfortunately, one year's control of weeds is seldom enough to be able to proclaim that weeds are under control. Prolonged vigilance using the techniques outlined above will eventually lead to depletion of the weed seed bank and a significant reduction in the population of undesirable species in the vineyard.

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Grape and Wine Research and Development Corporation
Industry House, Cnr Botanic and Hackney Roads, Adelaide SA 5000
PO Box 610, Kent Town SA 5071
Telephone (08) 8273 0500
Facsimile (08) 8373 6608
Email gwrdc@gwrdc.com.au
Website www.gwrdc.com.au

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