Weedy species or early succession pioneer plants… what do they tell us about our soil?

by Dr Mary Retallack, April 2022

What is a weed?

Weedy species are often referred to as plants located in an undesirable location. But what if that plant provides an indicator of soil health and is performing a vital role in healing the land? Many weeds act as accumulators of minerals in deficient soils and when they die and decay, the minerals are returned to the soil in a form that is plant available. There are many other benefits of having plant cover in preference to bare soil. In this fact sheet we will discuss the attributes of weedy species commonly found in vineyards on Kangaroo Island and provide a broader perspective of the role they play.

The process of ecological succession

Ecological succession is the process where an ecological community progressively transforms itself from an unstable system, towards stability and resilience. When we consider the ecology of a site, one of the first things we notice is the role of early succession coloniser (pioneer) plant species, which are often referred to as weeds. They may take the form of lichen and moss where soils are bare and sterile - to annual species with a fine and spreading root system; followed by tap-rooted forbs (flowering plants without woody stems); and annual and perennial grasses, which are generally found in association with bacterially dominated soils. Then we start to see the presence of shrubs and trees, which eventually culminate in a mature 'climax' woodland or forest and signals a habitat with low disturbance and fungal dominated soils.

An empty paddock left undisturbed for long enough will eventually grow into a fully formed woodland or forest. Given enough time, nature will fill bare or disturbed ground with pioneer plants, which quickly stabliise, build soil health and prepare the ground for progressively larger plants, until the area is filled with a complex mix of both ground cover and upperstorey species. These areas have the capacity to support functional biodiversity, which provides habitat for a wide range of flora and fauna, and a balanced, natural, system where pest and weed rarely dominate. An understanding of plant succession can be used to establish favourable sites, address underlying soil health issues, and potentially break the cycle of intervention.

The process of ecological succession:

1. Annual pioneer plants populate disturbed soil and they often spread by producing many seeds that are dispersed by wind. They are adapted to grow in hot, dry, and exposed conditions, and often in very poor soil conditions. These plants are short lived and improve the soil by creating a layer of mulch, which breaks down to contribute organic matter back into the soil.
2. Pioneer plants help to create an environment which can support perennial plants and grasses, many of which have their own special adaptations and survival mechanisms that allow them to further transform what the pioneer plants have left behind.
3. Once these changes have taken place, the space becomes suitable for the growth of woody pioneer or shrub species. The transformation into a shrubland elevates the height of the vegetation and creates a protective microclimate which supports the growth of small trees.
4. Fast growing small, short-lived pioneer trees help to transform the area into a young woodland.
5. Short-lived pioneer shrubs and trees are gradually replaced by taller and longer-lived hardwoods trees (also called climax trees), with an understory of shade tolerant species which grow below them, creating a mature woodland or forest.

Each time we clear the land or remove pioneer plants which are growing to protect bare land, this ecological process starts again in a counterintuitive cycle. Conventional agricultural systems aspire to maintain the ground at annual (weedy) plant stage. It takes a huge amount of energy to try and reverse natures processes, while also burning an inordinate amount of fossil fuel and energy in the process!

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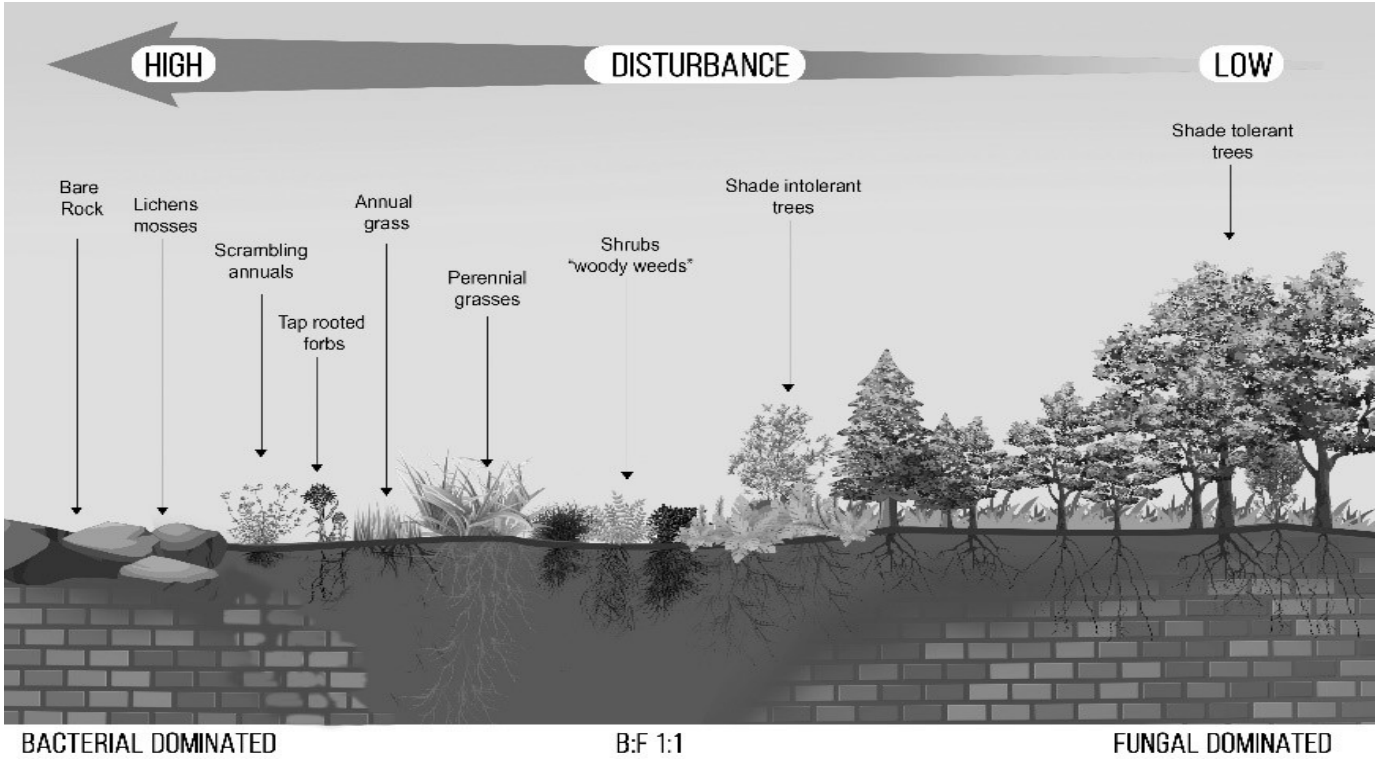

Figure 1. An example of the types of plants involved in ecological succession (Masters, N., 2019).

Soil attributes

Some of the reasons for the prevalence of weedy species include sites with:

- **bare or sandy soil** (i.e., caltrop, *Tribulus terrestris;* pigweed/purslane, *Portulaca oleracea*). Often these plants have a prostrate growth habit and quickly cover bare ground.

  The ability to colonise disturbed ground and support soil building is an example of plant succession. Early colonisers include moss, lichen, and ferns (also called cryptogams, or plants that reproduce by spores without flowers or seeds). They help to provide protection of the soil surface when there are no flowering plants present and where soils are sterile due to excessive weedicide application. Cryptograms provide food for soil arthropods, larger herbivores and often remain dormant in dry conditions until moisture stimulates them to grow and photosynthesise. They help store carbon and provide a source of nitrogen.

  The use of herbicides in a vineyard is often problematic with many weedy species quickly becoming herbicide resistant. What might be considered competition from weeds may in fact be due to other factors including allelopathy (i.e., wireweed, *Polygonum aviculare* and ryegrass, *Lolium sp.*), which produce suppressive chemicals, or weedy species that feed bacterially dominant soils via their exudates.
- **heavy clay soil** (i.e., couch grass, *Elymus repens*; plantain, *Plantago lanceolata*)
- **bacterial dominated** (i.e., capeweed, *Arctotheca calendula;* couch grass, *Elymus repens*; kikuyu grass, *Cenchrus clandestinus;* foxtail barley, *Hordeum jubatum;* wild oat, *Avena fatua)*
- **fungal dominated** (i.e., hollyhock, *Alcea* sp.; St John's wort, *Hypericum perforatum;* gorse, *Ulex europaeus;* English broom, *Cytisus scoparius*; African boxthorn, *Lycium ferocissimum*)

  The Soil Food Web[1] recommends a 1: 2 to 3.5 ratio of bacteria to fungi in vineyards. Disturbed soils tend to be bacterially dominant, while a lack of disturbance supports fungal population growth and abundance. Perennial woody crops are better suited to a fungal dominated environment.
- **compacted** (i.e., chicory, *Cichorium intybus*; plantain, *Plantago lanceolata*; curled dock, *Rumex crispus*; *Plantago lanceolata;* dandelion, *Taraxacum officinale;* sedge and rush species)
- **poor draining or waterlogged** (i.e., dock, *Rumex* sp.; marshmallow, *Malva parviflora*, sedge and rush species)

[1] https://www.soilfoodweb.com

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- **low in nutrients** (i.e., dandelion, *Taraxacum officinale*, fern species, plantain, *Plantago lanceolata;* Scotch thistle, *Onopordum acanthium*)
- **high in nutrients** (i.e., chicory, *Cichorium intybus*; pigweed/purslane, *Portulaca oleracea*; and fat hen, *Chenopodium album*)
- **high in nitrates** (i.e., capeweed, *Arctotheca calendula;* stinging nettle, *Urtica dioica;* fat hen, *Chenopodium album;* foxtail barley, *Hordeum jubatum;* milk thistle, *Sonchus oleraceus*)
- **High in available potassium and low in phosphorus** (i.e., blackberry nightshade*, Solanum nigrum;* dandelion, *Taraxacum officinale;* pigweed/purslane, *Portulaca oleracea*; plantain, *Plantago lanceolata;* Scotch thistle, *Onopordum acanthium;* wild radish, *Raphanus raphanistrum*; St John's wort*, Hypericum perforatum*)
- **Low pH (acidic)** (i.e., blackberry, *Rubus* sp.; dandelion, *Taraxacum officinale;* plantain, *Plantago lanceolata*)
- **High pH (alkaline)** (i.e., fat hen, *Chenopodium album*; wireweed, *Polygonum aviculare*)

Attributes of weedy species (or pioneer plants)

Root systems:

- Weedy species that have deep **taproots** (chicory, *Cichorium intybus*; plantain, *Plantago lanceolata*; and dandelion, *Taraxacum officinale*) generally indicate soils that are compacted, preventing plants with more fibrous roots from establishing. These taproots break up compacted soil layers and as they decompose, create pathways for water, nutrients, and more fibrous roots systems to follow.
- Weedy species that have fine, spreading, and **fibrous root systems** are likely present to stabilise soils that are loose and erosive. They help to reduce erosion on slopes and banks.
- Plants with **thorns** (i.e., caltrop, *Tribulus terrestris)* or are **poisonous** (i.e., Paterson's curse, *Echium plantagineum*; perennial ryegrass, *Lolium perenne*, St John's wort*, Hypericum perforatum)* protect the ground cover plants from being over-grazed by herbivores.
- Legume roots (i.e., Scotch broom, *Cytisus scoparius*; gorse, *Ulex europaeus;* garden, lupin, or vetch) have nodes which contain nitrogen fixing bacteria.

Management options

While there is much focus on chemical and cultural control options (including cultivation and grazing/slashing before flowers form) in the literature and readily available fact sheets, here we explore the underlying reasons for weedy species colonising areas. By taking an ecological perspective, it may be possible to address any underlying issues that provide perfect conditions for these plants to thrive and create greater balance into the system.

Rather than feeling compelled to automatically kill or remove weedy plants, we can consider them as potential food producers, providing root exudates to feed microbes, or alternatively, as living mulch to protect the soil surface, reduce ground temperatures, increase soil moisture stored at depth and increase organic matter.

One of the underpinning principles of functional biodiversity is that when a system is in balance - it is unlikely that pest weed, or insect species will dominate. We also know that a bacterial dominant soil will tend to support annual weedy species, whereas a fungal dominated soil will support perennial and/or woody species.

It is likely that weeds are present because the soil has a deficiency, or lacks a condition that allows them to thrive, thus prompting nature to repair systemic damage.

There are many ways to achieve desired outcomes and some growers have tried brewing weed teas, with mixed results. This technique may provide impressive results or very little impact. If you wish to try this technique, it is recommended to collect a drum full of the weedy species that you would like to manage and let it stew in its own juices concentrating the trace elements that the plants have been accumulating. Add water to help with the breakdown of woody species. Collect the resulting liquid from the bottom of the drum and spray onto the weedy species that you would like to manage working to a rate of up to 20L/ha (Masters, N., 2019).

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How to accelerate the process of ecological succession

There are several ways to work with the natural flow of nature (rather than pushing against it) and to accelerate the benefits of ecological succession. They include:

1. **Working with what you have**

   Utilise existing annual pioneer plants and weedy species to increase soil health, if they are providing functional benefits including stabilising the soil, accumulating minerals, and providing mulch when they die.

   Graze or slash annual species before they set seed to interrupt the reproductive cycle. Or smother unwanted plants with a compost or mulch layer to suppress further growth. Or plant a diverse mix of perennial species to outcompete new growth from annual weedy species. The process of solarisation - covering the soil with black plastic for several months over summer, may provide an effective remedy where there are small patches of unwanted weeds.

   Perennial weedy species often regrow if they are slashed and may need to be physically removed or cultivated to get rid of them quickly. However, soil disturbance may trigger the annual weed seeds, which are sitting dormant in the soil, to germinate and re-populate the disturbed area. Conversely, if there is active competition and/or an upperstorey shading ground cover species, then annual species are likely to regress over time.

2. **Plant a diversity of native perennial species**

   Consider planting naturally adapted, native plants that will survive dry, hot conditions. By covering bare land with nature's solar panels, they will convert light energy via photosynthesis into sugars (glucose) that are exuded by the roots to support populations of microorganisms including bacteria, fungi, protozoa, and predatory nematodes.

   They in turn help to nourish plants by increasing soil organic matter, plant available nutrients and soil water-holding capacity. They also create suitable conditions for higher-order, woody, ground cover plants and shrubs (including crops like grapevines and orchard trees).

   Seek out local pre-European plant community lists to help inform the selection of appropriate plant species. For more information, please see https://www.wgcsa.com.au/ecovineyards-factsheets.html.

3. **Incorporating organic matter**

   It is possible to improve soil health and resilience by adding organic matter to the soil through the application of mulch, compost, green manures, or natural fertilisers such as manure, seaweed, worm castings, and soil microorganisms via the application of high thermal, aerated, fungal dominant compost tea.

4. **Select plants that support ecological succession**

   We can choose native species in line with ecological succession, rather than relying on the natural recruitment that may occur on site, which may comprise a mixture of native and introduced plants.

   While grapevines may be the focal cash crop, it may also be possible to incorporate additional native bush foods, or to harvest native grass and forb seed to provide an additional income stream.

   Participants of the EcoVineyards program will be aware of the many benefits provided by native insectary plants, which provide habitat (a source of food, shelter and/or alternative prey) for a range of life forms including insectivorous and raptor birds, microbats, reptiles, frogs, turtles, and predatory arthropods.

   We can work with nature to speed up ecological succession while potentially benefiting from a myriad of ecosystem services.

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blackberry nightshade, *Solanum nigrum* (Cav.)

(Solanales: Solanaceae) (other common names include black fruited nightshade, black nightshade)

Figure 2. (a) Blackberry nightshade leaves (b), green and mature fruit [Photos: Sheldon Navie], and (c) blackberry nightshade habit in a vineyard mid-row [Photo: Peter Foster].

Indicator species: The presence of blackberry nightshade indicates soils that are low in calcium, and phosphate, high in potassium and magnesium and soils with low porosity and levels of humus, along with anaerobic bacteria and poor residue decay. Balancing these soil attributes may help to reduce the abundance of blackberry nightshade.

Beneficial attributes: Blackberry nightshade has been used by some cultures as a medicinal plant.

Description: A short-lived (i.e., annual, or short-lived perennial) herbaceous plant growing up to 1.25 m tall.

Origin: Native to north-western Africa, Europe, western and central Asia, China, and the Indian sub-continent.

Life cycle: Germination occurs mainly in spring and summer. Flowering occurs 5 to 9 weeks after germination and continues until the plant dies. It is usually upright in habit, but plants may become spreading in habit with age. The fruit are dull green when young, and turn purplish black, remaining dull as they mature.

Roots: Light coloured taproot with many laterals. High shoot: root ratio.

Soil: Wide range. A weed of cultivated land and disturbed sites.

Negative attributes: Blackberry nightshade is a host for a range of pests, diseases, nematodes, bacteria, fungi, and viruses that have a detrimental impact on crops.

Dispersal: Seed often spread by birds, with up to 178,000 seeds produced by one plant.

Allelopathy: Blackberry nightshade produces alkaloids and fatty acids that may be responsible for the growth reduction or inhibition of surrounding plants.

Supports populations of arbuscular mycorrhizal fungi: Yes

Legislation: Not declared or considered noxious by any state government authorities.

Management options: For general management options please see http://www.herbiguide.com.au/descriptions/hg_blackberry_nightshade.htm (always ensure control options are compatible with vineyard requirements).

Fun fact: Solanum comes from the Latin ‘solamen’ meaning to quieten or comfort and refers to the narcotic properties of some species. ‘Nigrum’ means black and refers to the black fruit. Blackberry nightshade refers to its black, berry fruit and membership of the nightshade family.

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fat hen, *Chenopodium album* (L.)

Caryophyllales: Amaranthaceae) (other common names include lamb's quarters, goosefoot, wild spinach)

Figure 3. (a) Fat hen leaves (b), flowers, and (c) mature plant [Photos: Sheldon Navie].

Indicator species: Fat hen can be found on a wide range of soils, which are often rich in nitrogen, and alkaline. Balancing these soil attributes may help to reduce the abundance of fat hen.

Beneficial attributes: It is reported that young leaves can be eaten as a spinach substitute and the seeds made into flour.

Description: Fat hen is an erect, annual, bushy herb with no aroma, which can reach a height of up to 1 metre. The leaves are elliptic to diamond-shaped with a pointed tip and angular teeth. The upper surface of the leaf is green, and the lower surface is mealy white. Fat hen has dense clusters of tiny green flowers, which are each 1.5 to 2.5 mm across.

Origin: This species possibly originated in Europe, although its exact native range is obscure. It is now very widespread throughout the temperate and tropical regions of the world

Life cycle: Fat hen is an annual herb. Germination occurs from spring to autumn, depending on soil moisture. It grows rapidly through summer and autumn (from November to August in South Australia), especially in irrigated crops or moist areas. It then dies quickly after maturity.

Roots: It has a stout taproot with many laterals.

Soil: Fat hen can be found on a wide range of soil types, often growing in disturbed soils.

Negative attributes: Fat hen competes with plants for water and nutrients.

Dispersal: Fat hen reproduces by seed, and it is reported that a single plant can produce more than 600,000 seeds in a season and buried seed can remain viable in soil for 30 to 40 years.

Allelopathy: Fat hen contains allelochemicals which may inhibit seed germination and growth of certain crop seedlings.

Supports populations of mycorrhizal fungi: No, or very low populations are supported (chenopod family)

Legislation: Not declared or considered noxious by any state government authorities

Management options: Mow or graze with sheep before flowering to reduce seed set. Hand pull plants after elongation and before seeding in summer.

Fun fact: Chenopodium is from the Neo Latin form of the Greek words Khenopous from khen, a goose, and pous, a foot and refers to the shape of the leaves in some species.

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kikuyu grass, *Cenchrus clandestinus* (Hochst. ex Chiov)

(previously *Pennisetum clandestinum*) (Poales: Poaceae)

Figure 4. (a) Kikuyu runners (b) leaves, and (c) dense stand [Photos: Sheldon Navie].

Indicator species: Kikuyu is an indicator of very low calcium and phosphorus, high potassium, very high magnesium and iron, low humus, compacted soils, and low soil bacteria. Balancing these soil attributes may help to reduce the abundance of kikuyu.

Beneficial attributes: Kikuyu can stabilise sandy soil and reduce erosion.

Description: Kikuyu is a creeping, aggressive, perennial grass that spreads by runners (runners and rhizomes) and with seed heads that are hidden within the leaf structure and only show long, white, thread-like stamens at flowering in summer. It is a weed of disturbed land.

Origin: Native to tropical eastern and central Africa.

Life cycle: Kikuyu is perennial and winter dormant. It flowers between October and March.

Roots: Fibrous roots develop at each node in contact with the soil. Many, stout, round, 5 to 10 mm diameter rhizomes covered with bracts and white pointed tips. Rhizome may reach a depth of 500 mm.

Soil: Prefers fertile loamy soils but also abundant on sandy soils. Tends not to persist on soils subject to severe drying or cracking.

Negative attributes: Kikuyu impedes water flows in drains, can be a fire hazard, forms dense mats and smothers most other species.

Dispersal: Kikuyu spreads locally by creeping stems and spreads more widely via dispersion of stem fragments by cultivation.

Allelopathy: Known to release allelopathic substances which may negatively impact nearby species.

Supports populations of arbuscular mycorrhizal fungi: Yes

Environmental impact: Kikuyu is regarded as an environmental weed in Victoria, South Australia, Western Australia, New South Wales, and Queensland.

Legislation: Not declared or considered noxious by any state government authorities.

Management options: Kikuyu is difficult to manage and an integrated approach using a combination of organic herbicide, grazing, competition (and solarisation in small areas) may prove effective.

For general management options see https://www.awri.com.au/industry_support/viticulture/weed-management/weeds/kikuyu/ (always ensure control options are compatible with vineyard requirements).

Fun fact: Pennisetum is from the Latin pena meaning feather and seta meaning bristle and refers to the feather like bristles on the flowers, of some species in this genus. Clandestinum refers to the clandestine or hidden seed heads.

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marshmallow, *Malva parviflora* (L.)

(Malvales: Malvaceae) (other common names include small-flowered mallow, cheeseweed mallow, little mallow, marshmallow)

Figure 5. (a) Marshmallow flower (b), young plant [Photos: Forest & Kim Starr], and (c) fruit [Photo: IEWF]

Indicator species: Marshmallow is an indicator of very low calcium and soil organic matter, high potassium, iron, aluminium, and very high magnesium. It is also an indicator of waterlogged, compacted soil with poor drainage. Balancing these soil attributes may help to reduce the abundance of marshmallow.

Beneficial attributes: Marshmallow produces palatable fodder and does not host the root lesion nematode.

Description: Marshmallow is an annual, biennial, or perennial weed that can grow up to 1.5 m tall. It produces small pink, mauve or white flowers throughout late autumn to late spring.

Origin: Mediterranean, south-western Europe.

Life cycle: Annual or biennial. Germinates in spring to autumn (from April to November in South Australia) and grows rapidly. Flowers August-December. Spring germinating plants may flower when only a few centimetres high and survive over summer to become biennial.

Roots: Marshmallow has a single taproot.

Soil: Most soil types including alluvial flats. A weed of cultivated land and disturbed sites.

Negative attributes: Marshmallow competes with other plants for water and nutrients. Plant toxins in mallow may cause ‘staggers’ (falling over with tremors) in stock that graze significant quantities.

Dispersal: Mallow reproduces by seed, producing up to 5,000 seeds per plant. Seeds are usually dispersed by water or soil.

Allelopathy: Known to release allelopathic substances which may impact the growth of nearby species.

Supports populations of arbuscular mycorrhizal fungi: Yes

Legislation: Not declared or considered noxious by any state government authorities.

Management options: For general management options please see http://www.herbiguide.com.au/Descriptions/hg_Smallflowered_Mallow.htm (always ensure control options are compatible with vineyard requirements).

Fun fact: Malva is from the Greek malache meaning soft and refers to the relaxing nature of these plants. Parviflora is from the Greek parvus meaning small and floris meaning flower referring to the small flower petals of this species.

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prickly paddy melon, *Cucumis myriocarpus* (E. Mey. ex Naud.)

(Cucurbitales: Cucurbitaceae) (other common names include gooseberry cucumber, gooseberry gourd, paddy melon, prickly paddy melon, prickly paddymelon)

Figure 6. (a) Paddy melon runners (b), green fruit, and (c) mature fruit [Photos: Rob and Fiona Richardson].

Indicator species: Prickly paddy melon occurs in disturbed soil and bare areas and thrives on summer moisture.

Beneficial attributes: May reduce erosion on sandy denuded soils.

Description: A prostrate, running, annual herb or vine (growing to 4 metres) with slender, rough stems. It has golf-ball size striped, softly prickly melons arising from yellow, five lobed flowers in summer. The green leaves, stems and fruit have a bitter taste and a strong smell when crushed. It flowers from November to March in South Australia.

Origin: Native to southern Africa

Life cycle: Annual. Prickly paddy melon in spring and summer, often after summer rain, and grows rapidly to over 2 metres in diameter. It flowers in summer to autumn.

Roots: Slender taproot with many, strong, shallow laterals.

Soil: Common on sandy, alluvial, clay and loam soils and depressions or flats that are occasionally flooded.

Negative attributes: Weed of fallows, stubbles, pastures, roadsides, summer moist areas, firebreaks, water courses, stock yards and summer crops.

Dispersal: Cultivating machinery spreads seeds by dragging vines along the ground and birds also aid in the spread of seed.

Allelopathy: Crude extracts of ground *Cucumis myriocarpus* fruits are reported to impart suppression qualities of the southern root-knot nematode.

Supports populations of arbuscular mycorrhizal fungi: Yes

Environmental impact: This vine is regarded as an environmental weed in Victoria, Queensland, South Australia, Western Australia, and the Northern Territory.

Legislation: Noxious weed of WA. Not declared or considered noxious by other state government authorities.

Management options: For general management options please see http://www.herbiguide.com.au/descriptions/hg_prickly_paddymelon.htm (always ensure control options are compatible with vineyard requirements).

Fun fact: Cucumis is the Latin name for cucumber, a close relative of Prickly Paddymelon. Myriocarpus is from the Greek myrias or Latin myrio meaning many and Greek karpos or Latin carpa meaning fruit referring to the abundant fruit production on the plant.

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Scotch thistle, *Onopordum acanthium* (L.)

(Asterales: Asteraceae) (other common names include cotton thistle, giant thistle, heraldic thistle, Scotch cotton thistle, Scotch cottonthistle, Scotch thistle, Scottish thistle, silver thistle, woolly thistle)

Figure 7. (a) Scotch thistle leaves [Photo: Sue Winterowd] (b) flower [Photo: H. Zell], and (c) plant [Photo: CSIRO].

Indicator species: Scotch thistles are most abundant in fertile soils that are high in nitrogen. Balancing these soil attributes may help to reduce the abundance of Scotch thistle.

Beneficial attributes: Scotch thistle produces nectar. Formerly cultivated as a medicinal plant for treating skin sores and ulcers. The roots, young shoots and flower buds were historically eaten.

Description: Scotch thistle is a large prickly, woolly, grey-green annual or biennial thistle with 1 to 3 large purple flowers at the ends of the stems.

Origin: Native to Europe, western and central Asia, and Pakistan.

Life cycle: Scotch thistle is an annual or biennial weed growing up to 2 metres tall. Flowering typically occurs from December to February in South Australia. Seeds germinate at any time, with a flush of germination in late summer to early autumn or late winter to spring. Flowers are mauve or purple.

Roots: The Scotch thistle has a stout tap root.

Soil: Uncommon on waterlogged soils.

Negative attributes: Scotch thistles are a weed of disturbed areas.

Dispersal: Scotch thistles are spread by seed and can produce more than 20,000 seeds per plant. Buried seed has a long life in the soil and germinates when returned to the surface. Birds are thought to aid dispersal.

Allelopathy: Scotch thistle is reported to produce secondary metabolites with phytotoxicity to other plants, and this helps to explain its invasive behaviour.

Supports populations of arbuscular mycorrhizal fungi: Yes

Legislation: Noxious weed of ACT, NSW, VIC, and TAS. Not declared or considered noxious by other state government authorities.

Management options: Manual removal of the taproot helps to eradicate this weed. Potential biological control agents include seed-head weevil, *Larinus latus*; stem-boring weevil, *Lixus cardui*; crown moth, *Eublemma amoena*; and rosette weevil, *Trichosirocalus briesei*.

For more general management options see http://www.herbiguide.com.au/Descriptions/hg_Scotch_Thistle.htm (always ensure control options are compatible with vineyard requirements).

Fun fact: Onopordum is the Latin name for thistles and is derived from the Greek onus meaning donkey and porde meaning flatulence because it was believed that donkeys passed wind more after eating these plants. Acanthium is from the Greek acantho meaning spiny.

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wireweed, *Polygonum aviculare* (L.)

(Caryophyllales: Polygonaceae) (other common names include prostrate knotweed, hogweed, and lowgrass),

Figure 8. (a) Wireweed seedlings [Photo: Mary Retallack] (b), leaves [Photo: Andrew Storrie], and (c) plant [Photo: Sheldon Navie].

Indicator species: Wireweed grows in a wide range of soils, but it prefers loams and heavy alkaline soils. Balancing these soil attributes may help to reduce the likelihood of wireweed abundance.

Beneficial attributes: Used as a medicinal herb, produces indigo like dye and is resistant to root knot nematode and other nematode species. It is also a useful rehabilitation species in areas affected by heavy metals.

Description: Wireweed is a hairless, ground-hugging or sprawling, annual or perennial herb with small oval leaves and small clusters of pink-tinged flowers. The stems are slender, up to 1 metre long, wiry and many branched.

Origin: This species is widespread in temperate regions of the world, and probably originated in Europe.

Life cycle: Seed germinates from autumn to early summer, and it flowers from November to May in South Australia.

Roots: Strong, deep, tough, fibrous non-mycorrhizal taproot.

Soil: Occurs on a wide range of soils and can tolerate a wide soil pH range from 5.6 to 8.4. A weed of cultivated land and disturbed sites.

Negative attributes: Wireweed competes with other plants for water and nutrients.

Dispersal: Reproduction and dispersal occurs by seed. Wireweed sets large numbers of seed.

Allelopathy: Wireweed has phytotoxic properties which inhibit the establishment of other plant species, especially medic and lucerne. It also affects rhizobium bacteria required for legume nodulation.

Supports populations of mycorrhizal fungi: No, or very low populations are supported.

Environmental impact: Wireweed is regarded as an environmental weed and is a serious weed of crops, pastures, disturbed sites, and waste areas in Australia. It also invades native vegetation and is regarded as an environmental weed in New South Wales, Victoria, and South Australia.

Legislation: Not declared or considered noxious by any state government authorities.

Management options: Control can be achieved by preventing seed set by grazing or cultivating early in autumn as new seedlings start to appear to reduce establishment.

For a longer-term management strategy, plant a competitive perennial such as wallaby grasses, *Rytidosperma* ssp. in cultivated areas to help prevent the re-establishment of wireweed.

It is also reported that applications of humate and seaweed extract will cause wireweed to go dormant (Walters, 1991). For more general management options please see http://www.herbiguide.com.au/Descriptions/hg_Wireweed.htm (always ensure control options are compatible with vineyard requirements).

Fun fact: Polygonum is from the Greek polys meaning many and gony meaning knee and refers to the many nodes on the stems. Wireweed refers to the wiry stems of this weed.

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Online resources

Controlling declared weeds in SA https://pir.sa.gov.au/biosecurity/weeds/controlling-weeds

Controlling vineyard weeds factsheets https://www.awri.com.au/wp-content/uploads/2019/08/s2100.pdf

Currently established biocontrol agents in South Australia https://pir.sa.gov.au/__data/assets/pdf_file/0005/159539/Currently_established_biocontrol_in_SA.pdf

Environmental weeds of Australia http://keyserver.lucidcentral.org:8080/weeds/data/default.htm

Herbicides in vineyards and impact on soil biota https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6096560/

Herbicide reduction strategies for wine grape production https://www.wineaustralia.com/getmedia/a7bd4066-4138-4f55-8f8c-0a0468ab97b0/UA-00-1

Herbicide resistance https://www.agric.wa.gov.au/grains-research-development/herbicide-resistance

Herbicide resistance in vineyards – glyphosate and paraquat resistant ryegrass https://ahri.uwa.edu.au/double-banger-glyphosate-and-paraquat-resistant-ryegrass/

HerbiGuide http://www.herbiguide.com.au

Managing weeds, pests and disease https://www.biodynamiceducation.com/wp-content/uploads/2013/05/Section-Six-Weeds-Pests-and-Disease.pdf

Weed control handbook for declared plants in South Australia https://www.pir.sa.gov.au/__data/assets/pdf_file/0020/232382/WEB_8867_PIRSA_Weed_Control_Handbook_2018.pdf

Vineyard weed management http://www.wine-grape-growing.com/wine_grape_growing/vineyard_weed_management/vineyard_weed_management_chemical.htm

Books

Bishop, G.C. (2013) Which weed? Invasive plants of the central Mount Lofty Ranges, South Australian Government, Adelaide.

Masters, N. (2019) For the love of soil. Printable Reality, NZ.

McCaman, J.L. (2013) When weeds talk. Jay L McCaman, Sand Lake, USA.

Pfeifer, E. (2020) Weeds and what they tell us. Floris Books, Edinburgh.

Walters, C. (1991) Weeds control without poisons, Acres USA, Louisiana, USA.

Whibley, D.J. and Christensen, T.L. (1991) Garden weeds, identification and control, Botanic Gardens of Adelaide, Adelaide.

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Thank you to our project partners!

Acknowledgement of country

The EcoVineyards project acknowledges Aboriginal people as the First Peoples and Nations of the lands and waters we live and work upon and we pay our respects to their Elders past, present and emerging. We acknowledge and respect the deep spiritual connection and the relationship that Aboriginal and Torres Strait Islander people have to Country.

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For more info about the EcoVineyards project see https://www.wgcsa.com.au/ecovineyards.html

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