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FACT SHEET

INTEGRATED SNAIL CONTROL IN VINEYARDS

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A TAILORED APPROACH TO SNAIL CONTROL IN VINEYARDS

Taxonomy

The common name 'snail' is used for most members of the molluscan class Gastropoda, which have a coiled shell that is large enough for the animal to retract completely into. Both snails and slugs are included in the phylum Mollusca and are also referred to as molluscs.

There are more than 1,000 species of land snails native to Australia which are not considered to be a problem in agriculture.

However, non-indigenous snails have become a problem in Australian vineyards due to several factors, including:

- being 'released from their natural enemies' in their original Mediterranean environments
- the lack of snail natural enemies in Australia makes it difficult to limit snail populations from increasing, especially in extended wet seasons where midrow vegetation is lush and contains a high proportion of clover.

Snail biology

Snail biology is very different to that of insects:

- snails survive as juveniles and adults by slowing their metabolism, which is a form of torpor
- not all individual snails within a population will be actively feeding, mating or breeding at the same time
- to manage snails in vineyards, controls need to occur at multiple times throughout the year
- timing of control methods is dependent on the species present.

Four species of snail *Cornu aspersum*, common garden snail; *Theba pisana*, white Italian snail; *Cernuella* spp., vineyard or common white snail; and *Cochlicella barbara,* small conical or small pointed snail predominantly cause vine damage especially at bud burst, they may contaminate grapes at harvest and can even block irrigation systems.

Information is presented below on how to identify what species of snail is present, when and how often different management strategies should be applied.

Snail identification

Some common terms used for the description of snails include:

- **Umbilicus:** the axially aligned, hollow cone-shaped space within the whorls of a coiled snail shell.
- **Whorl:** a complete 360° turn in the spiral of a mollusc shell.

Whorls are counted from the apex (centre), hence tip (esp. for conical snails) of the shell outwards.

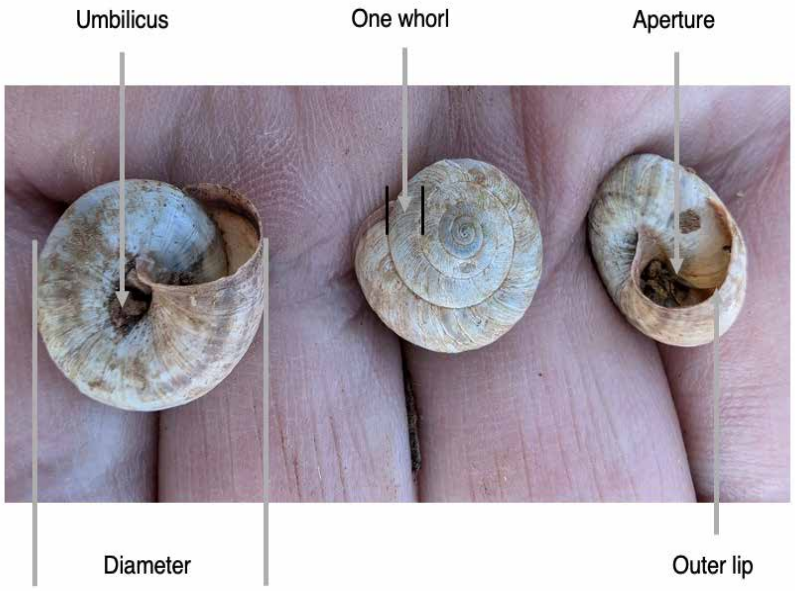

Figure 1: Key diagnostic features used for snail identification [Photo: Michael A Nash].

Key snail pest species

Table 1: Commonly found snails in Australian vineyards in order of economic damaged caused [Photos: Michael A Nash].

			
Cornu aspersum **common garden snail**	*Theba pisana* **white Italian snail**	*Cernuella* spp. **vineyard or common white snail**	*Cochlicella barbara* **small conical or small pointed snail**
25 to 40 mm, does not have umbilicus (hole at the centre of the shell whorls)	Partly closed, semi-circular or partly closed umbilicus, 10 to 30 mm	Open, circular umbilicus 10 to 25 mm	Up to 12 mm long and 8mm diameter
Herbivore (feeds on a wide range of host plants)	Herbivore (feeds on green plant material)	Microphagous (feeds on minute particles or microorganisms) and occasionally green plant material	Detritivore and herbivore (feeds on dead organic and green plant material)
Can cause extensive damage to buds	Contaminant	Contaminant	Contaminant
Winter torpor in the ground and base of vines	Summer torpor in vine canopies	Summer torpor in vine canopies, posts and sprinklers or in the ground	Summer torpor under vine bark, moving into sprinklers to hydrate

Figure 2: White Italian snails in a vineyard [Photo: Michael A Nash].

FAMILY HELICIDAE

Cornu aspersum, common garden snail

Figure 3: *Cornu aspersum,* common garden snail marked [Photo: Michael A Nash].

DESCRIPTION: Large round snail with a diameter of < 40 mm and 4 to 5 whorls. Often a reticulated pattern of various shades of brown bands interrupted with yellow streaks. Shell characters are extremely variable.

DISTINCTIVE FEATURES: Closed umbilicus with distinct lip on out border of the shell.

BIOLOGY: Garden snail populations have an extremely plastic biology, living for up to 12 years.

They are found in all disturbed situations across temperate Australia, in particular irrigated areas. Only a proportion of the population is actively breeding at one time, with individuals typically breeding from 1 to 3 years after hatching, once they have undergone torpor. Hence in one block, garden snail populations can include eggs, juveniles, pre-reproductive, breeding and individuals in torpor.

In Australia, warm winters allow this species to breed all year round, although recent data from WA and SA vineyards indicate the greatest proportion of the population breed over summer. In colder areas common garden snails go into dormancy over the winter, hence they do not breed.

It is suspected that under irrigation in warmer inland regions a 'many-small-eggs strategy' is adopted with more than one egg clutch laid from spring to late autumn. This sporadic behaviour gives the impression that garden snails do not move out of the vine canopy, which is not correct. Individual garden snails move out of the vine when they are ready. Individual behaviour of seeking refuge in vines for extended periods of time makes application timing imperative for successful control.

A proportion of individuals seem to become active based on strong low-pressure fronts prior to rain or storm conditions when they move out of canopies, to feed and breed, once conditions are warmer.

WHEN TO MONITOR: All year round, especially in early spring once temperatures rise and during rain fronts.

SUGGESTED ACTION THRESHOLDS: Most damaging species, especially at bud burst when individual snails become more active as temperatures rise.

Spring and summer are the best time to apply organically certified baits containing iron once individuals are actively breeding. Multiple bait applications are needed as not all individuals will be actively feeding at the same time. Garden snails require higher bait rates per hectare than other species.

NATURAL ENEMIES: None, however garden snails are a known carrier of rat lungworm disease.

FAMILY HELICIDAE

Theba pisana, white Italian snail

Figure 4: *Theba pisana,* white Italian snail [Photo: Michael A Nash].

DESCRIPTION: Medium sized round snail whose diameter is < 30 mm, white shell with brown bands that are variable.

DISTINCTIVE FEATURES: Partially closed umbilicus.

BIOLOGY: Breeding typically occurs from autumn through spring. However, this snail has been observed breeding in late summer in coastal climates.

They are found in all disturbed situations across temperate Australia. This species feeds mainly on green plant material. This species mainly aestivates (hibernates) elevated on plant or other structures to escape high ground surface temperatures. Activity is triggered when surface relative humidity is > 90% in late summer and 85% to 90% once breeding.

WHEN TO MONITOR: All year round, especially from late summer through to early winter once weather fronts bring dewy mornings, as adults become active after summer torpor (hibernation).

Autumn is the best time to apply organically certified baits, once individuals are active.

SUGGESTED ACTION THRESHOLDS: Damaging species because they feed on fresh vine growth, especially new transplants within protective tubing.

NATURAL ENEMIES: None.

FAMILY HELICELLINAE

Cernuella spp., vineyard or common white snail

Figure 5: *Cernuella* spp., vineyard or common white snail [Photo: Michael A Nash].

DESCRIPTION: Medium sized round snail whose shell diameter < 25 mm with 5 to 7 whorls. Often a white shell with broken brown bands but individuals can have no markings. Shell characters are extremely variable. Commonly referred to as *Cernuella virgata*, recent molecular work would suggest caution when attributing a species name to this group.

DISTINCTIVE FEATURES: Open umbilicus.

BIOLOGY: Breeding typically occurs from autumn through spring. Found in all vineyards across temperate Australia. Can tolerate a wider range of temperatures than Italian round snails, hence has the potential to expand its distribution in Australia.

It can survive up on plants or other structures, or in the ground to escape high temperatures. Activity is triggered when surface relative humidity is > 95% in late summer when not breeding and 80% to 90% in autumn when breeding.

WHEN TO MONITOR: All year round, especially in the autumn once weather fronts bring dewy mornings, as adults become active after summer torpor (hibernation).

Autumn is the best time to apply organically certified baits, once individuals are active.

SUGGESTED ACTION THRESHOLDS: Greater than other snail species because it causes limited damage to fresh vine growth, mainly a contaminant at harvest.

NATURAL ENEMIES: None.

FAMILY GEOMITRIDAE

Cochlicella barbara, small conical or small pointed snail

Figure 6: *Cochlicella barbara*, small conical or small pointed snail mating [Michael A Nash].

DESCRIPTION: A small snail with a conical shell up to 12 mm high and 8 mm wide, with up to eight very slightly convex whorls. The shell colour is variable, ranging from off-white to yellow to grey, and dark-coloured spots or stripes may also be present.

DISTINCTIVE FEATURES: A conical snail whose diameter to height ratio is < 1:2.

BIOLOGY: Breeding typically occurs once > 6 mm in height, which can occur anytime of the year in coastal climates and under irrigation. Generally breeding has not been observed during the spring.

Small conical snails are the most widely distributed species across temperate Australia, found on acid soils and areas above 450 mm rainfall. This species feeds mainly on green plant material and mainly aestivates (hibernates) in the ground to escape high ground surface temperatures. Activity is triggered when surface relative humidity is > 95%.

WHEN TO MONITOR: All year round, especially in the autumn once weather fronts bring dewy mornings as adults become active after summer torpor.

Autumn and winter are best times to apply organically certified baits, once individuals are active.

SUGGESTED ACTION THRESHOLDS: Greater than other snail species because it causes limited damage to fresh vine growth, mainly due to their activity over winter. Where high numbers exist can contaminate harvest, however the biggest issue is blocking irrigation drips and sprinklers where they congregate over summer.

NATURAL ENEMIES: Parasitoid marsh flies (Family: Sciomyzidae).

Planting of native plants, such as *Bursaria spinosa*, sweet bursaria and *Leptospermum continentale*, prickly tea-tree in vineyards may provide resources for conical snail parasitoid flies, which can contribute to the biocontrol of small conical snails.

Cultural control

Cultural control provides an important component of an integrated approach to snail control. Cultivation between vine rows will limit moist refuges and food resources, as will the removal of broadleaf weeds. Thus, removal of food resources at ground level over the winter will help limit populations.

However, it is important to keep bare soil covered and a mix of native grasses including *Rytidosperma* spp., wallaby grasses and forbs can provide multiple soil health and ecosystem services benefits without providing favourable habitat for vineyard snail pest species.

Sheep

Although direct trampling might crush the occasional snail, sheep grazing in the vineyard over the winter is an important management tactic for some species of snails.

The grazing alters microclimatic conditions between vines, which reduces snail activity and egg laying over winter. The preferential grazing of brassica weeds will also reduce favourable food for snails.

In grazed vineyard blocks, numbers of Italian snails are consistently half those of blocks not grazed.

Figure 7: Sheep in the vineyard [Photo: Mary Retallack].

Rolling

Physical crushing of snails with modern heavy metal rollers as used in broadacre to crush rocks has been shown to reduce numbers by up to 80%, especially in late summer when snails have climbed up stubble. This management strategy relies on snails dehydrating in combination with cracking shells, hence environmental conditions must be favourable; that is > 35 °C and < 50% relative humidity.

In vineyards, rolling will not achieve the same results as broadacre due to snails being in vine canopies, lower work rates so rolling may not occur when conditions are optimal, and for mortality to occur rolling will be more reliant on actual crushing of individuals when they are active (spring) when then are less likely to dehydrate as conditions are still moist. Because rolling should occur when snails are inactive, hence not breeding, eggs are not released when snails are crushed.

Rolling can be another tool to reduce snail numbers in vineyards.

Figure 8: Snail roller used at Guichen Bay and Wrights Bay Vineyards, Mount Benson, SA [Photo: Dean Barker]..

Plant management

Growing of plants that accumulate nitrates and calcium (brassica weeds such as wild mustard) favour snail breeding. Growing of cover crops that limit brassica plants will limit snail food resources, as will cover crop species that limit mollusc growth, such as linseed and chickpeas.

Controlling brassica weeds as another tool to reduce snail numbers in vineyards.

Biocontrol

Encouragement of generalist predators, such as flatworms and nematodes, within the vineyards will help limit snail populations, but will never eliminate snails. Native species of nematode have been found to burrow into snails and release bacteria with mortality >90 % observed in laboratory trials within 10 days of the nematodes being placed with snails, but field validation has not occurred. Two parasitoid fly natural enemies with some potential to limit snail populations are being used in other agricultural systems and are discussed further below.

Figure 9: Indian runner ducks in the Angove Vineyard, McLaren Vale [Photo: Angove Wines].

Ducks, chickens and geese

Snails are preyed upon by variety birds such as starlings, crows and all forms of poultry. Ducks have been suggested for the control of aquatic *Pomacea canaliculate*, golden apple snail in Asian rice paddies stocked at a rate of 5 to10 per ha, with a cross between Khaki Campbell and Mallard showing the greatest preference for feeding on snails reducing densities from 5 to less than 1 m^2.

Ducks feeding on snails under vines is well suited as a biological control in organic viticulture if foxes can be controlled. A suggested stocking rate would be 2 to 5 per ha. Indian runner ducks are a breed of *Anas platyrhynchos domesticus*, the domestic duck and are commonly used in vineyards to contribute to biocontrol of snails and other molluscs.

Lizards

Anecdotal evidence suggests shingleback lizards enjoy eating garden snails in vineyards and Italian snails on the edge of crops. Providing habitat for lizards is another tool to reduce snail numbers.

Figure 10: Shingleback lizard, Adelaide Hills, South Australia [Photo: Mary Retallack].

Parasitoids

Family Sciomyzidae (commonly known as marsh flies) have been released as a classical biological control agents in Australia.

Sarcophaga villeneuveana, a flesh fly was selected due to its host specificity on pest snails, in particular *Cochlicella acuta*, pointed snail but has also been found to parasitise *C. barbara* now known as *Prietocella barbara*, a sister species of European small snail with rates up to 25% in areas near flowering vegetation. These have been released in broadacre areas of SA and WA, but not specifically into vineyards.

Chemical control

Current chemical control of snails relies predominantly on baits that contain metaldehyde. However baits that rely on iron, available as elemental iron, iron phosphate or sodium EDTA form, are registered for use in Australian vineyards.

Both actives, metaldehyde and iron, are reported to have minimal impact on non-target invertebrates.

However, the EDTA present in some iron-based baits will disrupt earthworm communities and metaldehyde is not recommended as it has been banned in the UK because it is toxic to vertebrates, such as birds, mammals and other animals.

The use of biorational products (some are organically certified) that contain iron are equally as effective at controlling snails in vineyards when compared to traditional metaldehyde baits, when applied a rates high enough rate that accounts for the number of snails present.

Baiting more often is recommended before snail populations damage crops.

The fundamentals for successful cost-effective use of baits requires two things:

1. To ensure an adequate chance of encounter choose a product that is attractive, has even distribution of baits with effective number per m^2 and movement of individuals.

   Applying baits under vine, spread evenly in a 1 m wide strip is much more effective than placing baits in heaps at the base of vines.

Figure 11: Juvenile *Cornu aspersum,* common garden snail [Photo: Mary Retallack].

2. To ensure a lethal dose is consumed, choose a product that is palatable, has enough active ingredient within the bait, and the right rate of product is applied.

   Using long lasting baits will ensure a lethal dose is available once individuals feed, whereas sprays do not. Sprays do not reduce snail populations in the long term; although they may act as a deterrent in some situations.

Modern baits produced using an extrusion process are rainfast, allowing for application before rain events, thus being available to individual snails once they are actively feeding. Waiting until after rainfall often leads to baits being applied too late.

The key to chemical control is applying baits when snails are ready, not when you have time. Application timing is dependent on species present, local and seasonal conditions.

NB: Metaldehyde is the active ingredient in many commercial slug and snail baits and is extremely attractive to dogs due to its palatability and appearance. Signs of metaldehyde toxicosis (e.g., muscle tremors, hyperthermia, seizures) generally appear 1 to 4 hours after ingestion. If left untreated, respiratory failure and death can occur.

Final comments

Due to their unique biology, managers need to shift their thinking from 'how do I control' snails in vineyards to limiting their impact on grape quality.

The integration of cover crops between vines, provision of resources for a stable invertebrate community including natural enemies, understanding environmental conditions favourable for snail breeding and occasional baiting with biorational molluscicides will lead to snails not causing economic impact even though some are present within the vineyard.

Further reading

- DPIRDWA: Snail baiting demonstration
- GRDC: Nail the snails, a practical guide to integrated snail control for Australian grain growers
- GRDC: Snail identification and control
- AWRI: Vineyard snail control: exploring the options and timing

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ACKNOWLEDGEMENT OF COUNTRY

EcoVineyards proudly acknowledges the Aboriginal and Torres Strait Islander Peoples, and their ongoing cultural and spiritual connection to this ancient land on which we work and live.

As the Traditional Custodians of this land, we recognise their wealth of ecological knowledge and the importance of caring for Country.

We pay our respects to elders past and present and extend this respect to all Aboriginal and Torres Strait Islander Peoples.


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