Snail Management Guide for WA Farmers

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COUNCIL OF GRAIN GROWER ORGANISATIONS LTD
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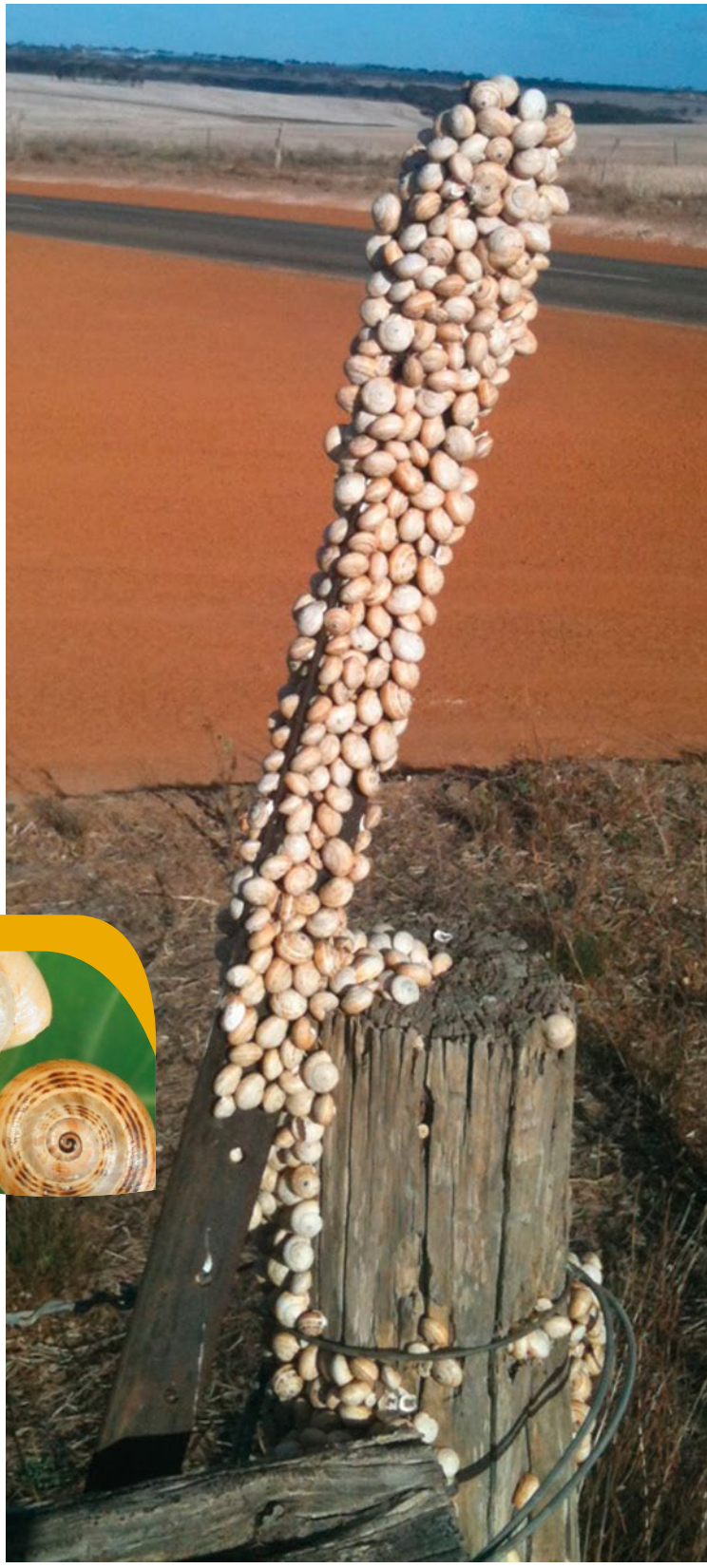
Introduction

Welcome to the Snail Management Guide for WA Farmers.

Snails are a growing issue for growers in the southern high rainfall agricultural zones of Western Australia. Contamination by snails poses a serious threat to grain exports in these regions with strict grain quality standards for snail contamination imposed at the silo. Snails also cause damage to emerging crops and larger snails can clog machinery at harvest resulting in delays and frustration.

The control of small conical snails is of vital importance in reducing crop damage and yield losses, and in preventing grain contamination at harvest. An integrated snail management strategy is needed on farms throughout the year to control snails, with regular monitoring of snail numbers to plan effective control strategies.

The purpose of this guide is to help growers develop an integrated snail management strategy for their farm.



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Contents

Key messages

Weed Control

- Summer weed control is important – uncontrolled summer weeds will provide habitat and food sources for snails.
- Control weeds along fence lines – snails reproduce less on bare ground and maintaining a weed free zone approximately 2m either side of a fence line will help to remove potential breeding grounds.

Burning

- Burning prior to seeding is one of the most effective methods for pre-breeding snail control.
- Windrow burning can be an effective control of snails. Be aware that snails in the inter-rows could still pose an issue for the next crop.

Baiting

- Slugs and snails can only be controlled by baits if they are mobile and looking for food.
- The best time to bait is early in the season when morning temperatures are low and dew forms, and after the first good germinating rains.
- Killing mature snails before autumn egg laying reduces the potential population build up for that season.
- Late bait applications are less effective, especially when lots of green material provides an alternative food source for the snails.
- The more bait points per square meter the better the kill rate as snails will feed on baits only if they come across them.
- Don't just bait the paddock, it is important to bait fence lines and laneways to ensure control.
- Calibrate spreaders – better calibration of bait spreaders ensures an even spread of baits, and saves time and money.

Bashing

- The most effective form of tillage to reduce numbers of snails is wide points or full-cut discs that are used in conventional tillage methods.
- Grazing – animals will knock snails from stubble and may also trample them. Grazing also helps to reduce stubble ground cover and decrease refuges for snails, however control of snails by grazing is variable and will depend on stock numbers and movement.
- Chaining or rolling of paddocks is not an efficient method of controlling SMALL POINTED SNAILS as these methods still leave refuges for snails to survive – under rocks, in stubble etc.

Cleaning contaminated grain

- Dislodge bars and a rotary brush fitted to the front of the harvester can reduce snail intake. These bars are most suited to large round snails.
- Snail-crushing rollers in combination with conventional grain cleaners can be effective at removing snails from grain of the same size.

Snail distribution

Three species of snails are found as agricultural pests over all soil types in WA; each species was introduced originally from Europe.

Small pointed or small conical snail

Prietrocella barbara

The small pointed snail has a conical shell with brown bands of varying width. It is usually less than 10 mm in length or diameter.

Small pointed snails are not restricted to alkaline soils. These snails survive the summer in many habitats - under leaf litter, under the soil surface (up to 50 mm), under stumps or stones and climb posts and vegetation. This behaviour of climbing up on vegetation makes them a contamination risk at harvest.

White Italian snail

Theba pisana

The larger White Italian snails are predominantly white, often with fine brown concentric lines of varying intensity. The body of the snail is creamy-white and the shell is round and 10 to 20 mm in diameter. The umbilicus (the hole about which the shell spirals) is partly obscured.

This species thrives in areas of alkaline sandy soils with high calcium content, mainly near the coast. It over-summers off the ground on vegetation and posts, and is commonly found on green weeds. This over-summering behaviour of sealing itself on vegetation off the ground makes them a contamination risk in harvested grain.

Vineyard or common white snail

Cernuella virgata

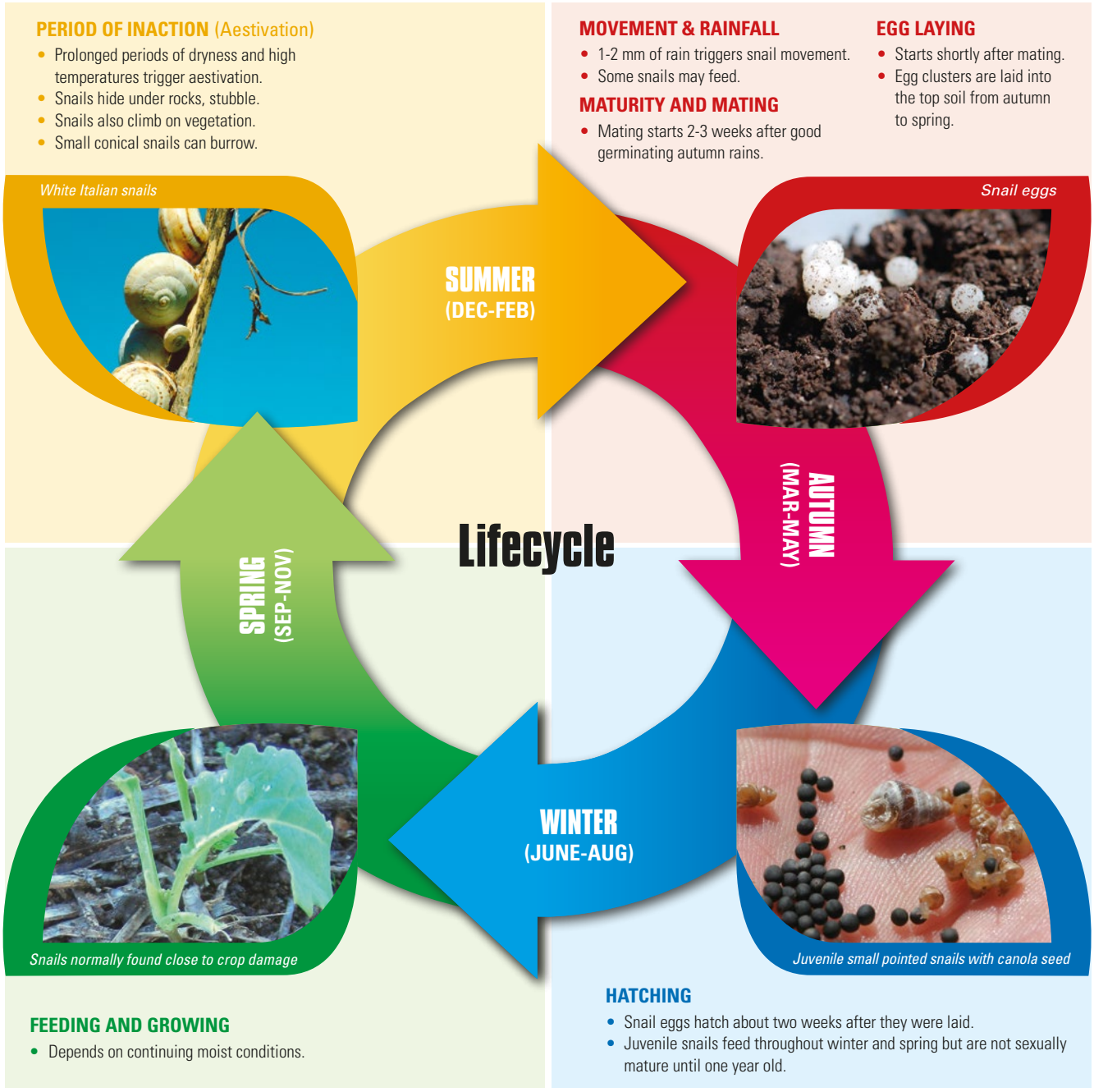
The vineyard snail resembles the White Italian snail in shape, size and colouring. However, the umbilicus (the hole about which the shell spirals) of the vineyard snail is entire and not partly obscured as with the White Italian snail.

This species thrives in areas of alkaline sandy soils with a high calcium content, mainly near the coast. It over-summers off the ground on vegetation and posts.

Biology of snails

The snail species listed on the previous page all have similar lifecycles. They are hermaphrodites - both members of a mating couple can lay eggs. Mating usually takes place from mid-autumn to mid-winter when favourable moist conditions return after summer.

Two to four weeks after mating, spherical pearl-white eggs are laid into moist soil. Egg laying can continue from the break of the season to late winter. Eggs cannot survive a hot, dry summer or lie dormant in the soil. After laying, eggs hatch in two to four weeks but young snails usually become sexually mature after one year.



Damage

Snails are not known to damage seed but may damage germinated seed close to the soil surface.

Irregular pieces chewed from leaves and shredded leaf edges are typical of snail presence. Damage to canola and legume crops can be difficult to detect if seedlings are chewed down to the ground during emergence.

Cereal crops are likely to survive damage by snails, while canola and lupins may not compensate for the damage or loss of early leaves to appear from a germinating seed.

How to tell if snails are becoming a problem on your farm

- Have you noticed snails in grain at harvest?
- Are snails easily seen in some paddocks?

If you answer yes to either of these questions, then consider control measures in the lead up to sowing rather than after crops have germinated. Control of snails in seedling crops is often difficult and expensive, especially if large areas need re-sowing.

Are you liming?

Be aware of snails before liming paddocks as lime aids their survival. Snails feed on calciferous material, including dead snail shells, to strengthen their shells. This enables them to survive a hot dry summer. There is some evidence to suggest snail reproductive ability also increases with lime availability. Independent testing has not found live snails in lime delivered to farms. Snails found in lime piles on farms were already there.

How many snails are too many?

Snail numbers, especially the small conical snail, are easily miscounted as these snails may be hard to find under stubble, in canola stalks, under rocks or on fence posts. Monitoring snail numbers in paddocks is essential to determine if control is necessary.

Snail Monitoring

Snail counts should be taken across the paddock to establish how many are present per square metre. A good way to find out how many snails are present is to estimate the number of snails in a 10 X 10 cm square. Do this in at least 50 spots in the paddock, multiply by 2 to give the number per square metre. Taking lots of sampling points within paddocks known to have snails will give a good indication of their numbers and where they are mostly found. Live snails are those that when squashed are moist.

Researchers at the Department of Agriculture and Food WA are currently investigating methods for remote monitoring of harvested grain as it enters the header storage to monitor snail numbers at harvest. This method will use a GPS enabled camera phone assembly to recognise the presence of snails coming in, and computer software that will enable a paddock map to be produced that will highlight just where the snails in harvested grain are being picked up in the paddock. Contact John Moore at the Albany Office of the Department of Agriculture and Food WA for further information on this technology.

Thresholds

If you find snail numbers are above or close to the recommended thresholds below (Table 1), consider undertaking control options before seeding.

Table 1: Thresholds for control of snails in broadacre crops

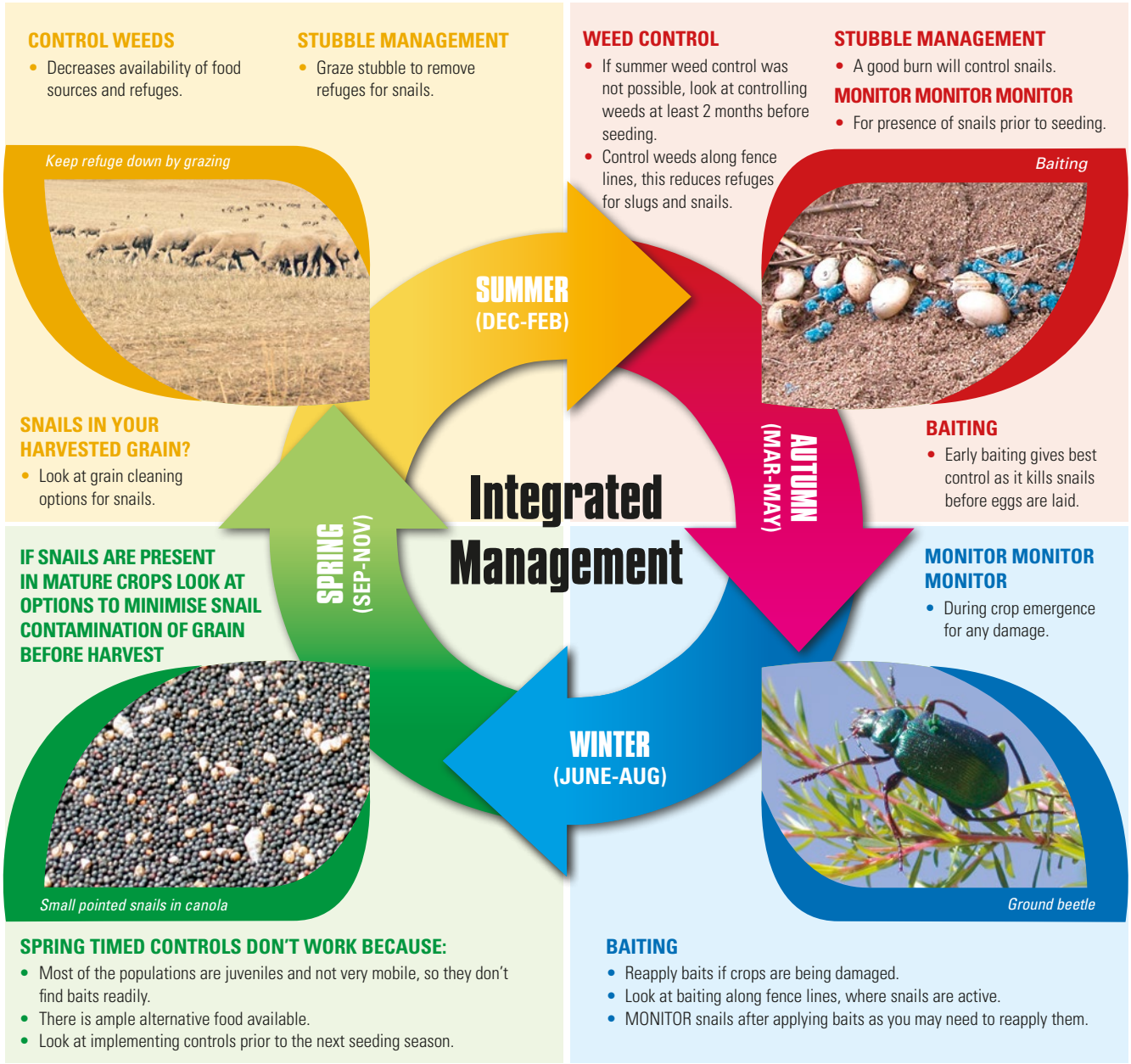
Species	Crops			
	Oilseeds	Cereals	Pulses	Pastures
Small pointed snail	20 per m^2	40 per m^2	5 per seedling	100 per m^2
White Italian snail	5 per m^2	20 per m^2	5 per m^2	80 per m^2

Integrated control – attacking the weak links in the lifecycle of snails

From a management perspective, the three snail species have similar lifecycles. This means similar management techniques can be employed to control them all in broadacre crops. Effective management requires applying controls that coincide with different phases of the pest's lifecycle. Stopping snails from laying eggs will stop the population in its tracks.

It is a good idea to monitor snails in accordance with their lifecycle as follows:

- **January/ February** - assess stubble management options for snail management.
- **March/April** - assess options for burning and /or baiting.
- **May to August** - assess options for baiting, especially along fence lines.
- **3 to 4 weeks before harvest** - assess risk of snail contamination of grain and if required, implement options to minimise the risk and reduce numbers.



Pre-seeding management

Burning

Burning prior to seeding, is one of the most effective methods for pre-breeding snail control.

Before deciding to burn, soil type and weather conditions need to be taken into consideration. Also, summer weeds should be desiccated and browned off. Rocks also provide hiding places and these, should be turned by cabling or fire harrowing just prior to burning, if possible.

It is important to ensure that an even burn is applied across the paddock, as unburnt patches will provide habitats (refuges) for snails. Burning on a warm day with little wind in a paddock that has a reasonable fuel load will achieve good control.

When snail populations are large, a strategic burn every three or four years will assist in controlling snail numbers.

Windrow burning

Farmers in the Albany port zone have been trialling the effectiveness of managing snails and weeds in one hit by burning windrows.

In 2016 local trials, burning caused 100% mortality of snails in the windrows. Snails in the inter-rows could pose an issue for the next crop. In a cereal paddock, there was no significant difference in snail numbers in the windrows and outside of the windrows because the amount of cereal residue across the soil surface was high (see Figure 1). Whereas in a canola paddock that had only standing stubble next to the windrows, the highest proportion of snails was in the windrow, and burning the windrow led to a significant reduction in the populations.

Windrows will attract snails as long as there is little cover on the soil surface.

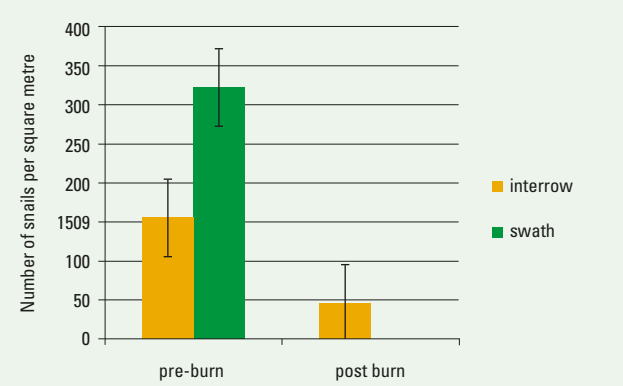


Figure 1: Number of small pointed snails in cereal windrows pre-and post-burning ± standard error

Weed control

Summer weed control

The presence of summer weeds may reduce the effectiveness of fire in controlling snails because green weed material will protect snails. A combination of desiccating weeds and using control methods, such as burning and baiting, can reduce snail numbers more effectively (by up to 95%).

Summer weeds also provide habitat and food sources for snails. If there is sufficient moisture, snails will continue to feed, however, they are not known to breed during summer if these conditions continue.

Fenceline weed control

Snails reproduce less on bare ground. Maintaining a weed free zone approximately two metres from either side of a fence line may help to remove potential breeding grounds.

Grazing

- Grazing animals will knock snails from stubble and may also trample them.
- Control of snails by grazing is variable and will depend on stock numbers and movement.
- Grazing helps to reduce stubble ground cover and decrease refuges for snails.

Chaining or stubble rolling

Chaining or stubble rolling has been shown to be effective if snails are on the outside of stubble and temperatures have been high.

For small pointed snails, however, chaining or rolling did not cause a large number of snail deaths. Live small pointed snails were still found inside flattened canola stalks as well as under clods and in the root zone of the stubble in a chained paddock. In a rolled paddock, small pointed snails were still found surviving under rocks and in the root zone of the canola stalks.

Tillage

The most effective form of tillage to reduce numbers of snails is wide points or full-cut discs that are used in conventional tillage methods. Ploughing the soil to a depth of 10 cm or more will bury surface refuges for snails. Burying snails, especially small pointed snails, can reduce surface numbers of snails by around 40 - 60%.

If tillage coincides with egg laying by snails, it may expose buried eggs to the environment. This may cause eggs to dry out and die, thereby decreasing snail populations.

Cultivation of the soil does bury surface trash, disturbing potential shelters for snails. Ploughing trash residues after harvest has been found to remove over-summering habitat for snails.

Chemical control

Baits

Slugs and snails can only be controlled by baits if they are mobile and looking for food.

Snail numbers should be monitored to determine if there is a need to bait, especially during crop emergence. Trials have shown that baiting will generally only kill 60% of a small pointed snail population at any one time. Better control of 100% mortality has been observed in round snails.

The success of baiting depends on two main factors, i) chance of snails encountering a bait, and ii) ingestion of a lethal dose. Snail cage trials undertaken by SCF and DPIRD have shown:

i) Chance of snails encountering a bait increases if:

- Snails are actively moving.
- There is limited alternative food sources, eg green plant material.
- Baits are evenly distributed and there are ideally more than 30 baits per square metre.

ii) Ingestion of a lethal dose depends on snails actively feeding because:

- All bait formulations were found to cause mortality.
- There was no difference in the efficacy of a rainfast versus a non-rainfast bait. However, non-rainfast baits lose their integrity after 14 days.
- The amount of active ingredient per bait did not affect mortality in snails.

Bait rates

Baiting with multiple applications rather than a single application of a high rate may be a better option as some pellets lose their effectiveness after a few nights. Consider increasing baits up to the highest registered rate if there are more than 80 snails (either round or conical) per square metre.

When to bait

The best time to apply pellets is early in the season when morning temperatures are low and dew forms, and after the first good germinating rains - this is when snails begin emerging and are looking for food. Killing mature snails before autumn egg laying reduces the potential population build up for that season.

Before baiting an entire paddock, consider placing a line of baits across the paddock to make sure snails are actively feeding.

Late bait applications are less effective as there is a lot of green material that provides an alternative food source.

Baits may become covered by soil during rain and decay after wetting. Consider reapplying baits after heavy rain.

All baiting must be stopped at 8 weeks prior to harvest to ensure baits are broken down and do not become a contaminant of grain.

Fence line and border baitings

Snails will spend summer on fence posts and road side vegetation. In autumn, when snails are active, these areas may have a high level of activity and baiting there will decrease the number of snails moving into a crop or paddock. Consider baiting at higher rates if snail numbers are high.

Better calibration of bait spreaders = better baiting, saving time and money

All baits will kill snails if the snails are actively feeding. According to recent trials, even bait coverage across an affected area is more important than bait type. The more even the bait spread is, the more likely it is that snails will come across the baits and feed.

Cost of control

The cost of baits generally increases with rain resistance qualities of the bait type (rainfastness).

More than one bait application may be needed to control snails. In recent seasons growers have reported at least two bait applications and up to four in a single season. Rough costings from baiting on three farms located in South Stirling, Jerramungup and Condingup are shown in Table 2.

South Stirling – Small pointed snails (conical)

South Stirling growers have used both Metakill® and Meta® on separate occasions to manage small pointed snails. In 2016, baits were applied prior to sowing and then on a second occasion due to extensive damage found in barley.

Table 2: Cost of different bait products used by 3 local farms in 2016 and previous years (baits were not mixed).

Products used	Active Ingredient (g/kg)	Cost $/kg	Rate Spread at kg/ha	Cost $/ha
Metakill®	Metaldehyde 50g/kg	$6/kg	5kg/ha	$30.00/ha
Meta®	Metaldehyde 15g/kg	$1.30/kg	7.5kg/ha	$9.75/ha
Aerial Spreading				$8.00/ha

Condingup – Small pointed snails (conical)

In 2016, a Condingup grower spread Eradicate® on one occasion, prior to seeding, to manage small pointed snails. The cost of this application is shown in Table 3. Their plan is to spread Meta® at a higher rate to provide more bait points in 2017.

Table 3: Cost of Eradicate® bait product used by local farm in 2016 (baits were not mixed).

Products used	Active Ingredient (g/kg)	Cost $/kg	Rate Spread at kg/ha	Cost $/ha
Eradicate®	Iron chelate 60g/kg	$3.75/kg	5kg/ha	$18.75/ha
Meta®	Metaldehyde 15g/kg	$1.57/kg	7.5kg/ha	$11.78/ha
Aerial Spreading				$7.80/ha

Jerramungup – White Italian snails

In 2016, Jerramungup grower spread Meta® baits once straight after seeding to manage White Italian snails. This was followed up by targeted baiting on areas with high density snail populations. For 2017, their plan is to bait twice. The first application will be metaldehyde (such as Meta®) or a low-cost bait, a month before seeding and the second application, of a more rain resistant (rainfast) bait such as Slimax®, will be spread just behind the seeder. The cost of application is shown in Table 4.

Table 4: Cost of Eradicate® bait product used by local farm in 2016 (baits were not mixed).

Products used	Active Ingredient (g/kg)	Cost $/kg	Rate Spread at kg/ha	Cost $/ha
Slimax®	Metaldehyde 30g/kg	$6.12/kg	5kg/ha	$30.60/ha
Meta®	Metaldehyde 15g/kg	$1.30/kg	7.5kg/ha	$9.75/ha
Aerial Spreading				$5.00/ha

In many cases, baiting alone does not effectively manage snails. Growers from South Stirlings to Condingup have used pre-seeding windrow burning followed by a bait application after seeding to more effectively reduce snail numbers. Windrow burning is preferred over wide scale paddock burning as it decreases the risk of wind erosion and is more environmentally friendly. Burning reduces stubble cover (snail habitat) and causes 100% mortality to snails under the windrows.

For canola, crop residue is windrowed at harvest time at no extra cost; while cereals commonly require a stubble rake to form the windrow. Stubble raking adds the additional cost of between $10-$15/ha. Windrow burning has previously been costed at approximately $17/ha. This accounts for finance, labour, fuel, repairs, and maintenance for one header as well as nutrient removal.

Sprays

There are no sprays registered for snail control in broadacre cropping. Be aware that insecticides, commonly used to control insect pests of broadacre crops, are not effective against snails.

Applications of liquid N or copper do not kill snails but may act as a deterrent for a short period of time, usually a few days, if there has not been a rain event.

If snail control during the growing season has not been successful, or only partially successful, then the risk of snail contamination in grain at harvest is higher.

The recent tightening of Cooperative Bulk Handling (CBH) standards for snails in feed barley from 10 snails per half litre down to 2 per half litre for 2016/17 and to nil for 2017/8 could have a significant negative economic impact on WA grain growers unless snail control is managed on farms in snail affected areas. Preventing contamination or cleaning grain after harvest may then be necessary and is less cost effective than managing snails earlier in the lifecycle.

Preventing contamination during harvest

If you do have snail contamination in your grain at harvest, one option is to use a combination of header modifications to reduce the number of snails entering the grain sample, although this is likely to be more the case for the larger snail types rather than the small pointed snails. The general trade-off will be reduced harvester throughput and/or increased grain loss.

Minimising snail intake options:

- **Early and strategic harvesting:** as summer progresses, snails become harder to dislodge from the canopy. They are easier to dislodge after light rainfall.
- **Harvest windrows early:** snails are attracted to windrows. Using harvesters with open raking fronts rather than belt feeders decreases snail numbers.
- **Use a stripper front:** this dislodges more snails than a conventional front.
- **Dislodge bars and rotary brush fitted** to the front of the harvester can reduce snail intake: decreasing the amount of snails and muck that has to be dealt with inside the header. These bars are most suited to large round snails located high in the canopy and are more effective when used early in the harvest season.

Maximising snail/grain separation

- **Threshing intensity:** Effective to crush large round snails.
- **Sieve sizes:** Replacing adjustable louvre sieves with fixed aperture sieve designs tailored to the size of snails and grain has proved a reliable modification to harvesters for removing round snails from grain.

Cleaning contaminated grain after harvest

Snail-crushing rollers, in combination with conventional grain cleaners, are effective at removing snails from grain of the same size. Overall performance of a snail roller depends on clearance between the two rollers, grain moisture, roller hardness, speed of rotation and feed rate of grain into the rollers.

The roller provides an economic, high capacity, versatile and effective on-farm cleaning option for snails but alone may not achieve a sample that meets receival standards. Pre-scalping and post screening using a traditional grain cleaner, either side of the rolling operation, are generally required for receival standards to be achieved.

In addition to the snail roller, a field bin and auger are required. If cereals and pulses are to be cleaned, two sets of rollers of different hardness are recommended.

Stirlings to Coast Farmers imported a snail roller to WA in 2016 and are in the process of improving its design for future manufacture. More information can be found on the SCF website – www.scfarmers.org.au

An inclined belt separator can be an effective solution for removing small pointed snails from canola, however, grain losses have also been reported by using this technique. Research at the University of SA assessed the performance of a farmer designed inclined belt separator. This separator concept requires suitable pre-scalping of the sample to remove bigger foreign particles, and provides the only practical solution to the removal of small conical snails from canola. More information can be found in the South Australian publication 'Bash 'em, Burn 'em, Bait 'em', available on the GRDC website at www.grdc.com.au/GRDC-Snails-BashBurnBait

Farm biosecurity

ALERT! Snails pose a significant biosecurity threat as they are easily transported between paddocks, farms and regions. Growers need to be vigilant and inspect equipment before moving it from paddock to paddock or off-farm if they want to reduce the risk of spreading these hard to see pests across farms. Equipment, machinery, vehicles and fodder should be inspected and cleaned thoroughly before bringing on farm. Ensure contractors and visitors to the farm thoroughly inspect and clean machinery and vehicles before entry, or have a dedicated wash/clean down area and monitor the area regularly for snails to reduce the risk of bringing snails onto your property. Small snails can be particularly hard to see and get into the smallest of spaces so extra care is needed when checking machinery.

Further reading

Bash 'em, Burn 'em, Bait 'em – Integrated snail management in crops and pastures (2003) South Australian Research and Development Institute, Adelaide, South Australia.

Snail identification and control – the back-pocket guide (2011) Grains Research and Development Corporation, Canberra, Australian Capital Territory.

Snail Management Fact Sheet – All year-round attack on snails required (2012) Grains Research and Development Corporation, Canberra, Australian Capital Territory.

Identification and control of pest slugs and snails for broadacre crops in Western Australia Technical Bulletin 4713, Department of Agriculture and Food WA, Perth, Western Australia.

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