Removing small conical snails from barley

Using a snail crushing grain roller to remove small conical snails from barley

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KEY POINTS

- Stirlings to Coast Farmers (SCF) sampled 70t Planet barley while it was being processed using a snail crushing grain roller.
- The snail roller reduced snail numbers in the barley by 70%, from 2.2 to < 1 per ½ hectolitre on average.
- The grower determined the optimal gap between rollers was 0.8mm as this setting did not damage grain while still achieving malt or feed receival standards most of the time.
- Rolling the grain did not affect measurements of hectolitre weight, screenings, skinned or cracked grain, protein, moisture or colour.
- Rolling grain can reduce snail numbers in barley to acceptable receival standards, but the set up needs to be right to maximise throughput while keeping the rollers cool.

BACKGROUND

Small conical snails are an emerging pest in southern WA. They can damage crops at germination, reduce pasture biomass and potentially downgrade harvested grain if not managed carefully.

Snail management requires a strategic approach that can include removing the green bridge, burning windrows and timely baiting early in the season to prevent snails from breeding. However, even with a good control program, snails can be a problem at harvest.

The 2019/20 grain harvest in WA saw the tightening standards for snail numbers in barley: currently there is a zero tolerance for snails in both grades of malt barley and a limit of one snail per ½ hectolitre in feed barley.

Snail crushing grain rollers have been used for <10 years in the Yorke Peninsula to remove snails from grains such as canola, wheat, barley, lentils and beans.

Over the 2019/20 harvest Stirling to Coast Farmers (SCF) set out to measure how effective a snail roller was at removing small conical snails from barley in order to meet the current receival standards. We also wanted to determine the optimal set up of the roller to maximise snail removal whilst minimising grain damage.

SCF sampled 70 tonnes of Planet barley before and after it was processed with a snail crushing grain roller. Before rolling, the barley had on average 2.2 small conical snails per ½ hectolitre.

We measured snail numbers and mortality, hectolitre weight, screenings, skinned and broken grains, protein, moisture and colour using CBH facilities and the current GIWA receival standards.

SNAIL ROLLER

This trial used a modified Shmik snail crushing grain roller which had a combination of rubber and metal rollers. Prior to the trial, the grower had modified the hopper shape and auger to optimise both grain flow and snail removal. The roller speed was 620 rpm and the gap between rollers was 0.8mm. The gap was initially set at 0.4mm but this caused the rollers to exceed 65°C which can potentially cause the rubber to fail. Rolling using a 0.8mm gap maintained roller temperatures of 48-50 °C. Modifications were made to the hopper of the snail roller to ensure that the hopper remained full during rolling. Having a full hopper helped to crush the maximum number of snails while maintaining rolling efficiency.

Photo 1. Barley moving from the auger into the hopper of the snail roller. A sensor ensures the hopper remains full to maximise grain turnover and improve snail removal.

Photo 2. The barley flowing between the rollers during sampling. The roller temperature may need to be monitored to make sure it does not exceed 65°C. Using a gap of 0.8mm the roller temperature remained between 48-50°C.

SNAIL ROLLER RESULTS

Using the snail roller with a roller gap set at 0.8mm significantly reduced the number of small conical snails from an average of 2.19 to 0.67 snails per ½ hectolitre ($p<0.001$) which represents a 70% decrease in snail numbers. Prior to rolling, the samples had 1-7 snails per ½ hectolitre, whereas after rolling the samples had 0-2 snails (Figure 1).

Rolling the grain significantly increased snail mortality by 90% ($p < 0.001$) with the average number of live snails per ½ hectolitre reduced from 1 to 0.1 (n=21).

Rolling the barley using a 0.8mm gap between the rollers did not cause any changes to grain quality. There was no significant change in any of the following quality measurements: hectolitre weight, protein, moisture, colour, screenings, skinned or broken grains. This is a reassuring result which demonstrates that under these conditions, rolling barley to remove snails is unlikely to compromise grain quality.

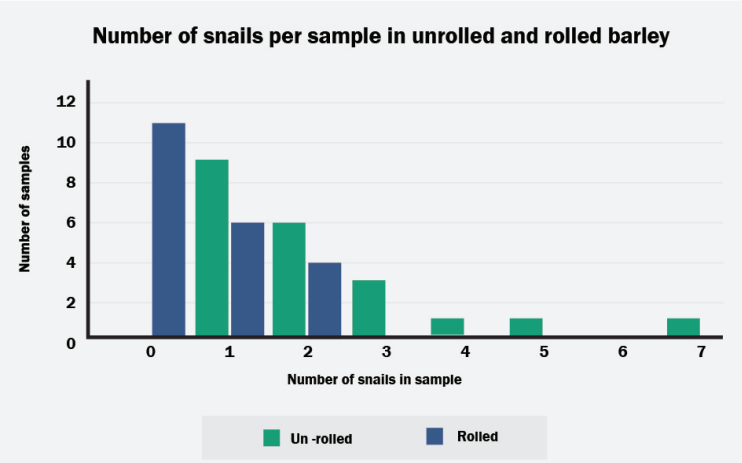

Figure 1. The number of snails per ½ hectolitre in unrolled and rolled barley (n=21). 1 snail = more than half a snail shell.

Table 1. Grain quality measurements conducted on ½ hectolitre samples using CBH facilities and GIWA barley receival standards. Averages and standard errors are given for 21 samples each rolled and unrolled.

Receival standard	Unrolled	Rolled
Number of snails	2.19	0.67
Std. error	0.34	0.17
Number of live snails	1.00	0.10
Std. error	0.14	0.07
Hectolitre weight (g)	316.9	317.8
Std. error	1.05	1.39
Protein %	11.33	11.54
Std. error	0.09	0.06
Moisture %	12.02	12.00
Std. error	0.03	0.03
Colour	55.8	56.1
Std. error	0.12	0.09
Screenings (g)	33.4	35.0
Std. error	0.76	0.88
Skinned grains/100	6.29	6.86
Std. error	0.64	0.43
Broken grains/100	4.00	3.85
Std. error	0.52	0.36

SUMMARY OF ROLLING TRIAL

The roller removed a large proportion of snails from the barley and allowed 52% of the barley to make malt whereas none of the barley would have achieved malt prior to rolling. This was achieved without damaging the grain and maintaining capacity. However, 29% of the rolled grain was classified as feed barley and 19% was undeliverable because it still had 1 or 2 snails per ½ hectolitre, respectively. To consistently meet the malt grade growers may have to clean barley prior to rolling or roll the grain more slowly and with a tighter gap. This technique has been effective to remove small conical snails from canola.

COST OF REMOVING SMALL CONICAL SNAILS FROM BARLEY

Stirling to Coast Farmers (SCF) worked with farm advisor Rod Grieve (*Evans and Grieve*) to compare the options available for removing small conical snails from barley and estimate the costs.

- Currently growers can either:
- Accept a discount or downgrade
- Use a rotary grain cleaner,
- Hire or buy a snail crushing grain roller (either a small or large model), or,
- Use a professional grain cleaner.

The analysis considered:

- The capital costs of cleaners or rollers and associated field bins, augers etc.
- Depreciation of machinery over time.
- Labour and fuel cost.
- Estimated grain losses.
- Changes in grain quality.
- The change in cost with grain volume.

TAKING A DISCOUNT OR DOWNGRADING ON DELIVERY

In the 2019/20 harvest there was no segregation for barley with higher snail numbers so we couldn't estimate the average discount for exceeding snail tolerances. It was more likely that growers with 1 or more snails had their grain downgraded from malt to feed grades where the average spread was $30/t. Since $30/t is higher than the cost of any other cleaning methods for volumes >350t, most growers would be better off cleaning their grain than accept a discount or down grade due to snails.

CONTRACT CLEANING

This is difficult to estimate as accurate information about the rates charged by professional seed cleaners to remove small conical snails from barley are hard to obtain. Anecdotally seed cleaners have said that it is difficult to clean small conical snails from grain without incurring significant losses, particularly if the snails are the same size as the grain. We set the cost per tonne for cleaning the grain at $20/t, which, with an estimated 5% grain losses, means that the cost of getting grain professionally cleaned works out at $25/t. While we have set this as a flat rate here it is likely that the actual cost will vary depending on the volume to be cleaned.

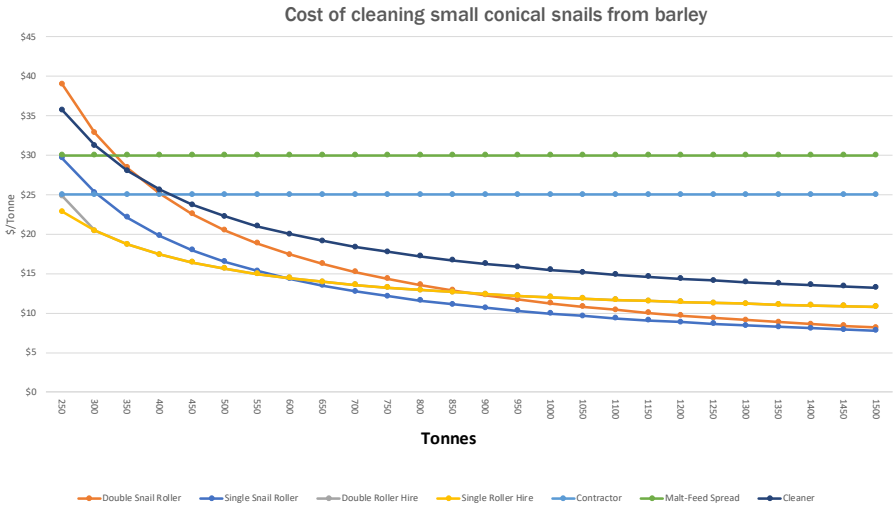

Figure 2. Graph showing the cost per tonne of cleaning small conical snails from barley with increasing volumes of grain. Methods assessed include taking the discount at delivery (Discount), using a professional grain cleaner (Contract cost), cleaning with a rotary grain cleaner (Grain cleaner), and buying or hiring a single or double snail roller.

Table 2. The individual cost per tonne of cleaning small conical snails from barley for volumes between 300 and 1500 t. Methods assessed as for figure 1

	Tonnes processed												
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
Discount	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
Rotary cleaner	$31	$26	$22	$20	$18	$17	$16	$15	$15	$14	$14	$14	$13
Contractor	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25
Hire Single Roller	$20	$17	$16	$14	$14	$13	$12	$12	$12	$11	$11	$11	$11
Hire Double Roller	$20	$17	$16	$14	$14	$13	$12	$12	$12	$11	$11	$11	$11
Buy Single Snail Roller	$25	$20	$17	$14	$13	$12	$11	$10	$9	$9	$8	$8	$8
Buy Double Snail Roller	$33	$25	$21	$17	$15	$14	$12	$11	$10	$10	$9	$9	$8

ROTARY GRAIN CLEANERS

While we did not test a rotary grain cleaner in this trial, it is likely to be the first option for many growers if they already have a cleaner on farm. From our canola cleaning trials we know that using a grain cleaner can be one of the more expensive cleaning options, largely due to grain losses, which we estimated at 5%. There is obviously a trade-off between using finer sieves to remove more snails and incurring larger grain losses. In the canola trial we found that reducing the slotted screed size by 0.3mm increased grain losses by 5% but reduced snail numbers by 95%. If growers can manage to process or use their seconds, this would obviously reduce the cost of using a rotary grain cleaner. If a grower has high numbers of snails it may be necessary to use a grain cleaner prior to rolling.

SINGLE AND DOUBLE SNAIL ROLLERS

We compared the cost of hiring or buying a snail roller since both options were used by growers in the 2019-20 harvest. The cost to dry hire a single or double snail roller was $5 or $7\t respectively. However, the costs associated with running the roller such as labour, fuel augers and field bins etc. will be the same whether growers hire or buy. The difference in cost of hiring a single or double snail roller was negligible after growers cleaned their first 300t as the speed of the bigger roller compensated for the extra cost. Hiring a roller was cheaper than buying a roller for the first 600-850t cleaned but thereafter became more expensive. The risk of not being able to hire a roller in a timely manner during harvest should be considered if you do not have adequate grain storage on farm.

In this analysis there was no extra cost associated with using a grain roller due to grain damage. However, if you had more snails per half a hectolitre and were required to run the roller harder to achieve the receival standard, then this will increase the cost of using rollers. Similarly, if growers with high snail numbers were required to either clean the grain before rolling or roll the grain twice to make specification, then the cost of using a roller will increase.

LABOUR COSTS

Cleaning or rolling grain is generally a full-time role and not something you can set and forget. Labour costs were based on the need for someone to regularly monitor the flow grain from chaser bins, through various augers and field bins to cleaners, rollers and ultimately onto a truck. In addition, augers and tractors need refuelling, the roller temperature needs monitoring and snail numbers need to be checked regularly. While labour contributed to between only 2 - 7% of the cost of cleaning or rolling grain, it can be difficult to employ and retain reliable staff in any farming operation, and needing an extra employee over harvest in order to clean grain is a significant consideration.

CONCLUSIONS

The tolerances for small conical snails in barley are necessarily low, being zero for malt grades and 1 for feed. As a result, it is important to be able to manage snails after harvest. This trial demonstrates that it is possible to remove small conical snails from barley and meet the malt receival standard without damaging the grain.

The grain sampled here had relatively low numbers of snails prior to cleaning (2.2 snails per ½ hectolitre) and we would have liked to have sampled grain with higher snail numbers in order to thoroughly test the roller's capability. However small conical snail numbers in cereals remain relatively low in southern WA. It is most likely that, as with canola, barley containing a higher number of snails will need to be either cleaned and rolled or double-rolled to achieve the tight receival standards.

WHAT'S NEXT?

SCF have their own snail roller which was hired out during the 2019-20 harvest to growers as needed. We will continue to monitor growers who are cleaning grain with either the SCF roller or their own machines and share information gathered on the best techniques to clean small conical snails out of grain.

ACKNOWLEDGMENTS

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