Effective baiting options for the control of conical snails in the Albany port zone

Kathi McDonald, SCF, and Svetlana Micic, DPIRD

Project objectives

It is expected that the main outcome of this project will be that growers will have easy access to information on the most effective bait options for conical snails in the Albany port zone for their farming system.

Our objective is to work out what are the most important factors affecting bait efficacy on small pointed snails. Is it rainfastness, bait formulation active in the baits or the rate applied per hectare? Currently, this is confused by various formulations of various sized baits with differing rainfastness and reported palatability.

The project reports field data only for the 2017 season. Different results may be achieved under different environmental conditions, especially given that snail activity is highly dependent upon environmental conditions.

Methodology

Grower baiting practices survey

In consultation with the other grower groups in the Albany and Esperance port zones, and CBH and DAFWA, a survey of grower baiting practices was designed and distributed to over 200 growers via the online Survey Monkey program, and 'hard copy' paper versions completed at Spring Field days across the region in September and October 2016. Surveys were distributed to all growers attending Spring Field days across the South Coast, and all members from the grower groups covering the southern Agricultural zone were invited to complete the survey on-line. There was no specific selection of participants apart from that they were all likely to be members of a grower group. Responses from 'hard copy' surveys were manually entered in to Survey Monkey, and all results analysed utilising the Survey Monkey analysis tool. A summary of results was written up and is included as an addendum to this report (Appendix A).

Caged baiting trials

For each of the 3 caged bait trials, cages were placed in a randomised block design in a shadehouse, with 4 replicates.

Small conical snails were collected in the field. Only those of uniform size, greater than 0.5mm, and found on the top of grass stalks to ensure they were actively moving were collected.

Snails and baits (applied at label rates) were placed in to cages containing a substrate of sand and peat, with 50g of stubble placed on the surface. The substrate was at field capacity and up to 10 mL of water was added daily to ensure substrate was moist enough to initiate snail movement. Temperatures in the enclosures ranged from 10°C to 32°C. For a list of treatments for each of the caged trials, please see Appendix B.

Counts of live and dead snails were conducted 14 days later.

Results were analysed using ANOVA that incorporated the factorial treatment structure and were reviewed by a statistician.

A letter was sent to all commercial registrants of snail bait products requesting permission to include their product and publish results in trial 3. Only those products readily available and with the registrant's permission were included. A copy of the letter is included in Appendix C.

Field trials

Three sites were chosen in paddocks with a known history of snail infestation, at different locations on different soil types – forest gravel, sandplain and Kalgan loam (see location table below). All sites were set up in the same way, and all were sown by the host farmers to canola. Monthly rainfall data from nearby weather stations was collected over the duration of the trial and is presented with the results.

Trials were pegged in one bank, with 3 replicates. Three treatments were applied at each site – nil baiting, rainfast bait and a non-rainfast bait. All baits were applied at label recommended rates. Each of these treatments was applied at the following times;

- Treatments applied post-harvest
- Treatments applied pre-seeding, at time of first weed control (Autumn)
- Treatments applied post-seeding, pre-emergence
- Treatments applied at crop germination

Host farmers applied all herbicides, fertilisers etc as per rest of paddock

Two weeks after the final bait application, plant damage assessments (% of cotyledon and true leaves damaged by snails) and counts of live and dead snails in 4 x 0.1m^2 quadrats per plot were recorded.

Results were analysed in GENSTAT ANOVA with a split plot design and were reviewed by a statistician.

Field cage trials – snail mortality

Twenty four large snail proof cages (plastic tubs with the ends cut out) were dug in to the ground along the fence line adjacent to the field trial at Kendenup in the late summer. Snails were collected and placed along with bait treatments in the cages at the same time as treatments were applied in the adjacent field trial. There were 3 treatments x 8 replicates for each time of application. All baits were applied at label recommended rates. Snails from half the reps were collected 20 days after and were placed on moistened filter paper. Active live snails were counted 24 hours later. The remaining 4 reps were harvested 24 hours prior to the next time of application, with snails collected and placed on moistened filter paper, and counts of active live snails taken 24 hours later.

Results were analysed in GENSTAT ANOVA with a split plot design and were reviewed by a statistician.

Results

Bait practices grower survey

Please refer to the attached report, *'Snail and slug baiting practices grower survey – summary of results'* for complete results for the survey. The main points from the report are listed below.

- Small pointed conical snails are an increasing problem in the Albany and Esperance port zones, with almost half of the survey respondents indicating snail presence on their farms. Almost 60% of those with presence reported a level of infestation that required a baiting program.
- Most growers are only recently becoming aware of the problem, although some have recognised snails as an issue for over five years.
- Canola and barley were the crops reported as most affected by snails (and canola by slugs).
- Snails were found across all soil types on respondent's farms, most commonly occurring on sandplain and duplex soils (these are also the most common soil types across the south coast). Slugs were predominantly recorded on clay and, to a lesser extent, duplex soils.
- Of those respondents that had applied baits in the past five years, most applied baits only once in the year, although 40% did apply baits twice. Most baits were applied in the post-seeding period, but some did also apply pre-seeding. Generally, growers that applied baits twice a year applied them pre- and then post-seeding.
- The level of infestation is the greatest consideration for respondents on whether to apply baits.
- Metaldehyde baits were by far the most commonly applied. These are also the most widely available with the largest range.
- Baits are mostly applied at recommended label rates, and are applied via spreader (baits alone). Some application via spreader (with fertiliser) or plane (aerial) was also reported.
- Respondents were mixed in whether they considered baits an effective control for snails, with almost 60% being unsure. Baits were considered an effective control for slugs by most.
- Apart from baiting, burning (of windrows and whole paddock) and good farm hygiene/biosecurity were considered as control measures.

Delivery to CBH of snail contaminated grain does not appear to have been an issue for most respondents, however almost 15% did record that they had some difficulty in the past five years.

Caged bait trials

In the caged trials, baits caused significantly ($p<0.001$) more snails to die than the control (nil baits) (Figures 1 and 2). However, there were no significant differences in how well the baits worked. Baits with the active ingredients metaldehyde, methiocarb and iron all caused similar mortalities to small conical snails (Figure 1).

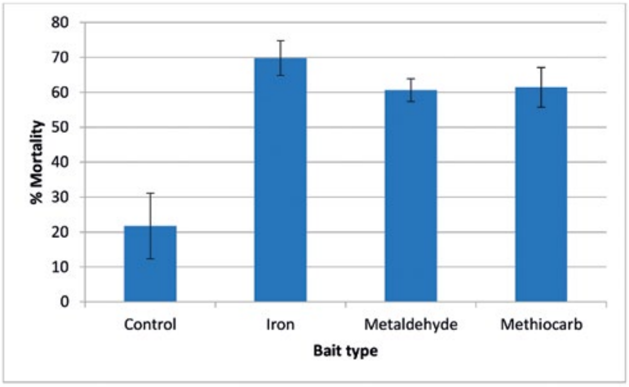

Figure 1: *Percentage (%) of dead snails at Day 14 after being exposed to different bait types. Error bars represent the standard error of the mean.*

➤ Metaldehyde baits with a higher percentage of active ingredient did not cause more mortality than baits with less active (Figure 2).

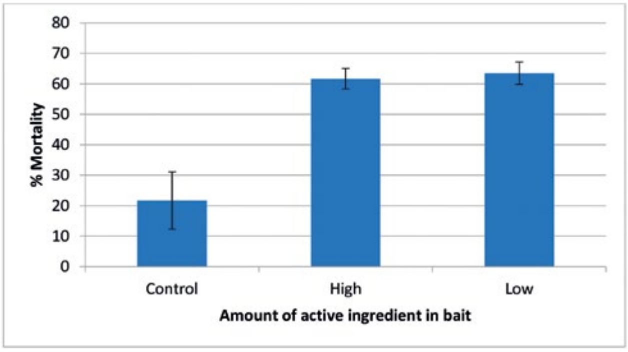

__Figure 2:__ Percentage (%) of dead snails at Day 14 after being exposed to baits with the same active ingredient but varying amounts of active ingredient in each bait. Error bars represent the standard error of the mean.

However, the number of bait points was a significant ($p<0.001$) factor in snail mortality. The more bait points there were, the more snails were killed (Figure 3).

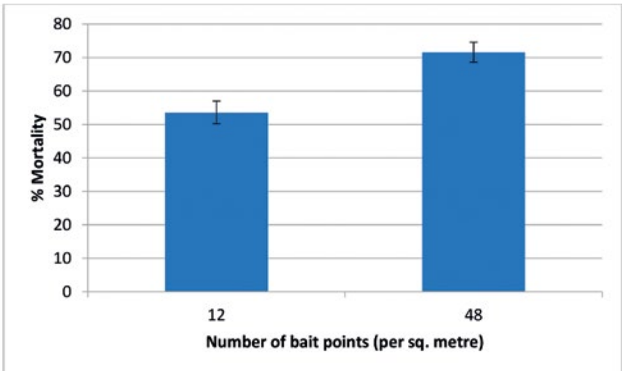

__Figure 3:__ Percentage (%) of dead snails at Day 14 after being exposed to baits with either 12 or 48 bait points per square metre. Error bars represent the standard error of the mean.

Rainfast and non-rainfast baits caused similar mortalities to small conical snails (Figure 4).

However, by Day 14, there was a difference in the structures of the baits. Non-rainfast baits had begun to degrade and were no longer shaped as a pellet, whereas rainfast baits still held their integrity as a pellet.

Analysis of photographs taken at Days 7 and 14, showed that over 80% of snails had not moved in baited enclosures, whereas 100% of snails had moved in the control. This indicates that by Day 7 snail death had already occurred in baited treatments.

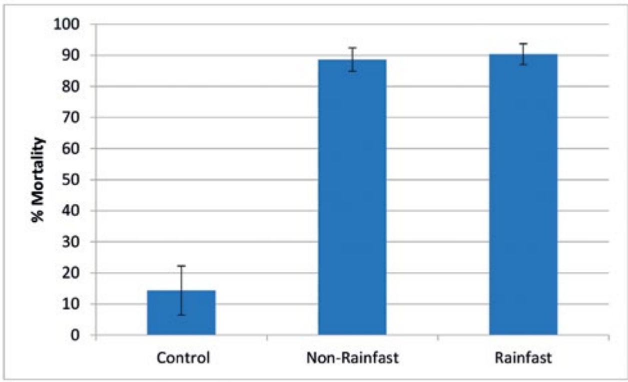

__Figure 4:__ Percentage (%) of mortality in snails at Day 14 after being exposed to rainfast or non-rainfast baits. Error bars represent the standard error of the mean.

Metaldehyde based baits caused similar mortalities to snails as iron based baits. There was no significant difference ($p=0.178$) between these formulations.

When all bait types were grouped together, metaldehyde and iron based baits caused similar mortalities in snails and were not significantly different ($p=0.164$).

Bait formulations containing iron caused similar mortalities in snails so were not significantly ($p=0.679$) different.

However, different bait types containing metaldehyde were found to be significantly ($p=0.038$) different in the number of snails killed (Figure 5) when compared to the control.

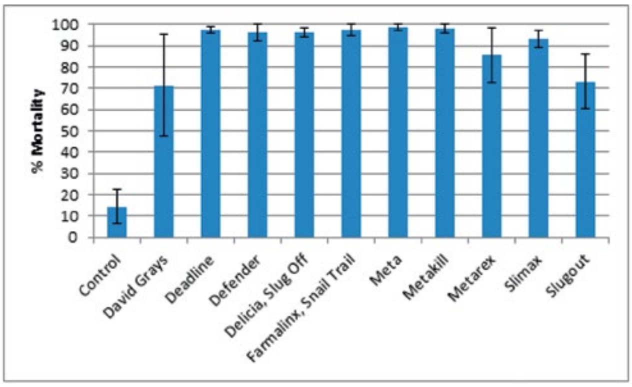

__Figure 5:__ Percentage (%) of mortality in snails at Day 14 after being exposed to different metaldehyde based baits. Error bars represent the standard error of the mean.

The amount of active ingredient in the baits does not explain the differences above as baits with the lowest amount of active ingredient, eg Meta contains 15 gai/kg, caused 98% mortality to snails in this trial.

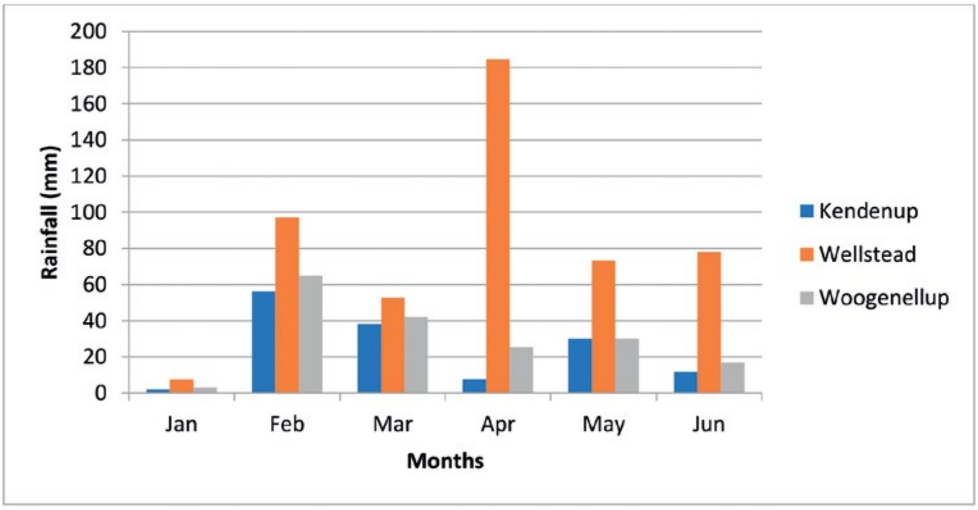

Figure 6: Monthly rainfall totals for weather stations located near each of the three trial sites.

Field trials

Monthly rainfall data was collected from nearby weather stations for each trial site and is presented below. Wellstead recorded consistently higher rainfall over the duration of the trial than either Woogenellup or Kendenup.

It was not possible to monitor the number of live snails at each site, as snails moved between plots. A single snail count was conducted at the end of the trial at each site. Different numbers of live snails were present over the three sites, Woogenellup had on average 149 snails; Wellstead 159 snails and Kendenup 56 snails per square metre.

Statistical analysis of each site separately did not show a significant difference in the number of snails between treatments or amount of damage between plots.

The Kendenup trial site had low snail numbers and very low levels of crop damage were assessed as a result.

The Wellstead site did show a significant interaction in the treatments. The interaction reflects that post-emergence there were significantly ($P = 0.017$) lower snail numbers as a result of bait treatments (Table 1).

Table 1: Average snail numbers at Wellstead for all plots counted 14 days after final bait application.

Time of bait application	Control	Non-rainfast bait	Rainfast bait
Post-harvest	25.0	42.5	51.7
Pre-seeding	12.5	24.2	51.7
Pre-emergent	44.2	33.3	6.7
Post-emergent	87.5	8.3	10.0

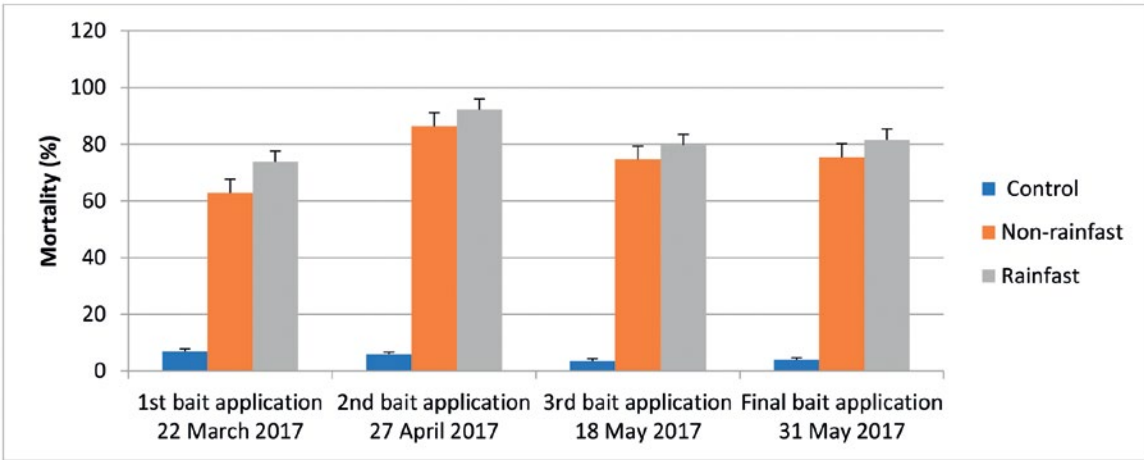

Figure 7: Percentage mortality in small pointed snails exposed to baits after 4 different times of baiting. Error bars represent standard errors.

Caged field trial – snail mortality

The timing of assessments of mortality of small pointed snails at 20 days was not significantly different to that of mortality assessed at 20+ days (P>0.05). This means that within 20 days snails that were going to consume the baits did so. Consequently, there was only one time of assessment of mortality of snails exposed to baits at the last baiting time.

Baits applied in April caused more mortality than baits applied at any other time (Figure 7, see previous page). In this case, there was also a difference between the two baits, the rainfast bait caused significantly (P=0.015) more mortality in snails than the non-rainfast bait.

Discussion of Results

The grower survey on baiting practices highlighted the increasing spread and impact of snails and slugs to growers in the southern agricultural regions of WA. While the findings also indicated that the majority of growers with a snail problem did engage in a baiting program, 60% of these were unsure as to the effectiveness of baits to control small conical snails. This project investigated the effectiveness of a range of baits and baiting strategies in the glasshouse and in the field across three different soil types.

The caged trials in the glasshouse showed that there was no difference in snail mortality from different bait formulations or amount of active ingredient. The main influence on snail mortality was the number of bait points per square metre – the more bait points the higher the snail kill. Snails did not appear to be attracted to particular baits, but only randomly came across them. Snails fed on all baits they came across. These results highlight the importance of having properly calibrated spreaders and achieving an even spread of baits across the paddock to increase the chances of snails coming across the baits and feeding upon them.

The field trials compared a non-rainfast bait with a rainfast bait, applied at four different times – post harvest, pre-seeding, pre-emergence, and post-emergence, across three different soil types – forest gravel, south coast sandplain and Kalgan loam. Despite having a paddock history of high snail numbers and crop loss due to snail damage (as indicated by the host farmer, and the main reason this site was selected) the Kendenup site had over all low snail numbers. It is possible that because of the generally dry conditions experienced at the site during the trial (Figure 6) snails were not actively moving and feeding and so were not visible. This fact highlights the importance of projects continuing over multiple seasons to ensure results take in to account seasonal variation in real world situations.

The remaining sites showed significantly increased snail numbers on control plots compared to baited treatments. All baiting treatments were effective in reducing snail numbers. There were no differences observed between the two bait types in the field, however there was a difference between bait timing, with less snail numbers found in plots baited after seeding.

Results from Wellstead did show a significant interaction between time of applications and bait treatments. There was no difference in snail numbers at the end of the trial between the two bait treatments for the two earliest times of application. This could possibly be due to the act of seeding burying any remaining baits on the plots and making them unavailable to snails that moved in to the area post-seeding. Snail numbers were lower for the rainfast baits compared to the non-rainfast baits for the pre-emergent time of application. This occurred in April when the site experienced high rainfall (figure 6) and non-rainfast baits applied at this time may have been compromised.

Results from the forest gravel field site at Kendenup were not included due to low snail numbers. Snails had been observed, though not counted, actively moving in greater numbers at this site earlier in the season (March). While receiving some good early rains in summer and early March, the site had not received significant further rain and was very dry over the trial period. It may be that snails that were previously actively moving at the site had returned to a dormant state due to the dry conditions and simply were not feeding, on either baits or plants. Despite a similar rainfall pattern (Figure 6) the site at Woogenellup did have high snail numbers. This site had significant quantities of stubble and trash retention, and the soil under this was noticed to be damp, possibly providing the snails with moist refuges to continue their life cycle despite the lack of rain. Mating and egg laying was observed at the time of final assessment (mid-May) at Woogenellup.

Baits applied in April in the field cages caused more snail mortality than at any other time. It may be that this coincided with a time that snails were most active and there were little alternative feed sources to 'distract' snails from the baits.

To minimise crop damage, baits need to be applied close to the time of germination, when snails are actively moving and feeding. Previous studies have found that cultural activities such as windrow or paddock burning can also be effective at controlling snail numbers but are only appropriate on heavier soil types that are not liable to be subject to wind erosion.

Further research investigating the implications of multiple versus single baiting options in a season, and the resulting impact on snail populations at the end of the season (at harvest) as well as prevention of damage to emerging crops at the beginning of the season, would better enable growers to make decisions on the most appropriate baiting strategies for their farm.

Conclusion

Small pointed conical snails are becoming an increasing issue in the Albany and Esperance port zones. Snails were reported across all soil types with canola and barley the crops most commonly impacted by snail activity.

Growers commonly bait once a year, post-seeding. For those that bait twice a year, baits are generally applied pre- and then post-seeding. Metaldehyde baits are the most commonly used bait type, generally applied via a spreader, baits alone, or sometimes mixed with fertiliser. A small amount of aerial application was reported.

Despite many of the grower respondents to the survey engaging in a baiting program, almost 60% were unsure as to its effectiveness in controlling small pointed conical snails.

Caged trials showed that there is no difference in the efficacy of a rainfast versus non-rainfast bait. However, the trials did suggest that non-rainfast baits lose their integrity after 14 days in wet conditions.

All active ingredients cause mortality to snails. However, there is more product choice in the metaldehyde range. In this range of products, Meta is one of the least expensive products on the market ($4/ha) and is non-rainfast; Metakill is rainfast, is more expensive ($8/ha) and contains 35 gai/kg more than Meta.

However, the caged trials show that the amount of active ingredient per bait does not affect mortality in snails.

In the field trials, less snails were found in plots with baits applied 2 or less weeks prior to crop germination. Baits applied 4 or more weeks prior to crop germination, need to be reapplied to suppress snail damage to germinating crops.

Results from Wellstead showed a significant interaction between the bait types and time of applications. It appears that at times of high rainfall/intense rainfall events, non-rainfast baits may be compromised and not as effective at controlling snail numbers.

Results from the field cages at Kendenup showed that baiting late in April when snails are actively moving and feeding will lead to a better kill.

From the results of the caged and field trials, it can be concluded that for protection at crop emergence, growers should be baiting close to the time of crop emergence. Depending on environmental conditions, cheaper non-rainfast baits can be just as effective as rainfast baits. However, the non-rainfast baits do lose efficacy in wet conditions and if longer term crop protection is needed, the rainfast baits are likely to be more effective. Multiple applications of non-rainfast baits may be another option.