FINAL REPORT 2015

Applicants must read the *SAGIT Project Funding Guidelines 2014* prior to completing this form. These guidelines can be downloaded from www.sagit.com.au

Final reports must be emailed to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.

PROJECT CODE	:	**YP 12-01**

PROJECT TITLE (10 words maximum)
Testing Innovative Snail Management Techniques on the Yorke Peninsula

PROJECT DURATION

*These dates **must** be the same as those stated in the Funding Agreement*

Project Start date	**March 2012**
Project End date	May 2015

PROJECT SUPERVISOR CONTACT DETAILS

The project supervisor is the person responsible for the overall project

Title:	**First Name:**	**Surname:**
Mrs	Kristin	McEvoy
Organisation:		
Yorke Peninsula Alkaline Soils Group		
Mailing address:		

Telephone:	**Facsimile:**	**Mobile:**	**Email:**

Office Use Only

Project Code	YP12-01
Project Type	Research

ADMINISTRATION CONTACT DETAILS

The Administration Contact is the person responsible for all administrative matters relating to the project

Title:	**First Name:**	**Surname:**
Mrs	Emma	Reade
Organisation:		
Yorke Peninsula Alkaline Soils Group		
Mailing address:		

Telephone:	**Facsimile:**	**Mobile:**	**Email:**

PROJECT REPORT

Provide clear description of the following:

Executive Summary (200 words maximum)

A few paragraphs covering what was discovered, written in a manner that is easily understood and relevant to SA growers. A number of key dot points should be included which can be used in SAGIT communication programs

Testing of innovative snail management techniques included initial testing with caffeine and Larvin 350. Significant further work was undertaken by SARDI focusing on efficacy of various commercially available baits. Regular collection of two snail species was carried out with speciemens frozen and stored in ethanol for dissection at SARDI. Research concluded that -

- Baits do kill juvenile snails
- Stubble and/ or green plant material reduces uptake of snail bait by juvenile snails.
- Optimal snail control will involve an integrated program of appropriate stubble and weed management at pre sowing.
- Bait spreaders need to be calibrated accordingly to optimize an efficient baiting program.
- Perlka did not have anhy significant effect on reducing snail population in caged field trials.
- Effectiveness of bait trials and bait size differs between snail species. Future research will enable bait programs to have recommendations appropriate for different species.
- A survey on cultural snail control practices by local farmers showed that 100% of farmers have found snails on their properties with 47% repoting an increase in snails numbers.

Project Objectives

A concise statement of the aims of the project in outcome terms should be provided.

The aim of this project was to investigate the role that various innovative on ground management techniques could have on reducing the ongoing and spreading impact of snails on crop productivity on Yorke Peninsula.

Methods included use of perlka and caffeine baits which were found to have little effect. The influence of crop and stubble on bait efficacy to control juvenile snails was investigated as was the effectiveness of spreader machinery in distributing snail and slug baits. The effectiveness of bait size and whether smaller bait fragments are as effective was tested with individual species data sets recorded on the amount of bait consumed. Influence of crop and stubble on bait efficacy to control juvenile snails demonstrated that baits are effective. The primary finding of the spreader machinery testing showed that the effective spread (bout) width of snail/slug bait was less that would be achieved when spreading fertiliser and differences were also evident between bait products. Even with best operational setting for each spreader, the spread width was consistently less than anticipated. Bait product and size had significant effects on the mortality of round snails but not for the conical snails and consumption values indicated a deterrent effect of meta bait. T. pisana snails (round snails) demonstrated significant differences in mortality between bait sizes and bait products. C. Virgata snails showed similar results with the exception that higher mortality occurred in the meta treatments. For C. acuta, no significant differences in mortality or consumption occurred.

Overall Performance

A concise statement indicating the extent to which the Project objectives were achieved, a list of personnel who participated in the Research Project including co-operators, and any difficulties encountered and the reasons for these difficulties.

Scientific personnel who were primarily involved in this project were Greg Butler (SANTFA) who did initial caffeine and Larvin 500 experiments. SARDI scientists, Greg Baker and Helen de Graaf continued cage and lab research, focusing on bait types, amount and efficacy.

Project objectives of investigating innovative techniques were achieved and ranged from recommendations of spreader calibration to the findings of the inefficacy of perlka as a snail control product.

There were no difficulties encountered in the actual trial research however, a year into the project a deed of variation was required to place SARDI in control of achieving objectives instead of SANTFA. A consultative working team of growers, scientists, SAGIT and YPASG representatives was formed after this and met to discuss snail management updates on a yearly basis.

Key Performance Indicators (KPI)

*Please indicate whether KPI's were achieved. The KPI's **must** be the same as those stated in the Application for Funding and a brief explanation provided as to how they were achieved or why they were not achieved.*

KPI	***Achieved (Y/N)***	***If not achieved, please state reason.***
2012, 2013, 2014 – Trial site selected	Y	
2012, 2013, 2014 – Trial design and treatments finalized and modified if required	Y	
2012, 2013, 2014 – Treatments applied	Y	
2013, 2014, 2015 - Trial results analysed, communicated and extended 2013 – Survey of grower management practices.	Y Y	

Technical Information (Not to exceed **three** pages)

Provide sufficient data and short clear statements of outcomes.

Effect of perlka on snail eggs – eggs from round snails (t.pisana) were collected from soil near Warooka. Plastic containers were prepared and 45 eggs and treatment applied to soil. Containers were incubated for 34 days with simulated rainfall to maintain soil moisture and numbers of hatched snails recorded. The results of lab trials indicate Perlka has a significant effect on eggs hatching under lab conditions. However, it is unknown how long the applied perlka would remain effective in preventing or limiting egg hatching in paddock conditions. The product, even applitd at the low rate of 250kg/ha tends to cause plant phytotoxicity. In canola crops it is recommended that Perlka is applied either pre sowing or after the 6 leaf stage which could have a limiting effect on the time of application relative to snail activity and crop vulnerability. Trials were also conducted in large scale field trials in canola and fallow to observe effects on the snail population with inconclusive results.

Efficacy of commercial baits against juvenile snails - TRIAL ONE: Juvenile snails were collected from Warooka (SA). The snail species were: T. pisana, Ce. virgata, C. acuta and P. barbara. Arenas were prepared in field and each contained germinating canola seedlings and stinging nettle weed seedlings.

30 snails (150 snails/m2) were placed in the centre of each arena and bait pellets distributed in an even circle around the snails. All baits were applied at label rates. After 7 days, snails were retrieved and assessed for mortality. The average snail retrieval rate

per cage was 85 ± 1%.
TRIAL TWO: At a wheat crop near Warooka, bait pellets were broadcast across each plot at the label rates. To examine the rate response Product 1 was applied at 2 rates, a low label rate (x) and a double (2x) rate. The pre- and post-treatment numbers of live and dead snails were estimated by collecting all snails in four 0.25 sq. m quadrats per plot and scoring them in the laboratory.
In Trial 1 the overall juvenile snail mortality was 47% and ranged from 18 to 80%. Theba pisana juveniles appeared the least affected by the baits compared to other species (Table 1). This may have merely reflected lower activity levels by this species, however there were some statistically significant differences in T. pisana mortality between several of the tested baits.
Among the other three species, although the mortality caused by the different baits ranged between 30 and 80%, the observed differences in mortality between the bait products were not statistically different. We suspect that higher replication may reveal significant differences. We know that some products perform better or worse under some environmental conditions (Godan, 1983). This trial was conducted in late winter, however better results might have been achieved in autumn. It should be noted that this trial was assessed after only 7 days, so these results do not take into account potential differences in the persistence of different bait products beyond this period.

Table 1. Percent mortality of juvenile snails contained in field arenas with label rates of commercial snail/slug baits and alternative food. (Values are adjusted using Abbott's Correction to account for the control mortality. Values followed by the different letters within the same column are significantly different, Tukey HSD test.)

Bait product*	T. pisana	C. virgata	C. acuta	P. barbara	All snails
Product 1	18.3c	53.4a	56.3a	44.3a	43.1
Product 2	32.0abc	47.8a	44.4a	40.5a	41.2
Product 3	22.7abc	51.6a	30.7a	49.7a	38.7
Product 4	20.6bc	67.9a	39.0a	40.0a	41.9
Product 5	42.8a	80.4a	65.8a	33.1a	55.5
Product 6	40.3ab	63.8a	65.1a	57.6a	56.7
Product 7	34.9abc	52.4a	61.4a	68.6a	54.3
All baits	30.2	59.6	51.8	47.7	
Sig. diff. Tukey HSD (0.05)	P=0.005 21.6	NS (P=0.119) -	NS (P=0.157) -	NS (P=0.191) -	

*Products 1-5 contain the active ingredient (a.i.) metaldehyde, Product 6 contains the a.i. iron EDTA and Product 7 contains the ai methiocarb.
In Trial 2 the overall mortality of round and conical snails was 46% and between product treatments ranged from 35 to 55%. In this trial it was the conical (C. acuta) juveniles that appeared the least affected by the baits compared to the other species - age groups (Table 2), with a mean mortality across the five bait treatments of only 26.7%; this result contrasts with that observed in Trial 1, where the lowest mortality occurred among the T. pisana juveniles.
The relative performances of the specific metaldehyde and mesurol baits were quite similar in each trial. For example, 55.5% (Trial 1) versus 48.1% (Trial 2) for the metaldehyde Product 5, and 54.3% (Trial 1) versus 54.5% (Trial 2) for the mesurol

Product 7. However Product 6 containing iron EDTA performed less well in the second (35.0%) compared to the first (56.7%) trial; whether this difference was due to climatic (e.g. cold weather during the 1st (mid August) trial versus mild-warm weather during the 2nd (mid October) trial) or other environmental difference(s) between the two trials is unclear, but will be the subject of further investigation.

Table 2. Percent snail mortality in Trial 2, Warooka, October 2012. (Values are adjusted using Abbott's Correction to account for the control mortality. Values followed by the different letters within the same column are significantly different, Tukey HSD test.)

Bait product*	T. pisana adults	T. pisana juveniles	C. acuta adults	C. acuta juveniles	All snails
Product 1 – low rate	58.2 a	38.6 c	41.5 a	21.6 a	37.5bc
Product 1 – high rate	75.1 a	69.3 a	68.6 a	30.7 a	53.2ab
Product 5	65.5 a	61.3 abc	55.1 a	30.2 a	48.1abc
Product 6	39.5 a	40.0 bc	26.6 a	14.7 a	35.0c
Product 7	70.3 a	67.5 ab	73.5 a	36.6 a	54.5a
All baits	61.7	55.3	53.0	26.7	45.7
Sig. diff. Tukey HSD (0.05)	P=0.106 39.6	P=0.014 28.1	P=0.049 47.8	P=0.311 38.1	P=0.009 16.2

Effect of size and density of bait pellets on snail mortality

<u>Effect of caffeine on snails in canola windrows</u>

Analysis of this trial is still underway; however initial observations and preliminary analyses suggest that the caffeine did not have a significant impact on snail presence in the windrows. One possible reason for this may be the limited penetration of spray into the dense layered windrow. Additionally we noted that when snails did drop off the surface of the windrows (either from caffeine or disturbance) often they got caught up in the next layer of pods and stems and would still potentially be picked up by machinery at harvest time. A similar trial was conducted in desiccated field peas with potentially more promising results.

<u>Effect of size and density of bait pellets on snail mortality</u>

Size of bait pellet does not significantly influence the likelihood of a snail encountering a bait. Table 3 reveals no change in juvenile snail mortality with whole and half sized pellets for both species tested at 20 and 80 baits/m2 rates. This suggests that doubling the total amount of active ingredient on the ground does not significantly improve snail mortality if the bait density (baits/m2) remains the same. It is the total number of baits on the ground (not total a.i.) that influences the likelihood of snails encountering baits. Doubling the bait density is likely to significantly increase snail mortality. This is made clear in Figure 1, with an increase in T. pisana mortality reflecting the increasing density of whole bait pellets. This trend occurred for both moderate and high snail densities and occurred similarly for C. acuta (graph not shown).

Table 3. Percent mortality of juvenile snails contained in field arenas with Metaldehyde (15g/kg) bait applied at different rates and pellet size along with alternative food. *Closest to label rate. Recommended rate is 16-24 baits/m2 (5 - 7.5kg/ha) (Values followed by the different letters within the same column are significantly different, Tukey HSD test.)

Baits per m2	Bait size	T. pisana	C. acuta
80	whole	70.4a	69.9a
80	half	65.2a	65.0ab
40	whole	62.0ab	65.4a
20*	whole	43.3bc	47.0bc
20	half	35.8c	33.5c
Control (0)	-	3.4d	3.6d
Sig. diff. Tukey HSD (0.05)	-	P<0.001 19.0	P<0.001 18.2

Conclusions Reached &/or Discoveries Made (Not to exceed one page)
Please provide concise statement of any conclusions reached &/or discoveries made.

- Juvenile snails can be killed with bait (mortality 18 – 80 %). However, snails species, bait product and environmental factors will impact bait efficacy.
- Bait efficacy is affected due to a number of factors but studies indicate bait density is more important than bait size. The size of the bait pellet does not significantly influence the likelihood of a snail encountering a bait. Doubling the bait density is likely to significantly increase snail mortality.
- Caffeine treatments do not appear to have any significant effect on snail presence in canola windrows.
- Use of perlka on snail eggs was significant in a lab setting however, questions remain on the efficacy of the product in a paddock situation due to environmental conditions and herbicidal effects.
- Ideally a snail baiting program should focus on the brief period of early season snail activity prior to the beginning of egg laying and appearance of juveniles.
- As a result of a snail management survey, the following factors were identified.

-Half respondents indicated that snails were the major limitation at harvest and that the greatest post harvest cleaning issues were experienced with conicals in canola.
- Calculation of cost to farmer for management (bait only) is $27/ha, post harvest costs (cleaning etc) are calculated at $16.50/ tonne. Growers are likely underestimating the total cost of snails to their farming enterprise.
- Awareness of specialized machinery to manage snails was good however, limited uptake is due to perceived issues with reduced capacity, slower harvesting and unacceptable grain losses. Farmers only consider machinery solutions viable if they do not impede harvest work rates or increase grain loss beyond acceptable limits.
- Conical snails are the most difficult to clean from grain.
- Snails in medium and heavy stubbles are managed by burning (41%), cabling (29%) and rolling (24%).

- Since the 2003 edition on 'Bash 'em, Burn 'em, Bait 'em' harvester capacities have evolved such that some recommendations are now less appropriate.
- Snail spreading machines must be calibrated for optimal settings suited to a particular bait and machine. Settings for spreading urea do not provide efficient spreading width.

Intellectual Property

Please provide concise statement of any intellectual property generated and potential for commercialisation.

Application / Communication of Results

A concise statement describing activities undertaken to communicate the results of the project to the grains industry. This should include:

- *Main findings of the project in a dot point form suitable for use in communications to farmers;*
- *A statement of potential industry impact*
- *Publications and extension articles delivered as part of the project; and,*
- *Suggested path to market for the results including barriers to adoption.*

Note that SAGIT may directly extend information from Final reports to growers. If applicable, attach a list of published material.

Dot points as listed above are suitable for use in communication to farmers.

The potential industry impact for effective snail control is huge. It is estimated that there is a price tag of $40 million in grain value loss, harvester damage and grain cleaning. Some growers on Yorke Peninsula are spending up to $30000 a year on snail baits, at a rate of between $15 and $85 per hectare.

Publication and Extension Articles

Spreader trial slugs snails – GRDC Ground Cover magazine Jan/Feb 2014

Summer rains window for snail control – Stock Journal November 2013

Local Farmers join SARDI in snail battle –Yorke Peninsula Country Times Sep 2013

Spreading word about snail damage on YP – Stock Journal, Dec 2013

Snail baiting, spraying and new distribution research – GRDC, Feb 2013

Improving snail management at harvest: discussion of survey findings and potential new research directions – SARDI, Jan 2015

Opportunities to improve snail control – YPASG newsletter, March 2015

Snail Update – YPASG newsletter July 2014

Can microwaves kill snails – SARDI March 2015

Presentations on this project were made at the following YPASG events – Spring Crop Walk (2012), YP Grower Update (2013), Winter Crop Walk (2013), Spring Crop Walk (2013), YP Grower Update (2014), Spring Crop Walk (2014), YP Grower Update (2015)

As research is ongoing, barriers to adoption are not an issue as yet until definitive control methods are identified. With innovative chemical management of snails, accreditation from relevant industry bodies will be a challenge.

POSSIBLE FUTURE WORK

Provide possible future directions for the research arising from the project including potential for further work and partnerships.

Further trials on the environmental variables that affect bait performance shows potential, including (but not limited to) the effects of temperature, UV light, alternative food sources, bait size, density, species, properties of baits, snail age and timing.

Further testing of 'innovative' techniques for snail control, such as microwave technology, steam and use of novel products such as perlka and caffeine which were researched for this project.

YPASG has a good working relationship with SARDI entomologists and access to a farming area with arguably one of the worst snail infestations which bodes well for cooperation into the future.

AUTHORISATION
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Signature:
Date:16/10/2015

Submit report via email to admin@sagit.com.au as a Microsoft Word document in the format shown ***within 2 months*** after the completion of the Project Term.