Department of
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GOVERNMENT OF WESTERN AUSTRALIA

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Monitoring small pointed snails and slugs for time of egg lay using cameras

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Introduction

Before snails lay eggs, the albumen gland starts to increase in size. The albumen gland produces a nutritive secretion onto the fertilised egg. Until this gland is developed, snails are not sexually mature nor laying eggs. If the timing of when this gland begins to develop is known, then control measures such as baiting can be implemented before egg laying. When control measures are put in place before eggs are laid the overall snail population will be reduced.

The most common control measure for snails is baiting. Commercial snail baits have varying degrees of weather fastness that can influence efficacy under different weather conditions. Effective baiting takes account of conditions that increase interception by actively moving snails and bait efficacy.

Aims

To determine environmental triggers that initiate movement, feeding and formation of the albumen gland in small conical snails.

Methods

Monitoring locations

This activity is continuing from snail monitoring and sampling sites conducted in the Esperance Port Zone by consultants at Farm and General and at the Albany Port Zone by DPIRD. Monitoring sites in the Esperance Port Zone were located at Condingup and Dalyup in 2017 and 2018, and at Scaddan, Gibson (Esperance Downs Research Station, EDRS), and Dalyup in 2019. Monitoring sites in the Albany Port Zone were located at Woogenellup in 2017 and 2018, and at Mount Barker in 2019.

Albumen gland size

Snails were collected at least monthly for 3 years. At least 20 snails were collected at each sampling time from each location. Snails were placed into a jar filled with water for 24 hours to drown, water was then drained and jars filled with 70% ethanol to preserve snails. Using a dissecting microscope, the shell length was measured before the albumen gland from each snail was removed and its length measured.

Scoring snail movement and weather parameters

Snail movement was monitored using time-lapse cameras, capturing an image every minute. At the 2019 EPZ monitoring sites, snail movement was scored 0-3 each 15 minutes block; 0 being no movement, 1 being very little snails moving slowly, 2 being snails moving with some feeding, and 3 being high snail numbers and high levels of activity. Weather parameters were logged for 1 minute every 15 minutes at each site using Hobo weather stations and sensors. These parameters were relative humidity (%), air temperature (ºC), soil temperature (ºC), leaf wetness (%), and soil water content (m^3/m^3). Rainfall data was collected from the nearest DPIRD weather station.

At the 2019 APZ monitoring site snail movement was scored from 0-1 each 1 hour block; 0 being no movement, 1 being snail movement. Relative humidity, soil temperature and air temperature was recorded every 1 hour and data collected from the nearest DPIRD weather station.

Data analysis

Mean weather variables (relative humidity, air temperature, soil temperature, leaf wetness and soil water content) were calculated from between 6pm and 6am daily. Snail activity was calculated as percent time snail movement score was above 0 between 6pm and 6am.

Results and Discussion

Time of egg lay based on albumen gland size

Increase in albumen gland size of snails was observed earlier in autumn when there was summer rainfall. The start of albumen gland size increase occurred 2-4 weeks earlier at sites and years with summer rainfall compared to no summer rainfall. For example, increase in gland size of snails collected in the Esperance port zone started from mid-March in 2018 when there was a wet summer, and from mid-April in 2019 when there was a very dry summer. However, all sites across all years consistently reached maximum mean albumen gland size by the first week of May (figure 1). This indicates that at this time most snails are laying eggs. Therefore, control for snails needs to occur before May to ensure eggs have not been laid, ideally in March and April.

Conditions required for snail movement

At Scaddan and EDRS increasing snail movement was strongly correlated with relative humidity and leaf wetness and negatively correlated with canopy and soil temperature (table 1). Only March to September data was included in these analyses as the strength of the correlation between relative humidity and snail movement decreased past September. One explanation for this could be the nature of monitoring only capturing an area under the field of view of the camera and other factors influencing the snail population (e.g. presence of alternative habitats in the crop area, death of larger mature snails). Past September, it was observed that the snail population in the monitored areas of the paddocks had drastically reduced in abundance. Yet the exact reason could not be confirmed.

Snail activity occurred when relative humidity was around 70% though they were most active when RH was >85% (Figure 2). Of the nights (6pm-6am) when mean RH was >90%, snails were active for 73% of the night at EDRS, 54% at Scaddan, and 66% at Mount Barker. Snail activity was observed 98%, 86%, and 85% of days when mean RH was above 90% at EDRS, Scaddan, and Mount Barker, respectively. Days with mean RH between 80-90% had 71, 35, and 80%with snail activity (table 2).

A score of three for snail movement only occurred when relative humidity was above 85% except for two points. Over 90% of scores of two were given when RH was >85%. A score of one was recorded when RH was above 80%, 98% of the time (figure 3).

Discussion and other baiting considerations

The start of albumen gland development consistently began in mid-March, peaking by the start of May, meaning a large proportion of the population is able to lay eggs. Therefore, bait timing should occur in the period between mid-March to May. This period also coincide with prevalence of conditions conducive for increased snail activity. This project has shown that snails are more likely to encounter a bait during periods of high relative humidity (overnight average above 85%) and mild temperatures.

Summer rain may trigger conditions conducive to snail movement and increase albumen gland size. Despite this, it is variable as to whether snails will die after consuming baits. Micic (2020) found that snails will continue to feed on green material and baits over summer though their mortality from bait consumption varied significantly throughout the year. In a separate study, Brodie (2020) found that increase mortality from bait consumption coincided with the period of snail reproduction, from April to September. Therefore, it is recommended that a small area be test baited prior to baiting to ensure baits are effectively controlling snails.

Rain-fast baits can increase the baiting window yet are costly. Farmers should aim to spread baits when overnight relative humidity will be above 80% but not when there is forecast heavy rain events to avoid baits degrading. There is currently only one active ingredient in snail baits, metaldehyde. Yet the composition of baits varies giving them different ability to maintain their integrity under environmental conditions. The most commonly used baits have limited rain-fastness and metaldehyde can degrade under extended exposure to high temperatures (Nash *et al.* 2016).

Nash *et al.* (2016) found that soil wetness was positively correlated to white Italian snail movement that equated to snail movement occurring at 90% relative humidity during summer and 80% relative humidity in autumn. Greater percentage of snail movement at EDRS and Mount Barker when relative humidity was below 90% compared to Scaddan (table 2) may reflect the requirement for higher relative humidity in summer compared to autumn.

There is no evidence to suggest that snails are attracted to baits; baits need to be spread at sufficient density to increase likelihood of snails randomly encountering baits. In caged field experiments in South Australia, optimal number of baits was determined to be 30 pellets/m^2, high snail densities may require 60 pellets/m^2, and repeat applications may be necessary to achieve sufficient control (Brodie *et al.* 2020). In addition, spreader calibration is an important consideration to ensure good control. Aerial baiting resulted in highly variable spread of baits, potentially costing 50% more to the grower to reduce spreader widths and achieve sufficient bait points (Micic, 2016).

Recommendations:

Aim to bait from mid-March to mid-April before seeding, and consider baiting again immediately post seeding. This timing will increase bait efficacy, increase likelihood of conditions suitable for snail movement, and be timed before most snails lay eggs.

Bait in autumn not summer even if there is a lot of summer rain as control from baits can be low during summer

Relative humidity above 85% is when snails are most active, so plan baiting to be before forecast periods of extended high humidity. Throw out test area before baiting whole program to be sure.

Extension and communication

Sarah Belli and Svetlana Micic presented data on albumen gland development at the Crop Updates

SEPWA newsletter May 2020

Tables and figures

Table 1. Correlation of snail activity with mean weather parameters. Snail activity (as per cent time snail movement score was above 0) and average weather variables were calculated from between 6pm and 6am daily.

Location	RH	Air Temp	Soil Temp	Soil water content	Leaf wetness
EDRS	0.67	-0.36	-0.27	0.25	0.63
Scaddan	0.54	-0.32	-0.14	0.41	0.54

Table 2. Days with snail activity at different ranges of mean relative humidity (6pm-6am). Snails were most active when relative humidity was above 90%

Location	**Mean RH %**	**Number of days no activity**	**Number of days with activity**	**Days with snail activity >0 (%)**	**Mean time snails active (%)**
EDRS	< 80	24	10	29	6
	80 - 90	7	17	71	31
	> 90	1	51	98	73
Scaddan	< 80	24	2	8	1
	80 - 90	15	8	35	12
	> 90	13	78	86	54
Mount Barker	< 80	34	56	62	58
	80 - 90	22	90	80	60
	> 90	8	45	85	66

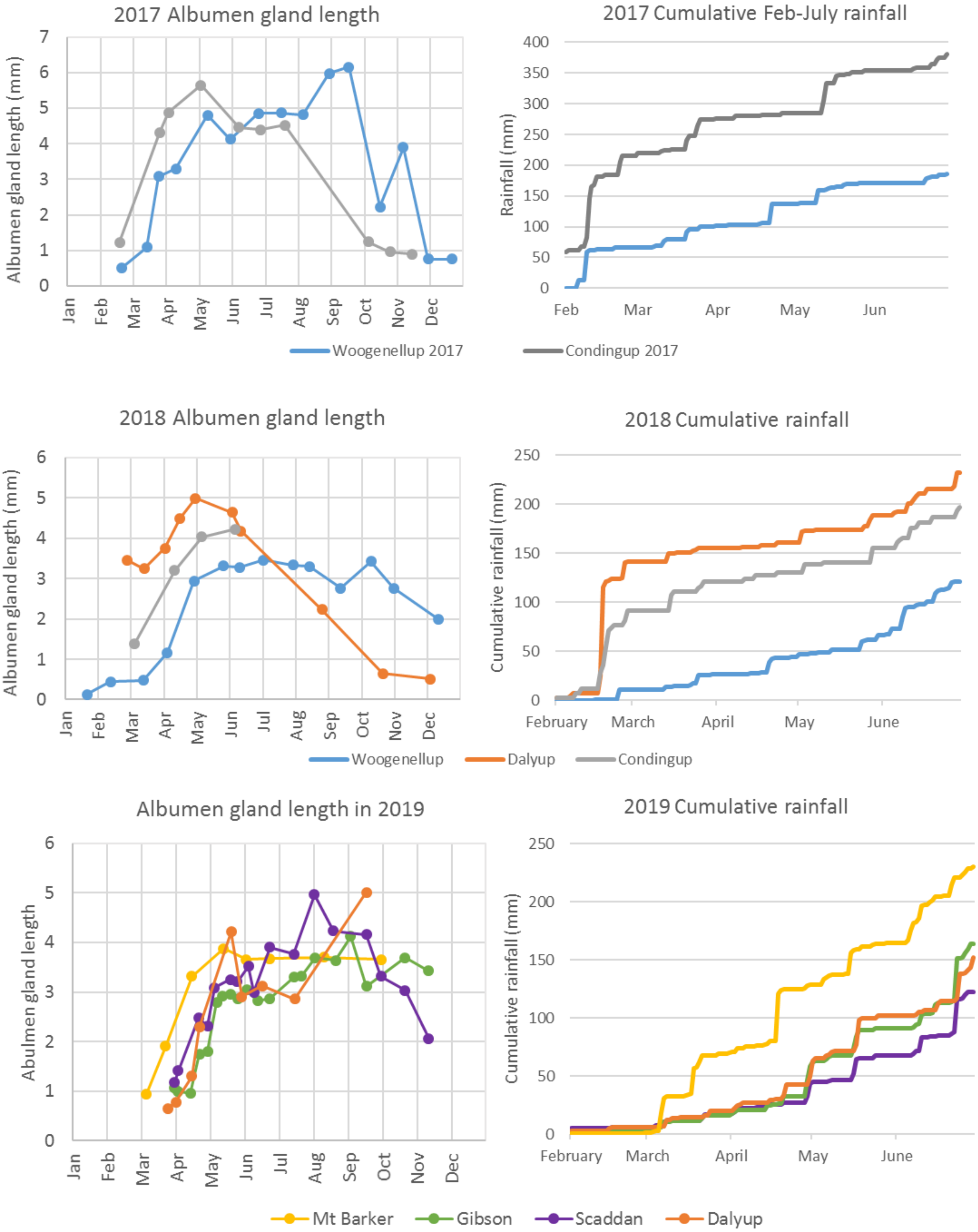

Figure 1. Cumulative February to July rainfall and mean albumen gland size (mm) of snails collected from the Albany and Esperance Port zone during the 2017, 2018, and 2019 growing seasons. At least 20 snails with >6mm shell height was sampled each time and dissected to measure albumen gland length.

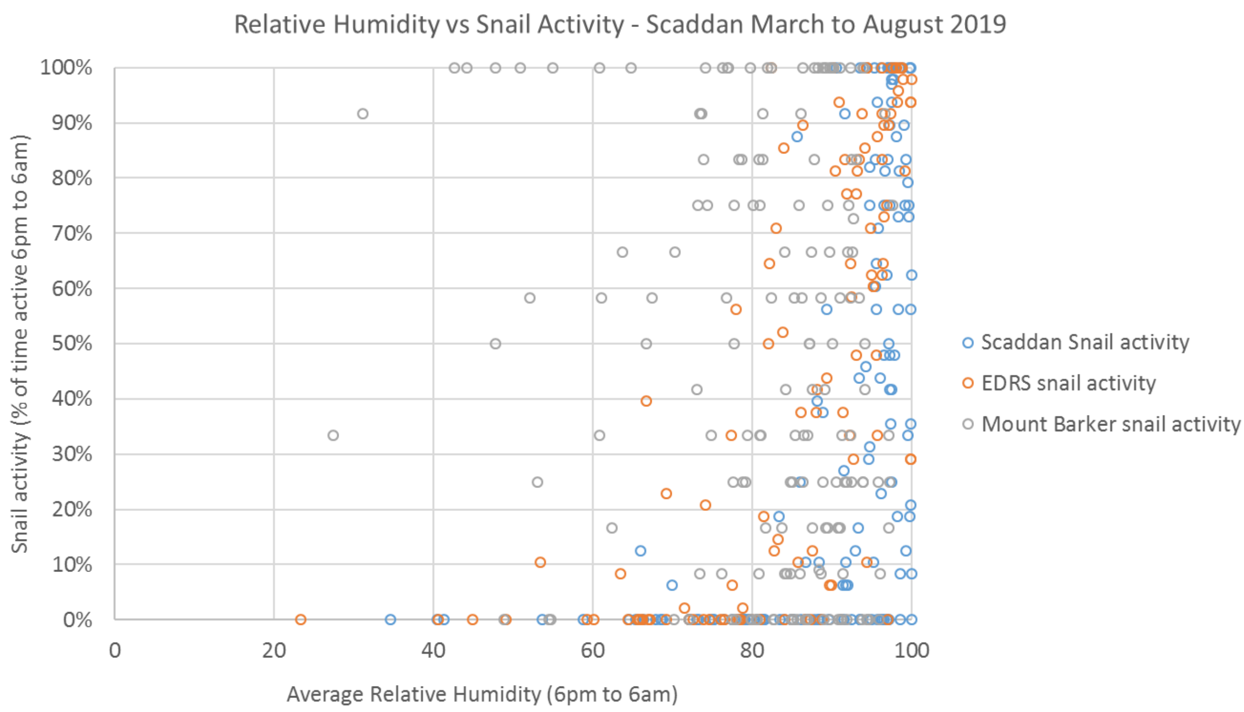

Figure 2. Mean relative humidity (RH) and snail activity between 6pm and 6am. Snail activity was calculated as percentage of time between 6pm-6am snails were active.

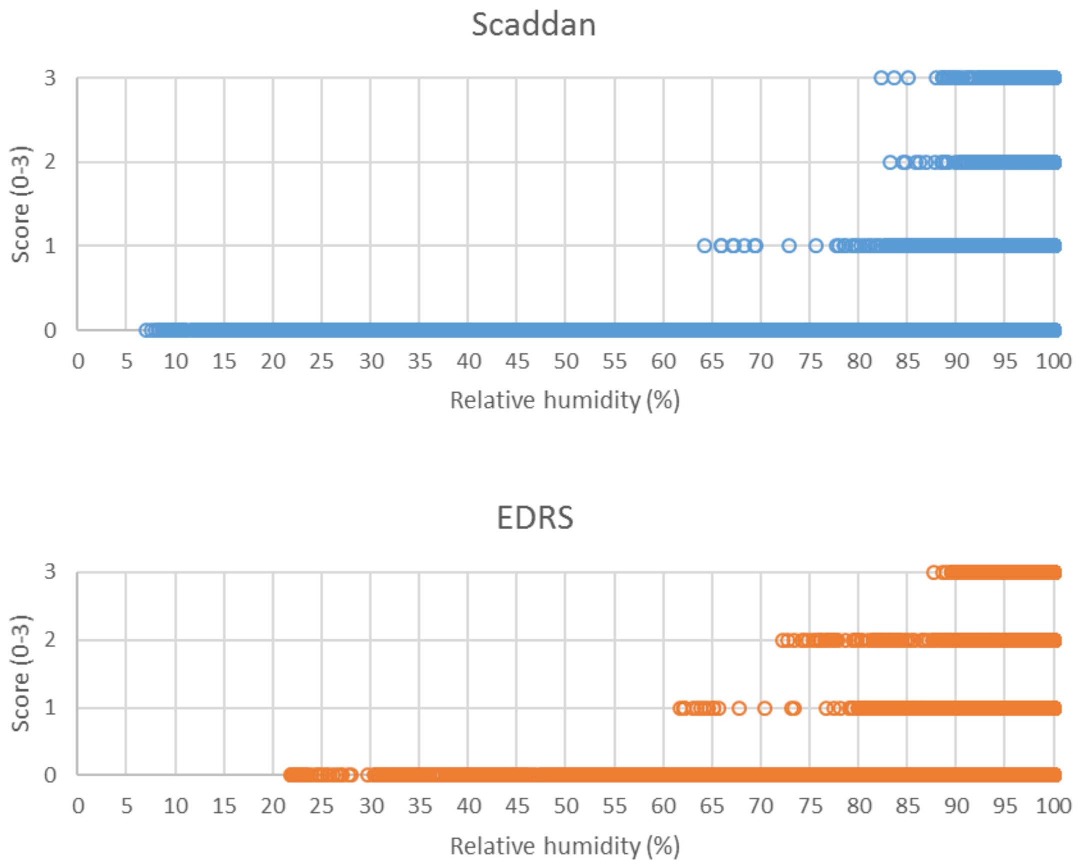

Figure 3. Snail score in relation to relative humidity (%). Snails were active when relative humidity was above 80% though was most active when relative humidity was above 85% (score of 2 or above).

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