Management strategies to effectively control slugs in the high rainfall zone cropping region

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Take home messages

- Managing slug populations is unlikely to be successful unless both cultural and chemical control strategies are used.
- Research has found burning, light cultivation and rolling improves slug control.
- Control measures must be carried out before slug damage is observed.
- Paddocks with a previous history of slug damage should be monitored first when growing a susceptible crop like canola.
- Slug bait should be applied at a rate to provide sufficient bait points per m^2 relative to slug populations in the paddock.
- Check the accuracy of your bait spreader to make sure of even distribution of bait across the spreading width. This may not be the same as the width you spread urea.
- Identify slug species present in a paddock for most effective control. Different species demonstrate different behaviours.

Slugs are now constant and major pests that frequently cause significant damage to crops at emergence and during the establishment phase. This may be attributed to a number of factors including the increase in adoption of stubble retention and reduced tillage and increased area of susceptible crops such as canola.

Slugs caused significant damage to some canola during the germination and early establishment phases of crops in 2013, especially in areas where damage had been seen previously. The extent of damage was unexpected given the very dry conditions of summer and autumn. Knowledge and skills to monitor slug populations and implement an effective slug control strategy are critical to reduce the impact of slugs.

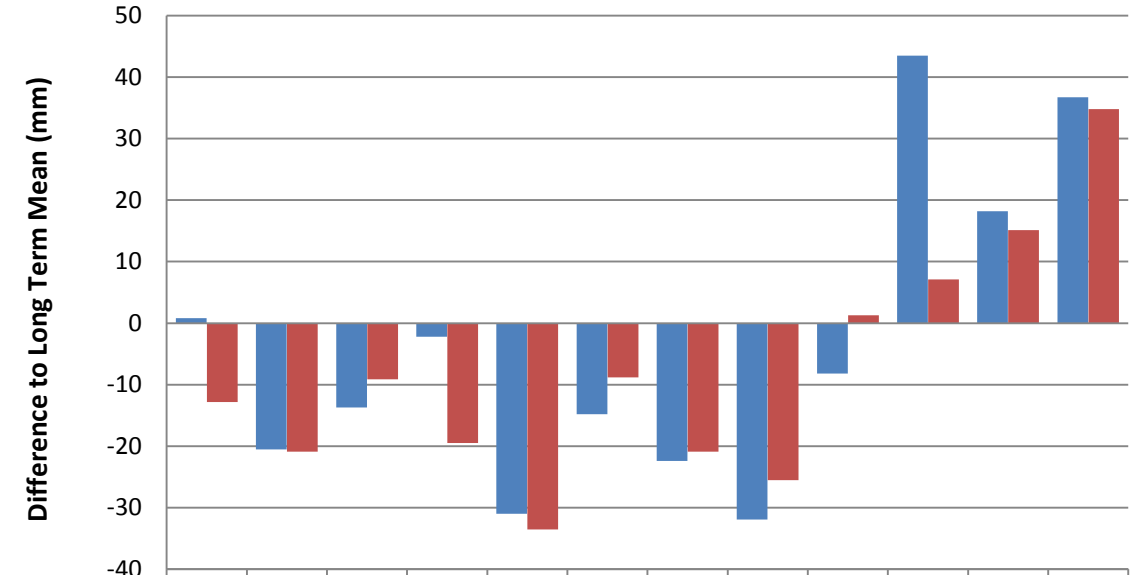
Currently growers, agronomists and advisers do not always use effective strategies that will consistently control slugs below thresholds for growing canola. The most common strategy often starts with applying slug bait once damage is seen in the establishing crop; unfortunately this approach is reactionary and doesn't lead to the most effective level of control. After the very high levels of damage seen in 2011 many growers are now looking to include additional cultural control techniques which include burning of stubble, cultivation and rolling.

During the spring of 2012 the GRDC HRZ Regional Cropping Solutions group put forward managing slugs in the HRZ as a major priority for growers and advisors and a Fast track project was initiated to demonstrate and evaluate a range of management strategies that could effectively reduce damage to emerging canola during establishment caused by slug species in the High Rainfall Zone (HRZ).

Twelve farms were surveyed across the Western Districts of Southern Victoria that were considered suitable as potential trial sites based on grower and adviser recommendations. All had sufficient slugs in the spring sampling to be potential trial sites. The key factor for the project would be, what would happen to the slugs over the summer, and what mortality rates will occur? The aim was to have at least three final sites which fitted the project criteria, with the target species being the Grey Field Slug (*Deroceras reticulatum*), as this is the dominant species in the Western Districts and to have at least one site where Black-Keeled slug (*Milax gagates*) was the focus species. The rationale for this was that there is a shift in species in response to seasonal conditions. The final sites were at Inverleigh (east), Skipton (central) and Hamilton (west).

The very dry conditions experienced in southern Victoria over the summer months affected the final methodology used in the project and some cultural management techniques were not employed either by grower request or by what was actually achievable at each site.

The data below shows the variation from the long term mean at two of the sites, from September 2012 to August 2013. Winchelsea BOM rainfall was used for the Inverleigh site.



	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Winchelsea	0.8	-20.5	-13.7	-2.2	-31	-14.8	-22.4	-31.9	-8.2	43.5	18.2	36.7
Hamilton	-12.8	-20.9	-9.1	-19.5	-33.5	-8.8	-20.9	-25.5	1.3	7.1	15.1	34.8

Figure 1. Difference in actual rainfall at 2 sites compared to the long term mean from September 2012 to August 2013

The final trial plan was:

1. Stubble – all stubble from the previous crop was burnt
2. Cultivation - none undertaken due to dry conditions and grower request
3. Rolling – rolling versus control. This was carried out using rubber tyre rollers
4. Grazing – grazing versus ungrazed. Only one site grazed the stubble pre burning
5. Baiting:
    - Applied immediately after sowing versus "grower strategy" baiting versus double bait.
    - Bait rates were a comparison of full label rate v grower rate.

Results

Inverleigh Site

Canola variety Crusher sown on 21st May into a burnt barley stubble. Sowing rate 4.2kg/ha on a 300mm row spacing. Slug species identified in this trial *Deroceras reticulatum* (Grey Field Slug), *Milax gagates* (Black-Keeled Slug) and *Lehmannia nyctelia* (Striped Field Slug).

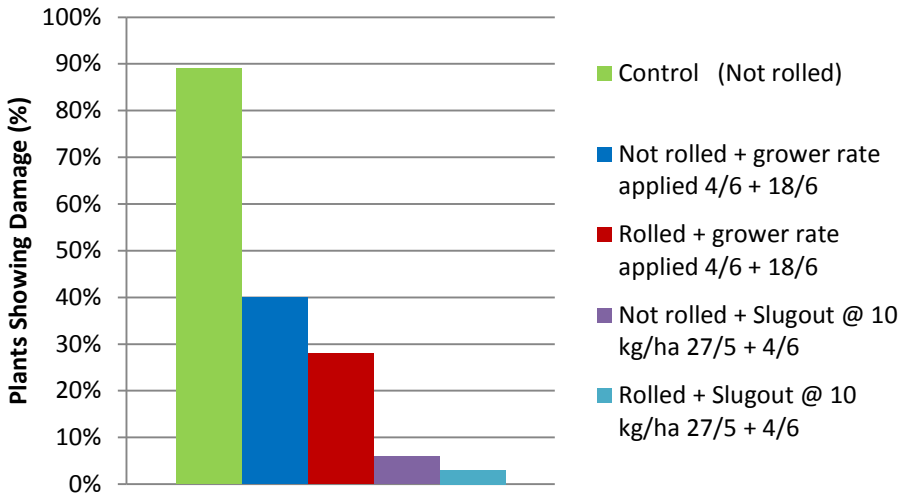
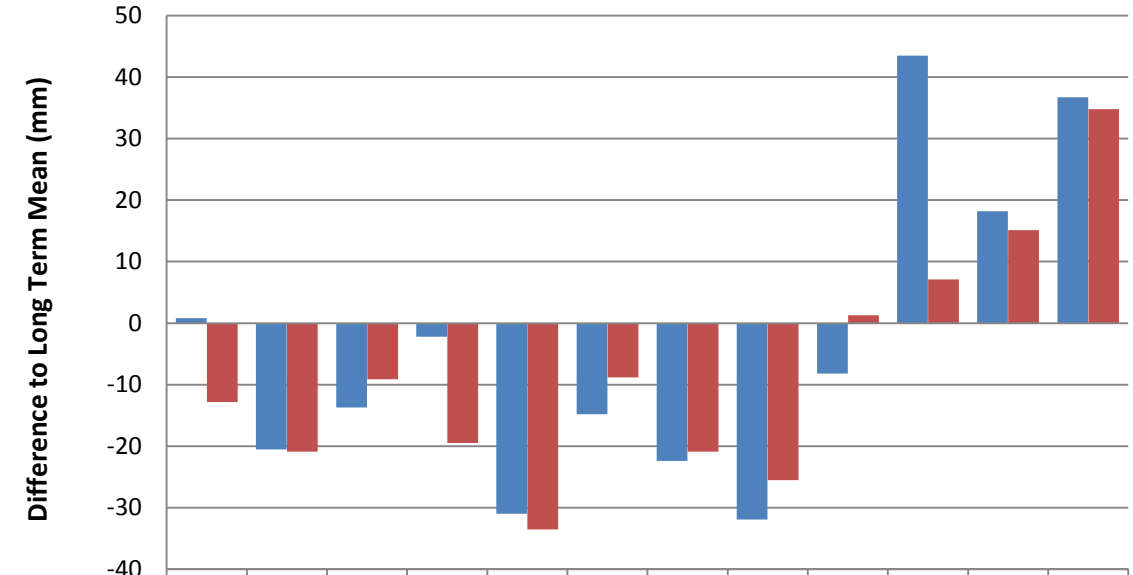


Figure 2. Inverleigh trial treatment effects on plants showing any slug damage.



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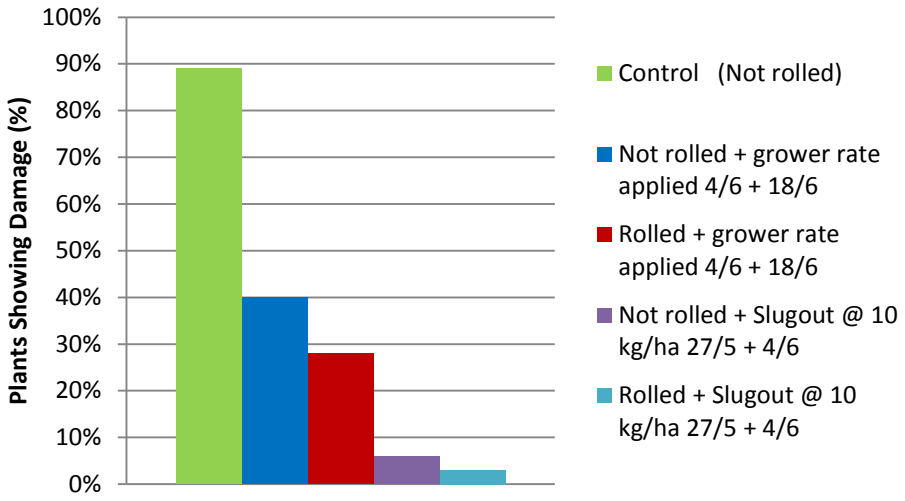

Figure 2. Inverleigh trial treatment effects on plants showing any slug damage.

Skipton Site

Canola variety Thunder sown on 17th May into a burnt wheat stubble which was grazed. Sowing rate 4.0 kg/ha on a 220 mm row spacing. Slug species identified in this trial *Deroceras reticulatum* (Grey Field Slug)

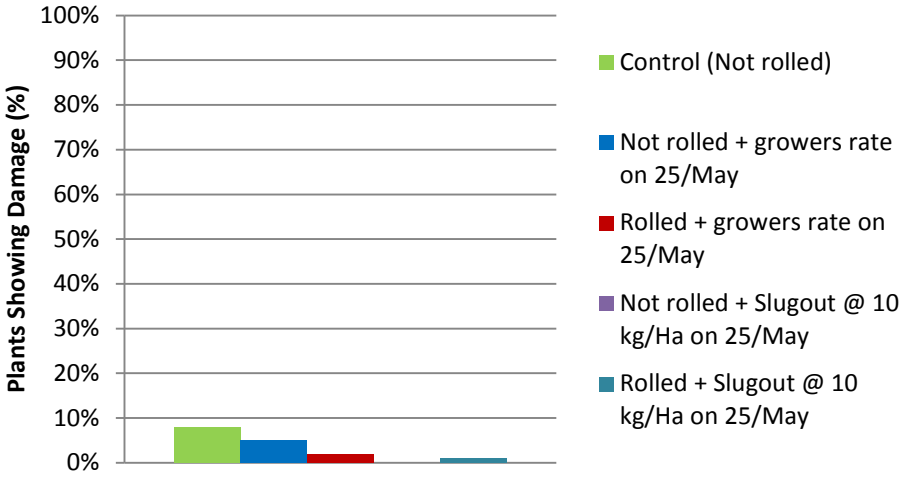

Figure 3. Skipton Trial showing Treatments effect on plants showing any slug damage

Hamilton Site

Canola variety Thunder sown on 14th May into a burnt wheat stubble. Sowing rate 3.5/ha broadcast and prickle chained. Slug species identified in this trial *Deroceras reticulatum* (Grey Field Slug) and *Milax gagates* (Black-Keeled Slug).

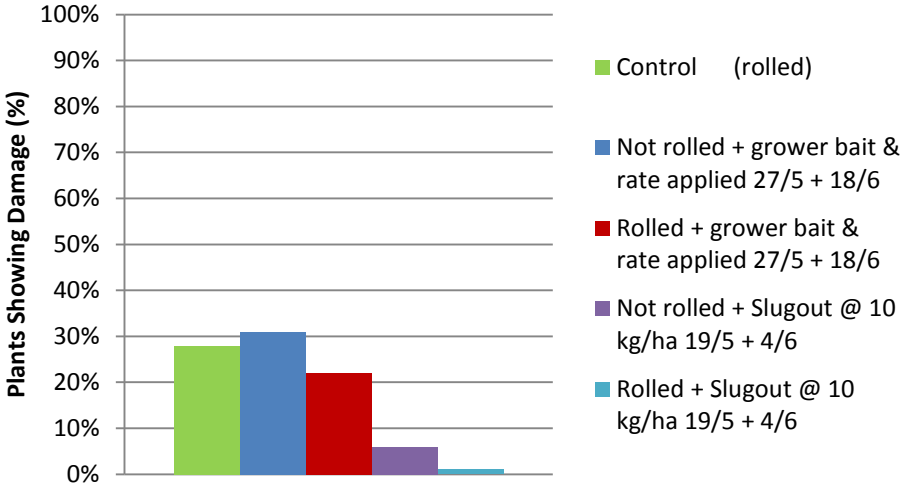

Figure 4. Hamilton Trial showing Treatments effect on plants showing any slug damage

What did we learn?

Timing of the bait

All the managed bait applications showed the lowest level of slug damage across all sites. This application was also applied post sowing but pre emergence of the crop and this gave a significantly improved level of control especially at Inverleigh and Hamilton where the first grower application was applied eight days later.

Influence of Rolling PSPE

All sites showed a positive result from rolling immediately after sowing compared to not rolling, with the greatest positive effects shown at Inverleigh and Hamilton, where there were higher slug numbers and more damage to plants. At Hamilton in particular, the control treatment was rolled which resulted in less crop damage compared to applying bait but not rolling. Rolling is a cheap, non-chemical, cultural control technique which in this trial proved very effective at restricting slug movement in the seedbed. Rolling also aids soil consolidation around the newly sown seed which can improve establishment.

Rate of Slug Bait

It is difficult to draw any conclusions from the differences in rates of product used as there were also differences in timing of application, which in itself almost certainly had a major influence on control. However growers are often

driven by what a bait will cost them per hectare and on its perceived ability to tolerate wet weather and remain active and not disintegrate. In light of this we looked at five commonly used baits and measured bait points/m^2 at full label rate compared to commonly used grower rates (Figure 5).

Growers apply different types of slug bait at individual rates which are often determined by cost/ ha and the rate their bait spreader is set to. A common application rate is 4 to 5 kg/ ha which equates to $30 - $35/ha. However, this rate is often applied without any understanding of bait points per square metre. The target amount should be 25/ m2 for a paddock population of 20 slugs/m2, assuming 80% encounter in the first night (M. Nash. GRDC Advisor Update 2013). A slug population of one per square metre is significant, and is considered the damage threshold for canola. An infestation of eight slugs per square metre is considered severe (A. Sabeeney. Crop Care. March 2013).

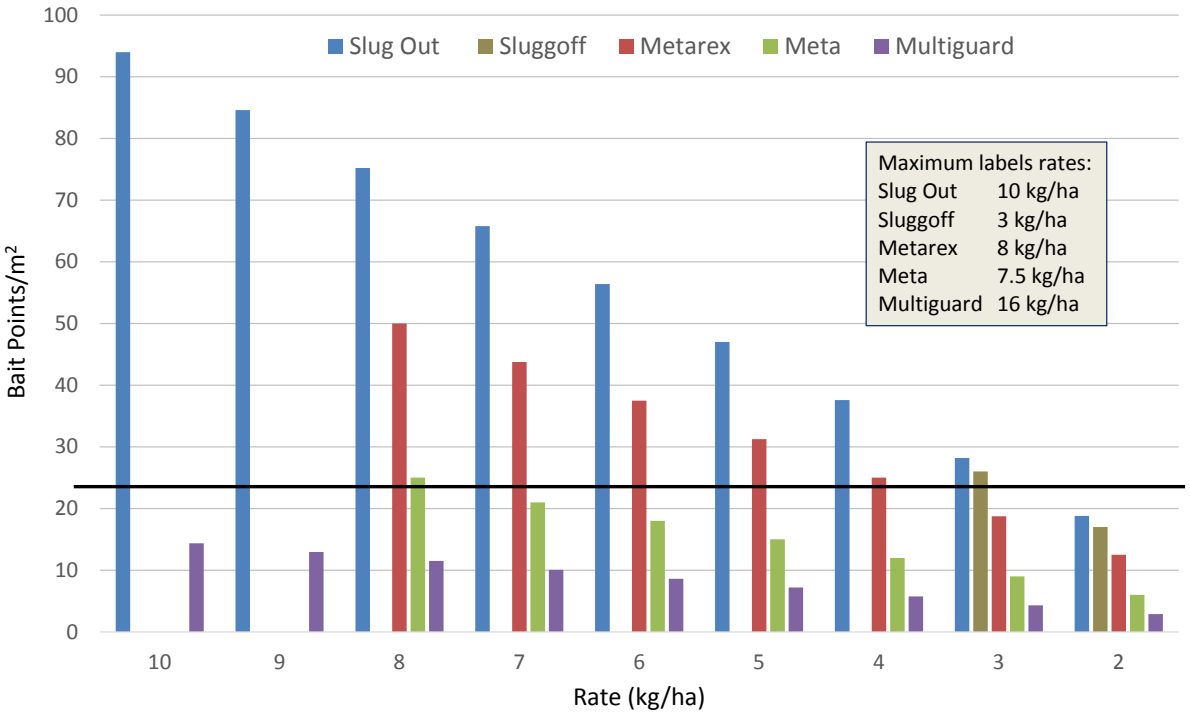

Figure 5. Bait points per square metre at various application rates (kg/ha)

Spreading Slug Bait

Recent research carried out by Ashley Wakefield and Greg Baker in SA on the distribution of slug and snail bait from standard farm spreaders adds further potential inaccuracy to applying bait:

- Many growers assume bait spreading requires the same machinery setup as urea spreading.
- Many growers are not spreading the product as widely as they think, when using spreaders set-up for urea rather than for bait.
- Ute spreaders that were set up for urea to spread to 15 m were only spreading bait 7 m.
- Fertiliser spreaders that were thought to be spreading bait to 35 m were only baiting to 20 m width.
- During the spreading process some of the bait was breaking up into smaller pieces. At this stage this is not seen as either a disadvantage or an advantage.

Species Identification

At both the Hamilton and Inverleigh trials damage levels were higher than at the Skipton trial. One of the reasons for this may well have been the presence of two species of slugs which can live at different depths in the soil.

The Grey field slug or reticulated slug (*Deroceras reticulatum*) is usually surface active and can produce three hatchings per year. While the slug generally breeds in autumn and spring, breeding can occur throughout the year if conditions are favorable, potentially producing 1000 eggs per breeding pair. The second species identified at these two sites was the Black-keeled slug (*Milax gagates*). This species can burrow up to 20 cm underground to escape the heat, and a breeding pair can lay up to 200 eggs per year.

The importance of identification of the species relates to the emergence of each species as the autumn break developed. This meant that at the very early emergence stage of the canola only Grey field slugs were causing plant damage but as the wet front penetrated the soil profile with increased rain the Black-Keeled slugs became active. This meant that just applying the initial bait treatment PSPE wasn't going to be sufficient to control the later emerging species.

Guidelines for Growers

Pest Species

- Growers and advisors need to be able to accurately identify the different slug species and know which species are active and where in a paddock to help with choosing appropriate control strategies.

Lifecycle

- Slugs breed continuously given moisture, and so summer rain can mean that 2 generations can develop between the last harvest and sowing the new crop.
- Slug populations can explode rapidly given suitable conditions – eggs laid in moist soil will hatch within 3 – 6 weeks. If conditions are favourable a breeding pair of grey field slugs can produce up to 1000 eggs per year.

Crop Damage

- Slugs are often underestimated as pests because they are mainly active at night and shelter during dry conditions, and therefore are not generally visible during daylight hours.
- Slugs are most damaging to seedlings because the growing point of a germinating canola shoot is, unlike cereals, above ground. Serious damage occurs up to the four true leaf stage.
- Populations as low as one grey field slug per square metre can inflict severe damage on a canola crop at establishment.

Risk Factors

- Moisture and temperature
  Activity, survival and reproduction are dependent on moisture. The optimum temperature for slugs is 17°C.
- Soil Types
  Slugs are more abundant in heavy soils with high clay content as these soils retain more moisture.
- Previous cropping
  Slug damage is much greater after leafy crops. Canola is very dense and leafy in its early growth stages (creating moist soil conditions).
- Crop residues, Organic matter, Weeds
  Crop residues especially in the autumn, as well as weeds and volunteers from previous crops provide slugs with a source of food and shelter which encourages them to breed.
- Cultivation
  Direct drilling or sowing into a heavy stubble increases the risk of slug damage, especially if the soil to seed contact is compromised.
  Delays in sowing into colder soil temperatures can slow down emergence and crop growth, which prolongs the vulnerability to damage.
- Seedbed
  Loose and cloddy seedbeds allow slugs easy movement and don't help maximise rapid crop establishment.
- Other agronomic conditions
  Lack of nutrients, inappropriate pH, poor drainage and weed competition can all result in slow growth, increasing the time it takes for the plant to grow large enough to tolerate some damage.

Monitoring/Assess the risk

- The best time to monitor slugs is when the weather is mild and the soil is damp. Sampling is best done using refuge traps as they provide valuable information on slug activity.
- Concentrate monitoring on areas in the paddock where slugs have been a problem in the past in order to assess population activity.

Control methods

- Cultural: There are many cultural techniques that can be used to improve canola establishment like adjusting sowing rate, cultivation, stubble burning and rolling. The best approach is to be aware of what the techniques are and being prepared to incorporate them into a broader IPM strategy, however, in some scenarios all controls are needed for successful crop establishment.
- Chemical:
  -Metaldehyde
  -Methiocarb
  -Iron EDTA

Application method

- Broadcasting is the best method of application and kills slugs more quickly than pellets that are drilled with seeds. It gives more consistent slug control, particularly in combination with fine, firm seedbeds that help protect seeds and seedlings.

Application timing and rate

- Broadcast slug pellets as soon as possible after drilling. Application is most effective up until the four true leaf stage in canola and GS14 in cereals.
- The rate of application will have direct result on the pellets applied/m^2 depending on the product choice. Make sure that there are sufficient bait points to match the slug population.