NORTHERN, SOUTHERN AND WESTERN REGIONS
SLUG IDENTIFICATION AND MANAGEMENT

In the higher rainfall zones where zero till and stubble retention is practiced, slugs are an increasing problem. As no single control method will provide complete protection, an integrated approach is best.

**KEY POINTS**

- Slugs need moisture and shelter to thrive. Cool wet summers and an abundance of stubble provide ideal conditions.
- Moisture availability is a key regulator of slug populations.
- The grey field slug, or reticulated slug, and black keeled slug are the main pest species, but brown field slugs can also pose a serious threat.
- No single control method will be completely effective; an integrated approach is needed.

Slugs are a major pest of crops globally, and have emerged as a serious pest for Australian grain growers in recent decades. Attacks on emerging crops can cause major economic losses, even when slug numbers are relatively low.

Australian growers spend an average $8.7 million annually on slug control. The incidence of slugs has increased with changes to cropping practices. Cultivation and stubble-burning previously kept numbers down, but the widespread adoption of minimum till and stubble retention has provided slugs with more favourable habitat.

Surface-active slug species such as the grey and brown field slug find crevices in the soil during dry summer conditions to avoid heat and drying out. They emerge when conditions are moist to breed and feed. Grey field slugs are most active at temperatures between 4°C and 20°C.

**Life cycle**

Slugs are hermaphrodites, therefore, both individuals of a mating pair lay eggs. They will breed whenever moisture and temperature conditions are suitable – generally from mid-autumn to late spring. Each pair will lay eggs in batches. Eggs are laid in moist soils and will hatch within three to six weeks, dependent on temperature. Juveniles look like smaller versions of the adult.

**Pest species**

The main pest species in Australia are the grey field slug and the black keeled slug, but the brown field slug has also been recorded in high numbers. More than one species may be present within a single paddock.

**Grey field slug or reticulated slug** (*Deroceras reticulatum*)

The grey field or reticulated slug is 35 to 50 millimetres long and light grey to fawn in colour with dark brown mottling. There are up to three generations a year. It will generally breed in autumn and spring, however, if conditions are favourable this species will breed any time – a pair can produce up to 1000 eggs a year. It is mainly surface active and is a major pest of crops and pastures.

**Black keeled slug** (*Milax gagates*)

The black keeled slug is 40 to 60mm long and black or brown with a ridge down its back. This species can burrow up to 20 centimetres underground to escape the heat. It is more problematic in drier environments, such as South Australia, although it is widespread throughout south-eastern and Western Australia. A breeding pair can lay up to 200 eggs a year.

**Brown field slug** (*Deroceras panormitanum*)

The brown field slug is 25 to 35mm long, and usually brown all over with no distinct markings. It is mainly surface active but can burrow to shallow depths. It is more common when pasture is a frequent part of the crop rotation. A breeding pair can lay up to 500 eggs per year.
prior to seeding. Look to control weeds at least two months if summer weed control is not possible, through grazing. Controlling weeds and managing stubble in the summer months, remove refuges by a reasonable level of control can be achieved. By understanding the system’s complexity, an integrated pest management (iPM) approach is required. No single method will provide complete control so an integrated pest management (IPM) approach is required.

By understanding the system’s complexity and working on pest control year round, a reasonable level of control can be achieved. In the summer months, remove refuges by controlling weeds and managing stubble through grazing. If summer weed control is not possible, look to control weeds at least two months prior to seeding.

Hedgehog slug (Arion intermedicus)

A significant pest species in Europe and New Zealand, the hedgehog slug has been recorded in a number of high-rainfall (more than 600mm) locations. It is up to 25mm long and grey in colour with a yellow foot. It is distinguished by its breathing pore at the front of the mantle (the section at the front of the slug that covers the internal organs).

Crop damage

Slugs can be underestimated as pests because they are nocturnal and shelter during dry conditions, and therefore are not generally visible during daylight hours. They will attack all plant parts but seedlings are the most vulnerable crop stage and can suffer major economic damage. Populations as low as one grey field slug per square metre can inflict severe damage on a canola crop at establishment.

Grey and brown field slugs are mainly surface active, requiring moist refuges at the soil surface such as volunteer crop plants and broadleaf weeds. Black keeled slugs are a burrowing species, and can feed directly on germinating seed. This often makes damage more difficult to detect compared to the surface-feeding species.

Control approaches

No single method will provide complete control so an integrated pest management (IPM) approach is required.

By understanding the system’s complexity and working on pest control year round, a reasonable level of control can be achieved. In the summer months, remove refuges by controlling weeds and managing stubble through grazing. If summer weed control is not possible, look to control weeds at least two months prior to seeding.

At the break of season, monitor for the presence of slugs. The most effective time to bait is at sowing, followed by rolling to consolidate the seedbed. However, this cultural practice may not fit with a zero-till operation, so assess the scale of the problem and make the management decision appropriate to your operation.

Baits are most effective when paddocks are bare, so if there is retained stubble, control may not be as good.

During the winter months, continue to monitor for any plant damage during crop emergence. Repeat baiting may be required during crop establishment. Baiting in spring is generally not effective because there are ample alternative food sources.

In Queensland, seedling canola, soybeans and sunflowers are the crops at greatest risk, particularly on creek flats where there is zero till and overhead irrigation.

Monitoring

The foundation of any IPM program is monitoring, but accurate estimation of slug numbers is difficult because slugs are hard to find, populations are often clumped and their activity is dependent on moisture availability.

One monitoring method is to create surface refuges in the form of terracotta paving tiles, carpet squares or similar. These can give an indication of slug activity and the relative number of slugs present. A 300mm by 300mm refuge represents approximately 1m² when soil moisture is favourable (more than 25 per cent). Concentrate monitoring on areas where slugs have been a problem in the previous autumn in order to assess population activity, especially after rainfall.

Check the refuges early in the morning, as slugs seek shelter in the soil as it gets warmer. Keep in mind that monitoring does not provide an accurate guide to the total numbers of slugs present. To counter this, sample more than 10 refuges per 10 hectares.

Where unexpected crop damage is occurring, inspect the area after 10pm on a mild, calm night.

As well as looking for slugs, check for other pests such as European earwigs or beetles that could cause similar damage.

When monitoring is not practical from a time or resource perspective, an alternative option is to put out lines of bait to gauge populations, especially in areas where slugs occurred previously.

Control methods

Effective control involves a combination of measures: chemical, cultural, and biological.

Chemical control

Baiting is still the only chemical control option. Apply baits after sowing and before crop emergence to protect emerging seedlings.

Three types of baits are registered for the control of slugs.

1. Baits based on metaldehyde (there are many products available), some of which are registered for all slugs and some for grey field slugs only. Metaldehyde is a Schedule 5 poison and is highly toxic to birds and mammals. Spread evenly and avoid heaping to avoid attracting off-target animals.

2. Baits based on methiocarb (Mesurol®), which is registered for all slugs. Methiocarb is highly toxic to carabid beetles, one of the few predators of slugs in Australia and New Zealand, which it kills by secondary poisoning.

3. A bait based on iron EDTA complex (Multiguard®), which is registered for grey field slugs only. Multiguard® iron EDTA complex bait is snail and slug-specific and has low toxicity to
The brown field slug has not been considered a major pest species but has nevertheless been recorded in high numbers and can inflict serious damage. It is mainly surface active but can burrow to shallow depths.

Slugs will attack all plant parts but seedlings are the most vulnerable. Damage to the cotyledons in canola seedlings can mean major economic losses.

Baiting can continue at this time, but it will only serve to minimise further damage; it will not be able to retrieve lost yield.

**Figure 1** Slug distribution in Australian grain-growing regions

These results are from an initial GRDC-funded SARDI survey of pest slug distributions throughout grain growing regions of Australia 2011 to 2012. WA was not sampled due to drought conditions; historical records from 2002 to 2007 indicate WA distribution. Darker colours indicate more attractive areas for slug populations. Circles indicate areas where damage from slugs was reported.
operation into a broader IPM strategy, however, in some scenarios all controls are needed for successful crop establishment.

**Biological control**

Predatory insects and organisms play a role in limiting slug populations. Carabid (or ground) beetles feed on both ground-dwelling pests and those that live on plants. Both larvae and adult carabids are predatory and they do well in the same conditions that favour slug populations. As they are easily killed by some pesticides, reducing pesticide use or avoiding broad-spectrum insecticides is essential to make use of carabid beetles. Research demonstrating the effectiveness of several species of nematodes as biological control for snails has been extended to slugs. The research is showing great promise in the laboratory.

**MORE INFORMATION**

Hugh Brier
QDFAF
07 4160 0740
hugh.brier@daff.qld.gov.au

Paul Horne or Jessica Page
IPM Technologies
03 9710 1554
ipmtechnologies@bigpond.com

Svetlana Micic
DAFWA
08 9892 8591
svetlana.micic@agric.wa.gov.au

Michael Nash
University of Melbourne
03 8344 2521
manash@unimelb.edu.au

Gavin Ash
(Charles Sturt University project information)
gash@csu.edu.au

Aisuo Wang
(Charles Sturt University project information)
awang@csu.edu.au

Currently the research team has had encouraging kill rates on some species of snails in South Australia. They expect results to be even better in high rainfall zones. However, moisture at the site at the time of application and other factors will play an important role in determining whether or not these are an economic control measure.

**Building a database for the future: reporting slugs**

Submitting specimens to researchers can help build a picture of slug numbers and damage across the grain-growing regions of Australia, although this is dependent on local weather conditions and tillage systems used. Building such a database will benefit researchers into the future.

Place collected slugs in a jar with moist paper and some crop leaves, then post or courier the specimen to Michael Nash at the University of Melbourne. See Reporting Slugs for address details.

Provide the following information along with the specimen:

- your name and full address; telephone number and email address;
- the date and location of collection (where the specimen was found, preferably with GPS coordinates);
- soil type;
- paddock history (zero/minimum tillage or regular cultivation and cropping history);
- crop attacked; and
- description of the damage (photos are optional but useful).

**USEFUL RESOURCES**

- Identification and control of pest slugs and snails for broadacre crops in Western Australia (1.7mb)

- Slugs in Crops Back Pocket Guide

- The current and potential costs of invertebrate pests in grain crops

- IPM Technologies
  www.ipmtechnologies.com.au

**REPORTING SLUGS**

Send slug specimens (in a jar with moist paper and some crop leaves) to:

Michael Nash
CESAR
Bio21 Institute
Melbourne University
30 Flemington Road
Parkville VIC 3100
03 8344 2521 or 0417 992 097


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