Who dunnit?

How feeding damage clues can aid in invertebrate pest identification

GRDC Investment CSE00059

The first principle of Integrated Pest Management (IPM) is to identify the pest through monitoring, and understand the threat posed to the crop. IPM is often described as a 'knowledge-intensive' approach to pest management, requiring an understanding of pest species ecology and biology. From an invertebrate pest perspective, determining what may be impacting on a crop can require a holistic consideration of all available evidence – a piecing together of puzzle pieces that can paint a picture of the true situation.

Feeding damage is an important piece of evidence. Having knowledge of different feeding types and feeding behaviours among key invertebrate pest groups can help with identification. For instance, each season **cesar** receives reports of feeding damage being attributed to non-pest species that happen to be in the vicinity of feeding damage, such as populations of detritivore springtails. An understanding of what type of invertebrate (and mouthpart) made the damage can quickly omit certain invertebrates from a line-up of suspect species.

Apart from obvious features (if the suspected pest is able to be found), there are several biological and ecological factors that can be considered to aid in pest identification. These include host type, the plant part affected, the time of year, the time of day, and the damage type (figure 1).

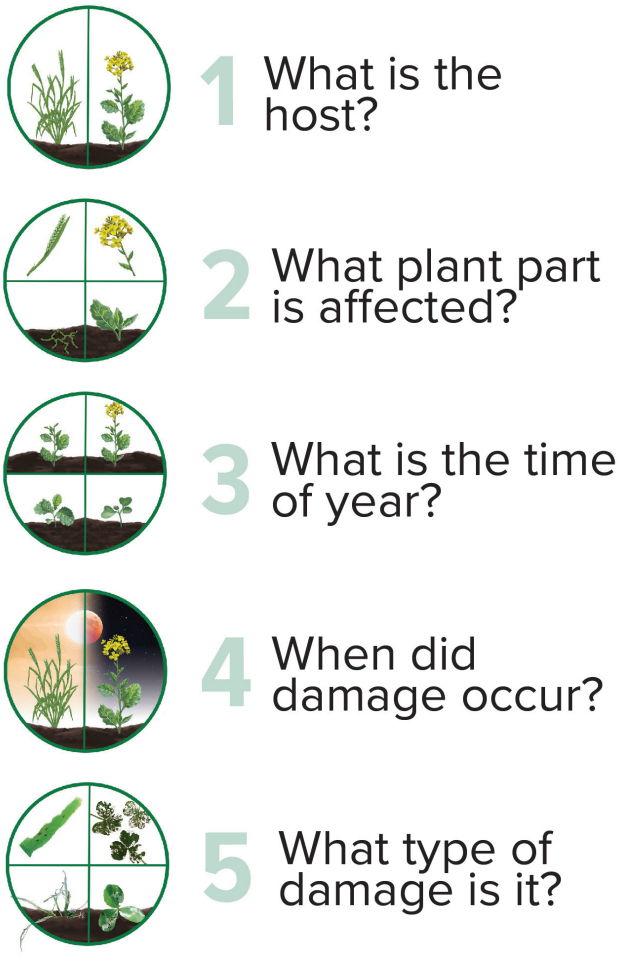

Figure 1. Key questions to ask when feeding damage is found.

1 - What is the crop that has been damaged?

An invertebrate pest may feed on a wide range of plant families or may be more specialised and restrict its feeding to a specific plant family or species. Even those pests with broad host ranges (termed 'polyphagous') have preferences for certain plants. Here are a few examples:

- The green peach aphid (*Myzus persicae*) has a very wide host range although it has a preference for feeding on plant hosts in the Brassicaceae family (e.g. canola) and is rarely found in cereal crops;
- The native budworm (*Helicoverpa punctigera*) also has a wide host range that includes many native species, although it is most typically found feeding on pulses and canola rather than cereals;
- The Russian wheat aphid (*Diuraphis noxia*) feeds on graminaceous plants (grasses), with a high preference for barley, wheat and triticale over other crop types.

2 - What part of the plant has been damaged?

As with host preference, invertebrate crop pests often have a preference for feeding on certain plant parts, such as the roots, the base of the stem, lower or upper canopy leaves, inflorescences, or the seed head. This preference also plays a role in the time of year that a pest is likely to be found. For example, lucerne seed web moth (*Etiella behrii*; 'Etiella') and pea weevil (*Bruchus pisorum*) are seed feeders and will overwinter in the soil until warmer weather supports flowering and pod set.

Some species that may look quite similar may have very different feeding habits. For example, some scarab pest species, such as the redheaded pasture cockchafer (*Adoryphorus coulonii*), feed on the roots of host plants as larvae. However, the larval stage of another scarab, the blackheaded pasture cockchafer (*Acrossidius tasmaniae*), emerges above ground to feed on stem and leaf tissue.

Another example of pests of the same family diverging in their plant part appetites is green peach aphid, in comparison with cabbage aphid (*Brevicoryne brassicae*) and turnip aphid (*Lipaphis pseudobrassicae*). While all of these aphid species can be found feeding on canola, green peach aphid generally colonise and feed on leaves (often on the underside of lower leaves), while cabbage and turnip aphid can often be found colonising growing points.

The question of what part of the host plant is being fed upon, is of course, strongly connected to the plant growth stage.

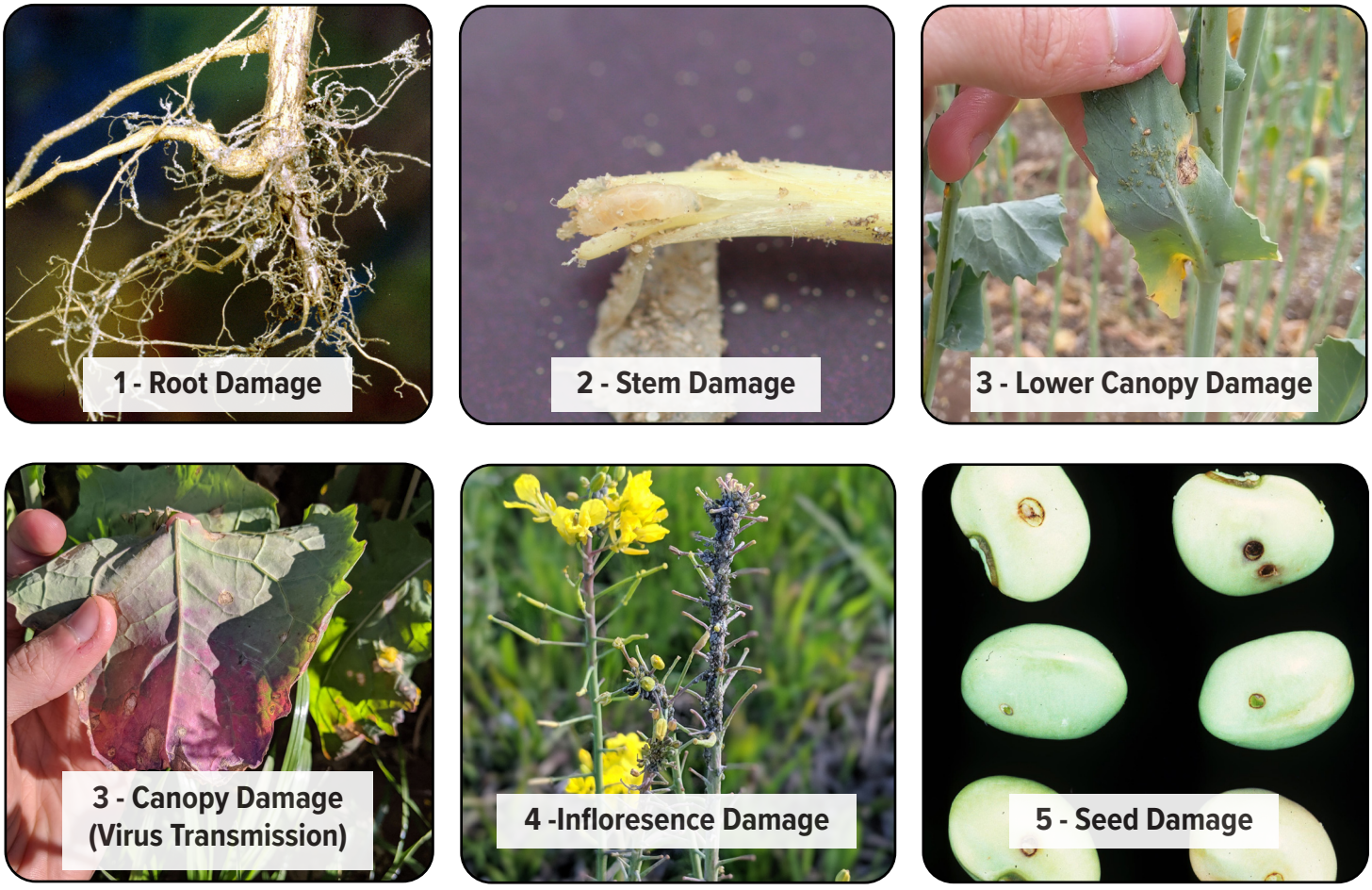

Figure 2. Examples of feeding damage on different parts of the plant.
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Collecting these feeding damage clues does not guarantee a correct identification. However, a holistic knowledge approach is needed when trying to identify crop pests, that takes into account the feeding behaviour of the pest, the feeding type and the damage symptoms. Understanding the interaction of these factors will help with the identification of pests when damage is observed in the paddock, supporting decisions for effective and sustainable management.

3 - What is the time of the year?

What is the time of year, and does the appearance of feeding damage align with the expected suspect pest? While some pests may be present in a crop for most or all of a growing season, there are others that use strategies such as hibernation, diapause or migration to ensure that they are surrounded by adequate food resources at the appropriate time of year. In addition, at different life stages the nutritional needs of an invertebrate pest can vary, which can in turn influence the extent of feeding and host preferences.

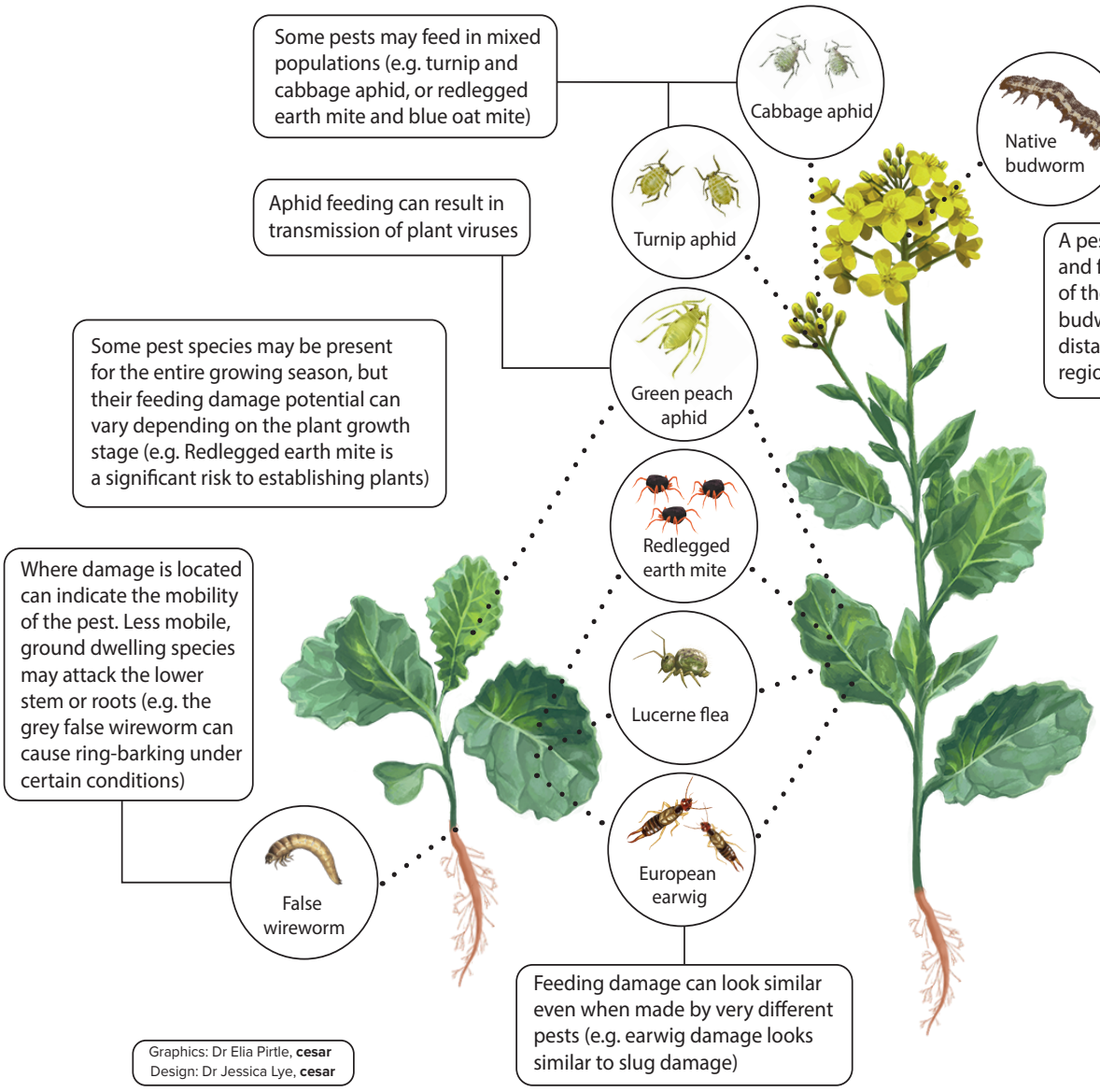


Figure 3. Using feeding damage symptoms as a clue to determine the underlying cause of damage requires an understanding of pest biology and ecology. This example uses canola at the rosette stage and at flowering in the southern grain growing region to highlight how feeding damage between species and across time can vary. Dashed lines indicate the plant part on which these species are commonly found feeding.

For example, even though the European earwig (*Forficula auricularia*) can act as a beneficial species, it can manifest as a plant pest under certain conditions and certain life stages of the earwig are prone to preference certain crops as a food source.

Common pest mite species also vary in the time of year when they feed on crops. The redlegged earth mite (*Halotydeus destructor*) diapauses over the summer months, emerging when temperatures drop in autumn in time to feed on autumn sown seedlings, such as canola. *Bryobia* mite tends to be less active once the temperature drops below 10 degrees Celsius and, depending on the species, may not diapause over summer. Thus, unlike redlegged earth mites, *Bryobia* can damage crop and pasture plants year-round.

In an example of annual migratory behaviour, native budworm breeds over winter in arid, inland regions of Australia on native broadleaf plants and weeds. When plants in these areas begin to senesce during late winter and early spring, the larvae become moths and migrate to coastal cropping regions where it may then be found feeding on canola and pulses. However, the related pest, cotton bollworm (*Helicoverpa armigera*), is less inclined to migrate long distances and diapausing pupae often remain in a cropping area, emerging in warm weather (spring and summer).

4 - When did damage occur - day or night?

Many common pests of broadacre crops are nocturnal, actively feeding at night and seeking shelter during the day. The European earwig and black Portuguese millipede (*Ommatoiulus moreletii*) actively feed at night, while some Noctuid moth larvae, including various species of cutworm and armyworm, are also active night-time feeders.

Monitoring paddocks at night with a torch, looking under materials that may shelter pests (such as stubble and rocks) or inspecting damaged plants near the base of stems during the day can reveal the pest that may be responsible. In the case of species such as the European earwig, feeding occurs within close proximity to the nest, which is buried a few centimetres under the soil surface. Placing pitfall or shelter traps near impacted plants can be useful to catch invertebrates for inspection and identification.

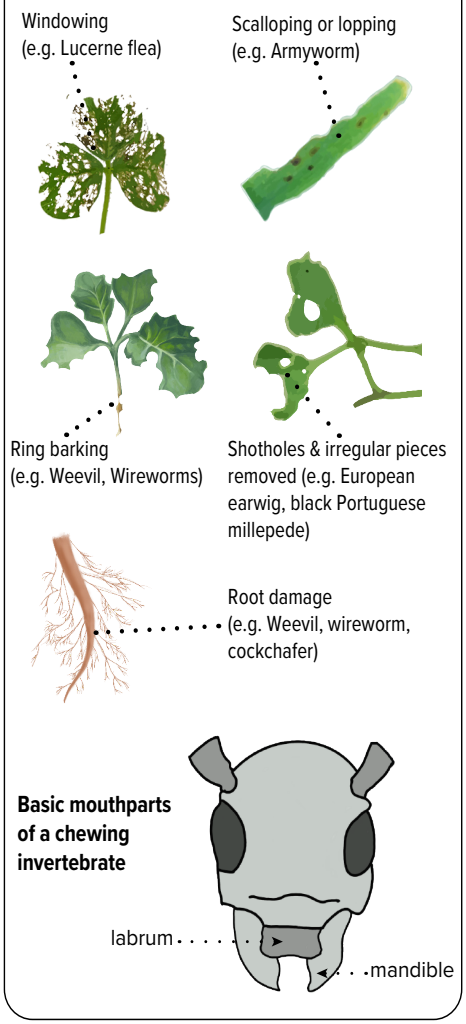
5 - What type of feeding damage is present?

Broadly, the major feeding types observed in grain crops fall under 'chewing' damage, 'rasping' damage, and 'piercing and sucking' damage. Damage is closely associated with the mouthpart morphology of a pest species with chewing invertebrates usually displaying quite prominent, jaw-like mouthparts. In other invertebrate pests, such as snails, the mouthpart itself can be difficult to see, however it is useful (and interesting) to have an idea of what it looks like, and therefore connect how form dictates function.

Chewing damage

Chewing pests have jaw-like structures for biting and grinding.

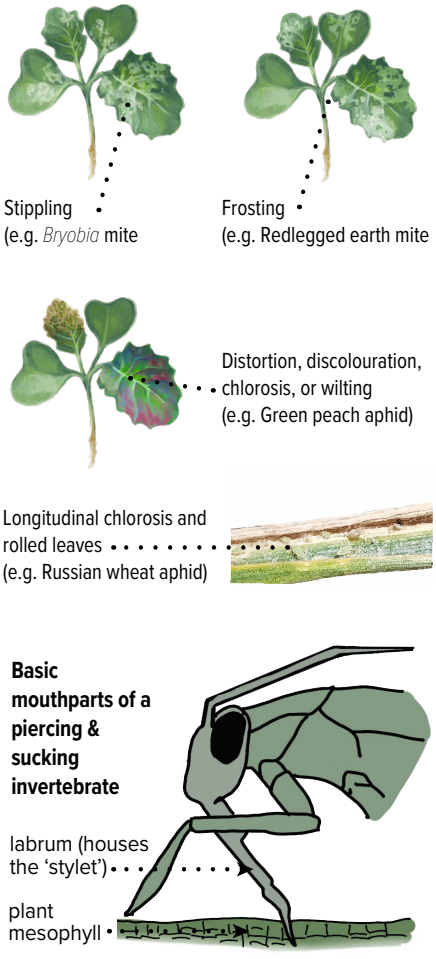
Examples are caterpillars, earwigs, milipedes and weevils.



Piercing & sucking

Piercing & sucking pests, such as aphids, extract phloem using a needle-like tube (stylet).

Some mites have mouthparts that act in a similar way to a stylet.



Rasping

Some invertebrates feed using a radula, which has microscopic 'teeth' to tear plant tissue into their esophohus.

Examples are slugs and snails.

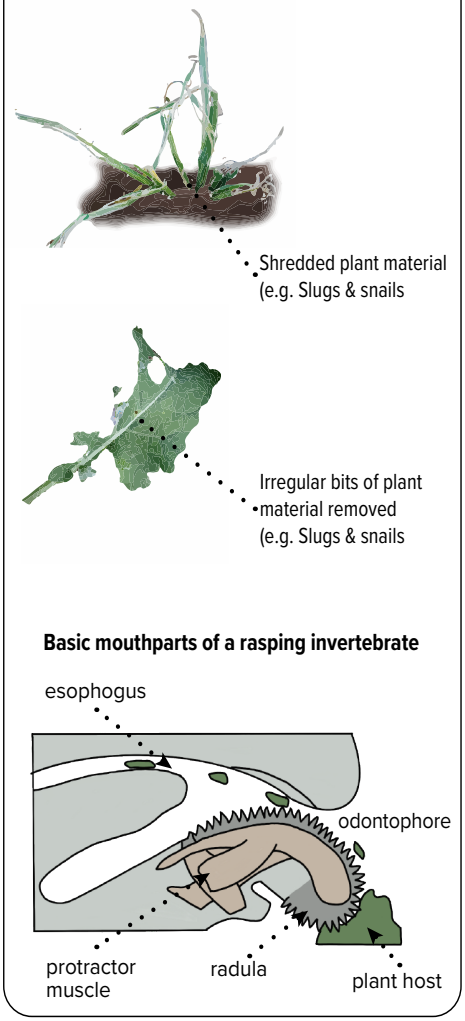


Figure 4. Damage often observed based on the feeding type and associated mouthparts.

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