Protecting germinating grain crops

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More than 15 million hectares of crops such as cereals, oilseeds and legumes are planted each year in Australia making it one of our largest primary industries. But while annual Australian grain exports are worth over $6 billion, growers spend several hundred million dollars each year controlling invertebrate pests that attack emerging seedlings.

In southern Australia, cropping rotations differ between regions depending on the timing and reliability of autumn rain.

Seedlings are the most vulnerable stage of crops with canola seedlings being the most at risk. Legume and cereal seedlings withstand pest damage better. Control costs, therefore, vary between crops. For all crops, factors such as depth of sowing, seedbed firmness and environmental conditions also affect establishment.

Feeding by pests can cause plant death and/or result in poor plant stands. This in turn leads to increased weed competition, poor canopy structure, delayed flowering, lower yields and, in some cases, complete re-sowing.

While the recent shift to minimum or no tillage systems has helped to conserve soil moisture and reduce wind erosion and fuel costs, it has also led to changes in the types of pests in crops. Minimum tillage creates micro-environments that suit both pest and beneficial organisms. For instance, no-till systems with stubble retention can favour slugs and snails.


**Mites**

The important mite pests in southern Australia are RLEM, blue oat mites (*Pentahaleus* species), clover mite (*Bryobia praetiosa*) and balataum mite (*Balaustium medicagoense*).

**Earth mites**

Earth mites (RLEM and blue oat mites) are important establishment pests of many grains. They are widespread throughout Victoria, South Australia, Western Australia and Tasmania. RLEM is also present in southern New South Wales and blue oat mites are present in northern New South Wales and southern Queensland.

Earth mites are active in the cool, wet part of the year, between April and November. They have two or three generations and oversummering eggs hatch in autumn.

Earth mite species look very similar which can lead to misidentifications and incorrect management. The biology of earth mites differs between species so growers need control strategies that target them individually. RLEM attacks a wide range of plants (pasture plants, field crops, vegetables, broad-leaved weeds, flowers) while blue oat mites are much more limited in their host plants. Mite damage to emerging crops sometimes necessitates re-sowing. Studying the differences in host plant preferences will lead to the development of cultural control strategies such as crop rotations, trap and border crops, and weed management.

Earth mites also differ in their tolerance to pesticides. One blue oat mite species is highly tolerant of several pesticides and is the cause of most chemical control failures.

Highlighting the need for better mite control is the recent discovery of resistance to synthetic pyrethroids in RLEM.

**Balaustium mite**

*Balaustium medicagoense*, found across southern Australia, is a pest of canola, cereals and lupins. While its life cycle is unclear, closely related mites go into diapause when conditions are unfavourable. Balaustium mite probably has at least two generations a season and is active from March to December.

No pesticides are registered for the control of this mite and it appears that many of those registered for earth mites are ineffective, which means it is difficult to control.

**Clover mite**

Clover mite (*Bryobia praetiosa*) is from the economically important spider mite family. This mite is widely distributed across southern Australia (all major cropping areas in Western Australia, South Australia, Victoria, New South Wales and parts of southern Queensland). They damage canola and, to a lesser extent, cereals. *Bryobia* can reproduce on lupins, wheat and pasture, and, in high numbers, may cause significant feeding damage to canola and lupins.

Little is known about the life cycle of clover mite in Australia but adults prob...
ably go into diapause during unfavourable conditions. Omethoate and bifenthrin are the only pesticides registered for the control of Bryobia mites in broadacre crops in Australia.

**Lucerne flea**

The lucerne flea (or clover springtail), *Sminthurus viridis*, has become a serious pest throughout Mediterranean regions of southern Australia. It lives on the soil surface and feeds on leaves. Lucerne flea has two or three generations on mainland Australia between March and November, sometimes more in irrigated pastures. It overwinters as eggs that hatch following cool temperatures and rain, around the same time as crop and pasture seedlings are emerging. Lucerne flea populations peak in late autumn, when severe damage can sometimes necessitate re-sowing, and decline through winter, peaking again in spring with the onset of warm, moist conditions.

Lucerne flea is primarily controlled using organophosphates. But in the laboratory, lucerne flea is much more tolerant than RLEM to several organophosphates and synthetic pyrethroids. Under laboratory conditions, methidathion was the most effective against lucerne flea.

**Slugs**

Herbivorous slugs are pests in high rainfall areas of southern Australia as stubble retention is increasingly adopted. Slugs remain dormant over the Australian summer in moist refuges. They reproduce whenever conditions are suitable.

There are two main slug pests of Australian grain crops: black keeled slug (*Milax gogates*) and reticulated or grey field slug (*Deroceras reticulatum*). Reticulated or grey field slug begins breeding in autumn and peaks in spring. It is surface active and requires moist places to hide.

Black keeled slug, a burrowing species, is adapted to drier environments. Its juveniles are generally around from late winter. Winter cereal damage ranges from hollowed grain, which prevents germination, to grazing on seedlings. Emerging canola cotyledons are particularly susceptible.

Slugs are active when it is cool and moist and crop growth is slow. Differences in biology between species can affect control options and chemical efficacy. For example, black keeled slug is more tolerant of conventional molluscicides. The most effective control option at crop establishment is surface application of baits formulated with metaldehyde or methiocarb. Application needs to coincide with the moist conditions that make slugs active.

New molluscicides utilising iron and copper as the active toxins will lessen effects on non-target invertebrates. But chemical control alone will not eliminate slugs where stubble is retained.

Cultivation and burning directly conflict with minimum tillage and stubble retention. This highlights the need for integrated approaches to slug control such as rolling after sowing to consolidate the seed bed – a practice gaining some acceptance in Australia. Generalist predators may control slugs in some minimum tillage systems and grasslands adjacent to crops provide effective refuges for beetle predators.

**Beetles**

Among the beetle pests of cereal crops are bronzed field beetle (*Adelium brevicorne*), grey false wireworm (*Iscopteran spp.*) and vegetable beetle (*Gonocephalum misellum*).

**Weevils**

Several weevils, in particular, vegetable weevil (*Listroderes difficilis*), spotted vegetable weevil (*Steriphus diversipes*) and mandalotus weevil (*Mandalotus spp.*) are also important pests though their importance differs across regions and crops.

**Vegetable weevil**

Vegetable weevil is found in all states and territories. While adults and larvae feed on a wide range of plants, canola is the only grain crop where feeding damages seedlings. These weevils, which have one generation a year, lay eggs on plants or the soil surface from mid March to September. Larvae feed on leaves and pupate in the soil. Adults emerge between September and October, and go into diapause during the hotter months.

Most damage is along crop edges or where host weeds are present in crops. Thus, they can be controlled using a border spray at crop emergence without the necessity for disruptive blanket sprays. Decreasing host weeds in paddocks can also reduce numbers.

**Spotted vegetable weevil**

Spotted vegetable weevil is found in all states except the Northern Territory. Their eggs, probably laid in the soil, hatch when there is sufficient moisture for seed germination. Larvae burrow under the soil to feed on grasses, cereals and capeweed. Adults emerge from spring through to early summer.

Cereals only suffer economic damage from larvae when numbers are high. Some feeding damage from adults has been observed in canola. They can be controlled through desiccation of weeds in paddocks before sowing. The pesticides registered for vegetable weevil control adults. Seed dressings can also reduce larval-feeding.

**Mandalotus weevil**

Mandalotus weevils have been recorded in the Mallee districts of South Australia and Victoria, parts of southern New South Wales and on the Yorke and lower Eyre Peninsulas of South Australia. Several species can cause economic damage to germinating crops.

There is probably one generation a year of mandalotus weevils with larvae present in soil during October and November. These weevils damage germinating canola and, to a lesser extent, cereals, peas, lupins, beans, vetch and medic pasture. In canola, they feed on leaves and can also cause above ground ring-barking.

**Other establishment pests**

Other common invertebrate pests of germinating crops are cockchafers (such as blackheaded pasture cockchafer), cutworms (for example, common cutworm), snails (vineyard snail) and earwigs (European earwig). Their impact varies between regions and/or seasons and they are generally regarded as minor or sporadic pests.

**Challenges for IPM strategies**

While many growers are using management practices that would fit comfortably into integrated pest management (IPM) strategies, implementation of IPM across the whole of the grains industry in southern Australia is still a challenge. For a start, more information is needed on many of the key establishment pests and their natural enemies.

The primary aim of IPM-suitable cultural
control practices is increased crop yield but they could also assist in decreasing pests. For example, controlling weeds lowers competition with crop plants but also eliminates breeding sites for some pests.

The limited uptake of IPM for establishment pests has several causes. For a start, broad-spectrum insecticides are easy to use and cheap. Then there are a number of complicating issues. The skills and training needed to identify and monitor both pest and beneficial species are lacking and there is little information on economic thresholds for invertebrate pests.

As yet ‘proven’ alternatives to broad-spectrum chemicals are few and some establishment pests are sporadic. Added to that are low grower confidence in IPM and low margins in some grains.

The heavy reliance on broad-spectrum and persistent pesticides at crop emergence is a big problem for IPM as this is likely to disrupt vital natural enemies. Alternative strategies that could be used in IPM include selective or ‘soft’ chemicals and the use of seed dressings. But it is essential that these measures are cost effective. The imminent introduction of transgenic crops with increased host resistance in the Australian grains industry could be an important IPM tool but they must be used wisely.

IPM strategies also need to include the effects of agricultural landscapes. There is limited information on the role of features such as remnant vegetation, shelterbelts and native grasslands in managing crop establishment pests. But studies on grass strips and shelterbelts adjacent to canola have shown that these non-crop landscape components can be managed to enhance pest control.

For instance, shelterbelts with ungrazed groundcover harbour beneficial organisms that suppress RLEM, blue oat mites and lucerne flea in adjacent paddocks. Cleared or grazed understories do not.

**IPM is just the beginning**

Developing an IPM program is only the beginning. It must then be successfully implemented. One essential is an effective and efficient on-farm pest monitoring program. Effective extension of research has underpinned IPM adoption in horticulture and cotton. Demonstration trials and training workshops were also important. The grains industry can learn from this.

Australian grain growers are facing increased international competition and so food safety and pesticide residue issues are important. As a result, restrictions on pesticide use have become more stringent. This, combined with resistance to pesticides in some species and increased awareness of environmental issues, has become a driver for IPM.

Avoiding prophylactic sprays, implementing monitoring programs that correctly identify pests and careful assessment of ‘non-target toxicity’ will result in control measures that drastically reduce negative impacts on natural enemies. These have become drivers for a move towards IPM.

Whenever and wherever IPM strategies are developed, they will need to be flexible so that they can be modified to include new pests, novel cropping systems and cropping in new regions.

This article on ecosystem services is a summary of a paper by Svetlana Micic, Ary Hoffman, Geoff Strickland, Andrew Weeks, Judy Bellati, Ken Henry, Michael Nash and Paul Umina on Pests of germinating grain crops in southern Australia: an overview of their biology and management options which appeared in the Australian Journal of Experimental Agriculture 48 (12): 1560-1573.

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