A range of control methods may beat grain pests

CSIRO Stored Grain Research Laboratory scientist David Rees shows how important it is to protect stored grain against lesser-known pests such as psocids and mites. These species, which are tiny and difficult to see, are increasing in numbers and can cause significant damage to stored grain.

Grain growers may have to make future changes in pest control management to reduce the threat of severe infestations of psocids and mites in stored grain.

According to CSIRO research, a combination of treatment methods could be required to effectively control psocids and mites in grain.

Most growers and grain storers are familiar with a variety of beetle pests which attack grain, referring to them as weevils. When present in large numbers beetle pests can be conspicuous.

But psocids and mites which are smaller (less than 1.5 millimetres in length), often pale and translucent in colour and difficult to see, have emerged as a significant pest problem of stored grain.

Range of species

Psocids are insects which are more closely related to cockroaches and lice than to beetles and moths.

Mites are not insects but belong to a class of animals called the Arachnida, along with familiar creatures such as spiders and scorpions.

More than a dozen species of psocids are now known to occur in Australian grain stores. The most important and damaging group are the small wingless species of *Liposcelis*, which can breed in bulks of grain. These are translucent, flattened, wingless insects which when fully grown are about 1mm long.

Photos: CSIRO Stored Grain Research Laboratory

CSIRO research indicates a combination of pest control methods and silo maintenance may be the best option to effectively reduce infestations of psocids and mites, which are emerging as potential problems for the future quality of stored grain.

The second group is a number of larger winged species which are mainly pests of structures and sometimes the surface of grain bulks.

In recent years psocids, especially *Liposcelis* species, have become more important as pests of stored grain in Australia.

Many mite species found in grain stores are pests which feed on grain. Other species are predators and parasites of other mites and insects (including psocids) (see Table 1).

Little is known about what mite species are currently present in Australian grain storages. But researchers know that cosmopolitan species including *Tyrophagus putrescentiae* (a grain feeder), *Cheyletus spp.* (predators) and parasites such as *Pyemotes spp.* are in Australia.

Increasing numbers

Both psocids and mites might be small but what they lack in size they can quickly make up for in numbers. Populations of thousands of psocids and millions of mites per kilogram can occur if left unchecked.

In terms of biomass (weight of insects present), such infestations usually far exceed those of other pest species experienced under modern Australian conditions. Grain exporters and buyers will not accept grain infested with these or other insects.

It is widely believed the *Liposcelis* species are scavengers and mould feeders and do not damage grain. Although they will feed on mould, they will also feed on grain, especially on the germ and on damaged grains. In this respect they are very similar to familiar beetle species such as flat grain beetles (*Cryptolestes spp*) and sawtoothed grain beetle (*Oryzaephilus surinamensis*).

In addition the huge numbers of *Liposcelis* which occur in heavy infestations lead to significant physical contamination of grain and storage structures and possible taint of grain.

The impact of heavy infestations of grain storage mites is similar to that produced by psocids.

In recent years, psocid species such as* Liposcelis entomophila *have become significant pests of stored grain. In the absence of competition or predators, population growth can be explosive.

in brief

- **Psocids and mites have emerged as future pest problems for stored grain due to changes in pest control practices over the years.**
- **These pests are small, normally less than 1.5 millimetres, often pale and clear in colour and more difficult to see than beetle pests such as weevils. If they are not managed, their population growth can be extremely rapid causing significant damage to grain.**
- **CSIRO research shows grain growers may need to use a combination of control methods to reduce the threat of severe infestations of psocids and mites in stored grain.**

Management...

In Europe mites are well known pests of compounded animal feeds and heavy infestations can reduce nutritional quality and feed acceptance. As a result, animals fed on infested food rations will not grow as well.

Both psocids and mites are vectors for mould spores. They can also produce allergic reactions in handlers and consumers of infested materials. In extreme cases these reactions can be life-threatening.

Future psocid protection

Although scientists do not yet fully know why psocids have become important as pests of stored grain, research is indicating changes in pest control methods could be the cause of the higher numbers.

The grains industry in Australia increasingly relies on fumigation with phosphine for control of insects — due to its relative ease of use and low cost combined with consumer preferences against the use of residual chemicals.

The psocids *Liposcelis spp.* can be effectively controlled with phosphine if applied to grain in a fully sealed system.

But application of phosphine to poorly sealed stores or to grain that can be easily re-invaded following fumigation may increase the long-term psocid problem.

Psocids are highly mobile insects and will often get back into a fumigated bulk of grain before other insects.

In the absence of competitors and predators, growth in psocid populations is explosive, resulting in the spectacular outbreaks sometimes seen.

CSIRO is currently investigating the use of dichlorvos space treatment of areas above open-topped bins fumigated with phosphine using the Siroflo system. Siroflo is a pressurised distribution system for phosphine use in partially sealed stores. Cylindered phosphine (formulated with carbon dioxide) is slowly released into the store at concentrations generally lower than conventional phosphine fumigation.

Mite species such as* Tyrophagus putrescentiae *thrive in cold moist grain and are more tolerant of grain protectants and fumigants than insects.

***Psocid damage to stored pulses. Out-turn chute of silo showing lupins heavily contaminated with dead* Lipocelis bostrychophilla.**

The combination treatment using Siroflo and dichlorvos is showing promise in controlling psocids.

Lowering grain temperatures to a level at which psocids are unable to breed rapidly or not at all following fumigation is another potentially useful strategy.

Liposcelis spp. need a minimum temperature of about 18 degrees Celsuis to breed. If the temperature of grain is reduced below this figure, the population growth of psocids will not occur.

Use of registered grain protectants may also be problematic as tolerance appears to exist among many *Liposcelis* populations to label rates of many residual grain protectants currently registered in Australia.

Dichlorvos appears to be effective but its use offers no lasting protection.

Mite control

Mites do not appear to be a major problem in Australia since most grain is stored at moisture contents too dry for them to thrive.

But developments in the grains industry which include taking grain production into cooler, wetter areas and storing moist grain under aeration or even chilled aeration, while being proposed for practical reasons, may inadvertently allow mite infestations to increase.

Unlike insects, mites thrive in cold moist grain, which is one reason why they are such a problem in Western Europe.

Pest mite species can breed in grain at temperatures as low as about 7°C. Mites are also more tolerant of grain protectants and fumigants compared with insects.

Control of mites on grain at low temperatures with the recommended label rates of the chemicals currently available could prove difficult. As a result, mites represent a potentially serious challenge to developments in the Australian grain industry.

CSIRO plans to continue its research into the future problem of mite infestations and potential control methods which may need to be implemented.

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TABLE 1 Physical and ecological differences between psocids and mites

Feature	Mite	Psocid
Number of pairs of legs on adult	4	3
Length of adult (millimetres)	Less than 1mm	1–2mm
Presence of antennae	No	Yes
Style of movement	Slow, gradual	Fast, jerky
Approximate maximum rate of population increase per month	500	50
Approximate minimum time taken for egg to develop to adult	9 days	28 days
Optimum temperature for population growth (degrees Celsuis)	23°–27°C	30°–34°C
Temperature range for population growth (degrees Celsuis)	7°–37°C	18°–40°C
Optimum relative humidity for population growth (per cent)	90%–100%	70%–80%
Minimum average relative humidity for population survival (per cent)	60%	60%

Note: The mite species is *Tyrophagus*. The psocid species is *Liposcelis*

The slow, gradual style of movement is true for grain feeding mite species but some predatory mite species are capable of rapid, steady movement.

Source: CSIRO Stored Grain Research Laboratory.