

# Health and safety issues related to mites in stored grain

R.B. Halliday

Stored Grain Research Laboratory, CSIRO Entomology, GPO Box 1700, Canberra, ACT 2601

**Abstract.** Several families of mites occur in stored grain, including grain feeders, fungus feeders, predators, and parasites. These can cause occupational health problems for grain industry workers, including skin contact dermatitis, inhalant allergy and asthma, and painful irritation caused by direct biting of human skin. Control measures for these mites include chemical pesticides, fumigation, controlled atmospheres, physical methods, and biological control.

## Introduction

Mites are common inhabitants of stored products of all kinds, including grain and grain-based commodities at all stages of processing. Mites that occur in these commodities belong to many different families and genera, and most of them are apparently harmless. However, some cause direct damage by attacking grain, or indirect damage by contaminating foodstuffs. That contamination can make commodities unpalatable to livestock and unacceptable as human food. Stored-product mites can also be a cause of occupational disease in staff working in the grain and food-processing industries. The mite groups that have been identified as significant causes of occupational disease fall into two main categories: the family Acaridae and related families, and the genus *Pyemotes* (family Pyemotidae).

## Acaridae and related families

Most mites that occur in grain and other stored foods belong to the Acaridae and related families. These mites are 0.5–1 mm long, just visible to the naked eye when on a dark background. They are usually white or pale brown, slow-moving, often shiny, and usually with visible long hairs, especially at the posterior end. A comprehensive review of the identification and biology of these mites was given by Hughes (1976). There may be as many as 50 species that fit this general description. Some of the most common of them have been implicated as the cause of occupational disease in the food industries, and are familiar enough that the symptoms they cause have acquired common names. Table 1 lists some of the most common species, and the names of the dermatitis-like conditions that have been attributed to them. The symptoms reported are probably caused by a combination of direct skin contact with mites or their products, and inhalation of mite fragments. The species listed differ

somewhat in their preferences for different commodities, hence the different names for the conditions they cause. There is some ambiguity in the details of these conditions, because the mite involved in a particular case may have been identified incompletely or not at all, and several species of mites may cause similar symptoms. All of the mite species listed occur in Australia, and all of the conditions listed have been recognised here. Other species are less well-known, but have also been implicated in occupational disease in Australia; for example, dermatitis caused by the brown-legged mite *Aleuroglyphus ovatus* (Troupeau) (Geary et al. 2000).

**Table 1.** Acaridae and related mites associated with skin conditions (Southcott 1976).

Condition	Putative causal mite
Baker's itch	<i>Acarus siro</i> L.
Copra itch, grocer's itch	<i>Tyrophagus putrescentiae</i> (Schrank)
Wheat pollard itch	<i>Suidasia nesbitti</i> Hughes
Grocer's itch	<i>Glycyphagus domesticus</i> (De Geer)
Dried fruit dermatitis	<i>Carpoglyphus lactis</i> (L.)

Apart from dermatitis-like symptoms of the skin, stored-food mites have also been implicated as a cause of allergy and asthma. Table 2 lists some examples of allergy and respiratory symptoms that have been attributed to these mites. In these cases, the symptoms have been caused by inhalation of mites, fragments of dead mites, or their excretory pellets. The examples cited come from outside Australia, but they all refer to mites that are well-known in stored products in Australia. It is possible that the symptoms observed are the result of cross-reaction to an allergy originally caused by some other sensitising agent but, in each case, reactions were induced in response to the mites listed.

Various methods have been used to control mites of this type. They include the use of grain protectants as acaricides, such as cypermethrin (Wilkin et al. 1988) and chlo-

ppyrifos-methyl (White and Sinha 1990), as well as fumigants such as carbon disulfide (Barker 1982) and phosphine (Jian et al. 1995). Biological control has been suggested, mostly involving use of predatory mites of the family Cheyletidae (e.g. Brennan and Duggan 1979; Zdarkova and Horak 1990). Physical methods such as heat treatment (Cunnington 1984), inert dusts (Cook and Armitage 1996) and modified atmospheres (Navarro et al. 1985) have also proven successful, and there have been some attempts to develop acaricides based on mite pheromones (Kuwahara and Sakuma 1982). All of these methods have the potential disadvantage that, even if the treatment is effective, dead mites can still be allergenic.

## The genus *Pyemotes*

Probably the most severe human health problems associated with mites in grain are caused by species of the genus *Pyemotes*. These differ from the species discussed earlier because symptoms are caused by the mites directly biting their human hosts. *Pyemotes* mites are small, less than 0.5 mm long, and are pale coloured and extremely difficult to see. The female mite attaches itself to an insect host, often the Angoumois grain moth, *Sitotroga cerealella* Oliver, but also a variety of other moths and beetles that occur in stored grain and hay. There it feeds as a parasite until it swells to many times its original size as its progeny develop and mature within the female's body. These progeny then mate and move off in search of further prey. The health problems caused by these mites arise when they bite humans or other mammals. These bites cause painful itching skin lesions that have earned the name 'hay itch mite' or 'straw itch mite' for the more common species. The attack actually involves the mite piercing the skin with its sharp stylet-like mouthparts, and injecting a venom that would normally be used to

paralyse or kill its insect host. A patient often has hundreds of these bites, which can be very painful. Examples of such cases are in a worker handling straw in Australia (Southcott 1976), and people handling hay, straw and grain in Israel (Yeruham et al. 1997), USA (Kinkle and Greiner 1982; Walter and Landis 1994) and Germany (Grob et al. 1998).

There is some confusion about exactly which species of *Pyemotes* are involved in causing these symptoms in humans. It was long thought that *P. ventricosus* (Newport) was responsible, and most literature reports of human disease cite this species. However, more detailed study of this taxonomically difficult group has shown that the culprit may actually be a different species, *P. tritici* (Lagrèze-Fossat and Montagne) (Southcott 1976), but for practical purposes it is sufficient to simply refer to all of these mites as *Pyemotes*.

Infestations of *Pyemotes* can be difficult to control. Grimm and Lawrence (1976) reported infestation of cultures of *S. cerealella* with *Pyemotes*, which they controlled by applying a chemical acaricide (dicofol). Schenone et al. (1973) successfully controlled an infestation by spraying the walls and floors of affected rooms with lindane. Qaisrani and Beckett (2002) reported an infestation of *S. cerealella* and associated mites (*Pyemotes*) in two grain-handling facilities, which were treated effectively by the application of heat to kill both insects and mites. The important point is that *Pyemotes* is a parasite of insects, so its effective eradication ultimately depends on control of its hosts.

## Discussion

The mite problems described above can have severe effects on the health and safety of employees in the grain-handling industry. At the moment, there is no single

**Table 2.** Examples of occupational allergy and asthma attributed to stored product mites. All of the species listed occur in Australia.

Mite species	Circumstances	Condition	Country	Reference
<i>Lepidoglyphus destructor</i> Schrank	Grain handler	Allergy	Canada	Warren et al. (1983)
<i>Lepidoglyphus destructor</i>	Grain elevator workers	Allergy	Denmark	Revsbech and Andersen (1987)
<i>Lepidoglyphus destructor</i>	Farm grain stores	Cough, wheeze	UK	Blainey et al. (1988)
<i>Lepidoglyphus destructor</i>	Cereal workers	Allergy	Spain	Armentia et al. (1997)
<i>Lepidoglyphus destructor</i>	Stored hay and grain	Asthma	Sweden	Hage-Hamsten et al. (1988)
<i>Acarus siro</i> L.	Cereal workers	Allergy	Spain	Armentia et al. (1997)
<i>Acarus siro</i>	Farm grain stores	Cough, wheeze	UK	Blainey et al. (1988)
<i>Acarus siro</i>	Grain elevator workers	Allergy	Denmark	Revsbech and Andersen (1987)
<i>Glycyphagus domesticus</i> (De Geer)	Farm grain stores	Cough, wheeze	UK	Blainey et al. (1988)
<i>Tyrophagus putrescentiae</i> (Schrank)	Grain elevator workers	Allergy	Denmark	Revsbech and Andersen (1987)
<i>Tyrophagus putrescentiae</i>	Farm grain stores	Cough, wheeze	UK	Blainey et al. (1988)
<i>Tyrophagus putrescentiae</i>	Cereal workers	Allergy	Spain	Armentia et al. (1997)
<i>Chortoglyphus arcuatus</i> (Troupeau)	Cereal workers	Allergy	Spain	Armentia et al. (1997)

simple way of controlling them. Little is known about how to control mites by fumigation. Until it is, effective control will depend on keeping moisture levels low, since the most important stored-food mites can breed only in grain with a moisture content of at least 14% (Wilkin 1984), including damp patches in otherwise drier grain.

## References

- Armentia, A., Martinez, A., Castrodeza, R., Martinez, J., Jimeno, A., Mendez, J. and Stolle, R. 1997. Occupational allergic disease in cereal workers by stored grain pests. *Journal of Asthma*, 34, 369–378.
- Barker, P.S. 1982. Control of a mite, *Lepidoglyphus destructor*, including hypopi, in wheat with carbon disulfide. *Journal of Economic Entomology*, 75, 436–439.
- Blainey, A.D., Topping, M.D., Ollier, S. and Davies, R.J. 1988. Respiratory symptoms in arable farmworkers: role of storage mites. *Thorax*, 43, 697–702.
- Brennan, P.A. and Duggan, J.J. 1979. The role of predators (*Cheyletus* spp.) in the biological control of pests of stored products. *Proceedings of Seminar on Biological Control*, Dublin, February 1977, 121–129.
- Cook, D.A. and Armitage, D.M. 1996. The efficacy of an inert dust on the mites *Glycyp hagus destructor* Schrank and *Acarus siro* L. *International Pest Control*, 38, 197–199.
- Cunnington, A.M. 1984. Resistance of the grain mite *Acarus siro* L. (Acarina, Acaridae) to unfavourable physical conditions beyond the limits of its development. *Agriculture, Ecosystems and Environment*, 11, 319–339.
- Geary, M.J., Knihinicki, D.K., Halliday, R.B., and Russell, R.C. 2000. Contact dermatitis associated with the brown-legged mite, *Aleuroglyphus ovatus* (Troupeau) (Acari: Acaridae), in Australia. *Australian Journal of Entomology*, 39, 351–352.
- Grimm, M. and Lawrence, P.J.T. 1976. Biological control of insects on the Ord. I. Production of *Sitotroga cerealella* for mass rearing of *Trichogramma* wasps. *Journal of Agriculture, Western Australia*, 16(4), 90–92.
- Grob, M., Dorn, K. and Lautenschlager, S. 1998. Grain mites: a small epidemic. *Hautarzt*, 49, 838–843.
- Hage-Hamsten, M. van., Ihre, E., Zetterstrom, O. and Johansen, S.G.O. 1988. Bronchial provocation studies in farmers with positive RAST to the storage mite *Lepidoglyphus destructor*. *Allergy (Copenhagen)*, 43, 545–551.
- Hughes, A.M. 1976. The mites of stored food and houses. London, Her Majesty's Stationery Office.
- Jian, F.J., Chen, Q.Z. and Lu, A.B. 1995. Some biochemical aspects of phosphine in combination with carbon dioxide against the adults of *Tyrophagus putrescentiae* (Schrank) (Astigmata: Acaridae). *Acta Entomologica Sinica*, 38, 13–19.
- Kinkle, G.A. and Greiner, E.C. 1982. Dermatitis in horses and man caused by the straw itch mite. *Journal of the American Veterinary Medical Association*, 181, 467–469.
- Kuwahara, Y. and Sakuma, L. 1982. Syntheses of alarm pheromone analogues of the mold mite, *Tyrophagus putrescentiae*, and their biological activities. *Agricultural and Biological Chemistry*, 46, 1855–1860.
- Navarro, S., Lider, O. and Gerson, U. 1985. Response of adults of the grain mite, *Acarus siro* L., to modified atmospheres. *Journal of Agricultural Entomology*, 2, 61–68.
- Qaisrani, R. and Beckett, S. 2002. Heat, an age-old technology conquers insect pests. *Australian Grain*, August–September 2002, 24–27.
- Revsbech, P. and Andersen, G. 1987. Storage mite allergy among grain elevator workers. *Allergy*, 42, 423–429.
- Schenone, H., Tello, J., Villarroel, F. and Rojo, M. 1973. An outbreak of dermatitis probably caused by mites in a hospital food service. *Boletin Chileno de Parasitologia*, 28, 40–41.
- Southcott, R.V. 1976. Arachnidism and allied syndromes in the Australian region. *Records of the Adelaide Children's Hospital*, 1, 97–186.
- Walter, E.D. and Landis, D.A. 1994. Straw itch mite, *Pyemotes tritici*, infestation in brome seed related to acute dermatitis in Michigan granary workers. *Great Lakes Entomologist*, 27, 125–128.
- Warren, C.P.W., Holford-Strevens, V. and Sinha, R.N. 1983. Sensitization in a grain handler to the storage mite *Lepidoglyphus destructor* (Schrank). *Annals of Allergy*, 50, 30–33.
- White, N.D.G. and Sinha, R.N. 1990. Effect of chlorpyrifos-methyl on oat systems in farm granaries. *Journal of Economic Entomology*, 83, 1128–1134.
- Wilkin, D.R. 1984. Ridding stored grain of pests. *Cereal Foods World*, 29, 415–416.
- Wilkin, D.R., Binns, T.J. and Dawson, B. 1988. The assessment of a new formulation of cypermethrin as a grain protectant. Brighton Crop Protection Conference. Pests and Diseases, volume 3, 965–970.
- Yeruham, I., Rosen, S. and Braverman, Y. 1997. Dermatitis in horses and humans associated with straw itch mites (*Pyemotes tritici*) (Acarina: Pyemotidae). *Acarologia*, 38, 161–164.
- Zdarkova, E. and Horak, E. 1990. Preventive biological control of stored food mites in empty stores using *Cheyletus eruditus* (Schrank). *Crop Protection*, 9, 378–382.