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Current status of the warehouse beetle *Trogoderma variabile* (Coleoptera: Dermestidae) as a pest of grain storage in Australia

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Abstract. The warehouse beetle *Trogoderma variabile* was first detected in Australia in the late 1970s, in southern NSW. Since then, and despite attempts at eradication, it has become established and is now a persistent pest of storage structures and is becoming a pest of bulk-stored canola.

Over the 2001–2002 and 2002–2003 seasons, a survey was undertaken to determine the current status of this pest. Sticky flight traps baited with synthetic sex pheromone were deployed during the summer flight period. In total, 154 sites were surveyed in WA, SA, Victoria, NSW and Queensland. *T. variabile* was detected at 66 sites and is now widely distributed from northern NSW to SA east of Port Augusta, but has only a restricted distribution in Queensland and WA. Of discrete grain handling systems, only the Eyre Peninsula in SA appears to be free of *T. variabile*.

Results were compared with data collected in 1990–1993. This showed that *T. variabile* has consolidated its position in south-eastern Australia but remains uncommon in WA and Queensland.

Introduction

The warehouse beetle *Trogoderma variabile* Everts (Coleoptera: Dermestidae) was first detected in Australia in 1977 in Griffith, NSW. By 1981 it had been found in Victoria and Queensland. An outbreak was recorded in Morawa, WA in 1979. It was not found again in that state until the early 1990s. It was first recorded in SA in the early 1990s. Despite several attempts at quarantine and eradication, *T. variabile* has become established in Australia (Wright 1993). Outside Australia, *T. variabile* is widely distributed in Europe, North America and temperate regions of Asia.

T. variabile is currently regarded as a persistent pest of grain storage and handling structures, where it is usually associated with residues. It will also attack a wide range of packaged goods. Recently, however, we have observed this insect becoming a pest of bulk-stored canola in southern NSW. *T. variabile* is of particular concern because of its very close physical similarity to the khapra beetle *Trogoderma granarium Everts* (Coleoptera: Dermestidae) which is not present in Australia and is of quarantine concern.

In the early 1990s an Australia-wide survey (E.J. Wright, unpublished) was undertaken to determine the extent of spread of this pest. The aim of this study was to update that work to show the degree to which *T. variable* has spread since then.

Methods

Between October and April 2001–2002 and 2002–2003, trapping was undertaken for *T. variabile*. Over the two seasons, 157 traps were placed in 154 settlements across WA, SA, Victoria, NSW and Queensland (Table 1). Most were placed near a grain storage facility run by a bulk-handling company. The trap used for the monitoring was the 'Pherocon II' sticky flight trap (Trécé Inc. Salinas, CA, USA) baited with a 'bullet lure' containing synthetic *Trogoderma* aggregation pheromone (Insects Limited Inc., Westfield, IN, USA). Typically, a single trap was placed at each site, usually hung about 2 m above the ground in a convenient tree close to the storage facility. Traps were left in place for about 2 months before being removed and their contents examined and identified.

Results

Data collected in 1990–1993 are shown in Table 1 and Figure 1. Since that time, the incidence of *T. variabile* appears to have more than doubled in Victoria and SA and increased by half in NSW. Incidence in Queensland and WA remains low.

Nationwide, between 2000–2003, *T. variabile* was detected at 66 or 42.9% of the 154 sampled locations (Table 2). Incidence varied considerably between states. *T. variabile* was detected at the majority of sites (>63%)

in NSW and Victoria, and at almost half the sites in SA. In contrast, the pest was only detected at single sites in both WA and Queensland.

Figure 2 shows the geographical location of sites surveyed, including those where *T. variabile* was found. Incidence of *T. variabile* was greatest in the southern half of NSW through to eastern SA. In contrast, many sites in northern NSW appeared free of the insect. No infestations were found on the Eyre Peninsula of SA.

Figure 3 combines data from both surveys to provide a cumulative distribution of *T. variabile* in mainland Australia.

Table 1. Incidence of *Trogoderma variabile* in Australia, 1990–1993 data.

State	Sites where *T. variabile* was detected	Sites where *T. variabile* was not detected	Proportion of sites infested (%)
Queensland	1	13	7.1
NSW	16	18	47.1
Victoria	2	6	25.0
SA	9	50	15.3
WA	2	98	2.0
Total	30	185	14.0

Table 2. Incidence of *Trogoderma variabile*, 2001–2003 data.

State	Sites where *T. variabile* was detected	Sites where *T. variabile* was not detected	Proportion of sites infested (%)
Queensland	1	17	5.6
NSW	41	20	67.2
Victoria	12	7	63.2
SA	11	14	44.0
WA	1	30	3.2
Total	66	88	42.9

Discussion

In the last 10 years *T. variabile* appears to have consolidated its distribution in the grain-growing areas of south-eastern Australia from eastern SA through to central NSW. This is especially noticeable in Victoria and eastern SA, where incidence of this pest has increased to levels approaching those seen in NSW. Within this area, *T. variabile* is gradually colonising more and more storage facilities—in effect, it is 'filling in the gaps'. This may be occurring as a result of a mixture of natural migration by adult flight and movement mediated by human activity. Given the ability of this species to survive on minimal quantities of residues and under bark of trees, once a site becomes infested then it is likely that it and/or the immediate vicinity will remain infested indefinitely.

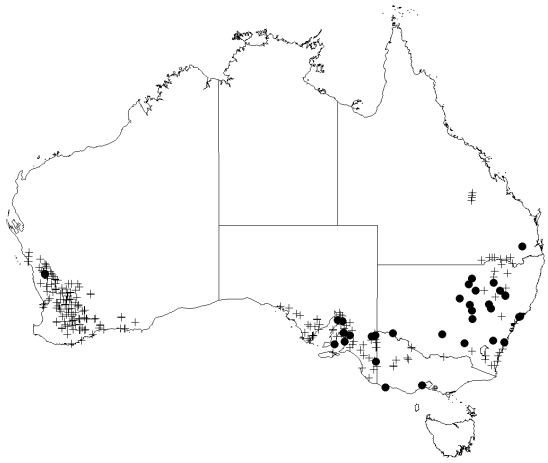

Figure 1. Incidence of *Trogoderma variabile*, 1990–1993.
● *T. variabile* found, + *T. variabile* not found.
No traps placed in NT or Tasmania.

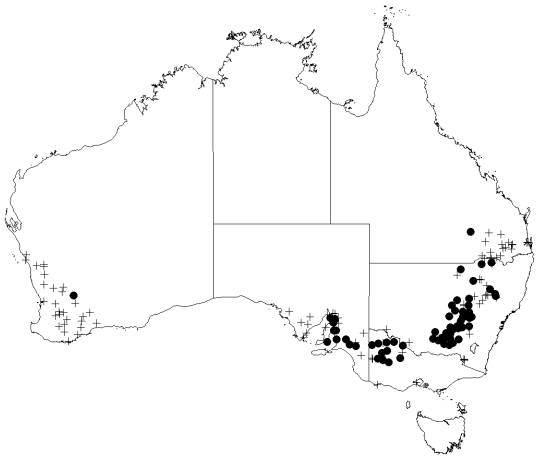

Figure 2. Incidence of *Trogoderma variabile,* 2001–2003 data.
● *T. variabile* found, + *T. variabile* not found.
No traps placed in NT or Tasmania.

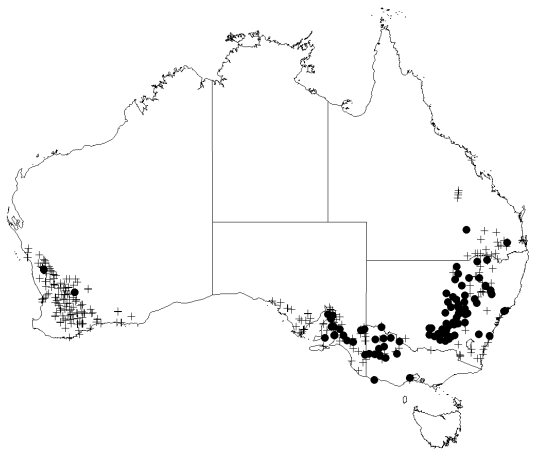

Figure 3. Incidence of *T. variabile*, combined data 1990–2003.
● *T. variabile* found, + *T. variabile* not found.
No traps placed in NT or Tasmania.

Elsewhere, *T. variabile* remains absent or uncommon. Its incidence in Queensland remains low. Reasons for this are unclear but may in part be a response to a climatic trend. Data suggest that in NSW, incidence of *T. variabile* gradually declines as one travels further north. The areas where this pest is best established have hot dry summers. In Queensland and northern NSW, summer rainfall is more common, which may create conditions less favourable for this pest. The related species *T. granarium*, while not present in Australia, is known to be highly tolerant of hot dry conditions and thrives in parts of its range with such a climate (Howe 1958; Freeman 1959; Calderon and Donahaye 1964). In more humid areas, it tends to be out-competed by other, faster-breeding storage insects, especially *Sitophilus* spp. (Coleoptera: Curculionidae) and *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae) (Haines 1991).

Another factor influencing its current distribution is the cultivation and storage of canola, which is largely grown in areas most severely infested by *T. variabile*. In contrast to the difficulty it has in breeding on clean samples of cereal grains, *T. variabile* thrives on canola. Indeed, in Australia, with the exception of the flour beetle *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) and psocids *Liposcelis* spp. (Psocoptera: Liposcelididae), other important storage pests do not appear to attack canola. In canola storages, large populations of *T. variabile* may develop in the bulk as well as in residues. Canola seed, being small and spherical, easily runs into cracks and crevices. In addition, no residual protectant insecticides are registered for use on canola. Canola residues are likely to form a persistent and difficult to control reservoir for *T. variabile* in south-eastern Australia.

The current incidence of *T. variabile* in the western half of the continent is in marked contrast with the eastern half. *T. variabile* appears to be absent from the grain-growing regions of the Eyre Peninsula. This is probably as a result of the geographical isolation of the region and with care there is an opportunity to maintain the region free of this pest. Grain is not brought into this region from outside. Transport infrastructure on the peninsula, such as rail wagons, is not shared with other infested parts of SA because the rail network is isolated and of different gauge to the rest of the state.

The situation in WA is most difficult to understand. In spite of climatic and agronomic similarities with badly affected areas in the south-east, the pest remains uncommon in WA. However, where infestations have occurred in WA, they have been heavy. The reasons why this pest has not become widespread in WA are probably complex. It may involve a combination of factors, such as the nature of grain storage in that state—a mostly export-focused industry heavily reliant on sealed, fumigable storage; the relative absence of poorly managed, on-farm storage; and the relatively low density of human settlement. It is possible that in WA the dispersal of infestations to other suitable locations may be sufficiently difficult to prevent widespread establishment.

In interpreting such data, it is important to understand that the status of any pest is dynamic and changes over time. Changes in management practices can have a rapid and dramatic effect on the incidence of a pest, as seen in the rise in the status of psocids during the 1990s (Rees 1998).

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