

# AN IMPROVED METHOD OF LABORATORY REARING THE SMALL HIVE BEETLE *AETHINA TUMIDA* MURRAY (COLEOPTERA: NITIDULIDAE)

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## Summary

A method is described for rearing Small Hive Beetle, *Aethina tumida*, in the laboratory. A diet comprising pollen, torula yeast and honey was nutritious for larvae. With adequate moisture provided adults could be maintained in a non-reproductive state if loose sucrose crystals were provided. Protein in the form of pollen and yeast was needed for females to develop eggs and for oviposition. If provided with protein females were capable of laying viable eggs within 3-6 d of emergence. At 29°C eggs hatched in 1-2 d. There were four recognisable larval instars. Larvae fed for up to 6 d. They remained as post-feeding larvae for another 4-13 d. Pupation occurred after the larvae were transferred to soil. In the laboratory rearing scheme 9 cm diameter plastic cylinders holding a depth of about 15 cm of loose, moist, sandy soil were used. The pupal period occupied 13-25 d.

**Keywords:** Small Hive Beetle, semi-synthetic diet, insect rearing

## INTRODUCTION

The Small Hive Beetle (SHB) (*Aethina tumida* Murray) was detected at Richmond in western Sydney in October 2002 (Fletcher and Cook 2002). It has now spread widely in eastern Australia (Gillespie *et al.* 2003). It has the potential to cost the honey bee industry millions of dollars through loss of export market, damage to hives and contamination of honey. The National Management Plan for SHB proposed in 2002 sought to implement control programs based on both chemical and non-chemical strategies. Although Australia was able to draw on the lessons learned by the Americans since 1998 when SHB was first found in Florida (Sanford 1998), further research, particularly insecticide efficacy trials were needed. To facilitate this work it was imperative that the beetle could be raised in large numbers in the laboratory in a systematic rearing regimen. Neumann *et al.* (2001) outlined some basic information on laboratory rearing of SHB using honey comb and bee brood. More recently Murrle and Neumann (2004) refined the method but still relied on brood comb. Here we describe a method that has been in operation for over 16 months that does not require comb or brood and has reliably produced many thousands of healthy, full-sized beetles or beetle larvae.

## MATERIALS AND METHODS

A Small Hive Beetle colony was established in the insectary at the Elizabeth Macarthur Agricultural Institute, Camden from a starting population of less than 30 adult beetles collected from hives at Richmond (NSW). The beetles were kept in plastic boxes (45 x 35 x 35 cm) that had ventilated lids and the upper 10 cm of the walls coated in fluon to prevent the beetles from escaping. The bases of the

boxes were lined with damp sponge cloth (Wettex™) to maintain high humidity, and had pieces of crumpled, damp paper towel as harbourages. The boxes were kept in room maintained at 29°C and with a 14:10 (L:D) photoperiod.

The maintenance diet for the beetles consisted of damp, loose sucrose crystals provided in 9 cm diameter petri-dishes. When eggs were required this was supplemented with a protein diet (Table 1) for females to develop eggs, and as an oviposition site. Beetles were allowed up to 2 d for oviposition after which the protein medium containing the eggs and larvae was removed. Depending on the number required, larvae were provided additional fresh medium. When 8-12 d old they were transferred into plastic containers (20 cm x 9 cm diameter) that were filled to a depth of 15 cm with a homogeneous steam-sterilised mixture of coarse sand and peat (1:1 v/v) with a final moisture content of approximately 100 g kg<sup>-1</sup>. These pupation tubes were covered with beetle proof cloth mesh held in place by an elastic band. A hand atomiser was used to moisten the soil surface about three times per week until the emergence of adult beetles. These were transferred from the soil tubes into new rearing boxes to continue the cycle.

## RESULTS

A colony of SHB was successfully established. When provided with the protein diet and adequate moisture, females laid prolifically. Even when adequate alternative food was available beetles were sometimes observed eating eggs. Under the insectary conditions (29°C and high humidity) eggs hatched within 2 d of oviposition. Four larval instars were recognised. Under the conditions described the larval

period comprised a feeding period of up to 6 d and a non-feeding, pre-pupal period of 4-13 d. Larvae were fully fed (typical mean weight 22.2 mg) after about 5 d but chose not to move off the food until they were about 15 d old. If transferred to moist soil full-size larvae pupated during the next 13 d. Emergence usually began *en masse* after about 16 d in soil but small numbers of adults continued to emerge for another 2-4 weeks. Typical mean adult beetle weight was 149 mg. The full life-cycle in the insectary is shown in Figure 1.

**DISCUSSION**

SHB was successfully established in laboratory culture. The general life-cycle (egg, larva, pupa, adult beetle) observed in and around bee hives has been described in numerous other publications. Here we provide more detailed observations collected under controlled laboratory conditions.

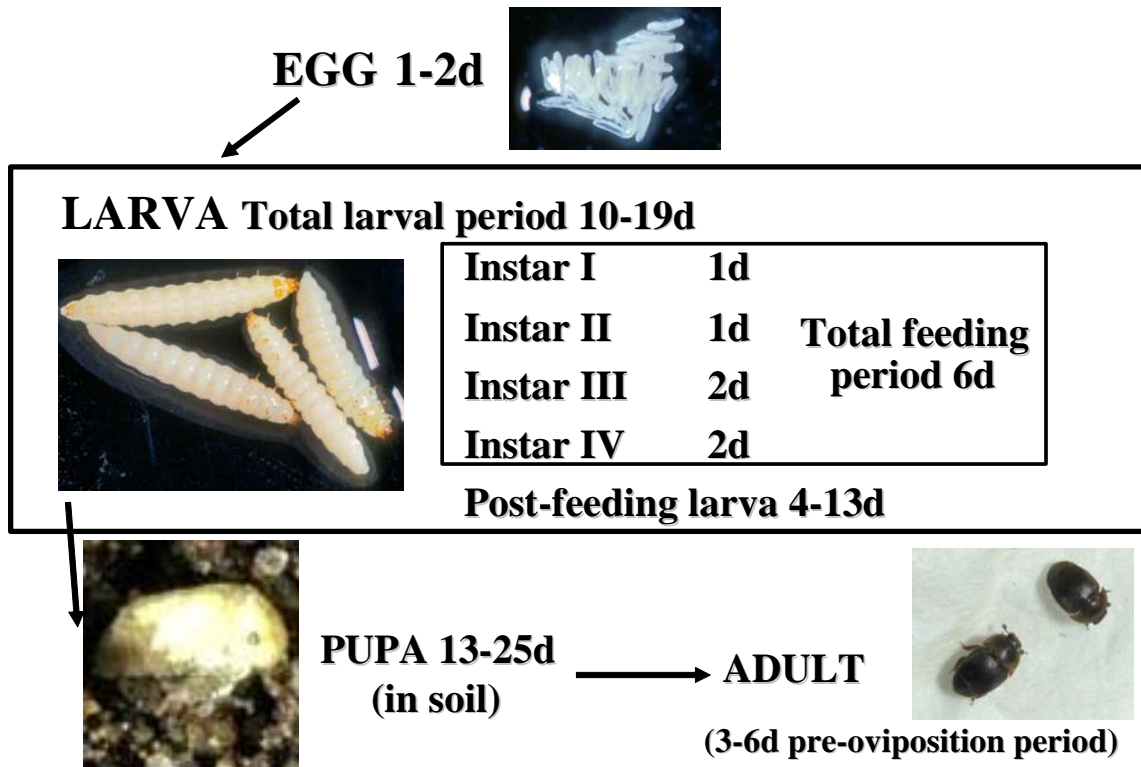
When adequate moisture was provided adults and larvae thrived on a diet of pollen, honey and torula

**Table 1. Protein source and oviposition medium for adult Small Hive Beetles and rearing medium for larvae.**

Diet component	Proportion in diet (g kg <sup>-1</sup> )
Western Australian pollen <sup>1</sup> (honey bee-collected)	500
honey	444
torula yeast	56

<sup>1</sup> C.B. Palmer and Co. Ipswich, Queensland

Figure 1. Life-cycle of the Small Hive Beetle under the insectary rearing conditions (29°C).



yeast. Unlike a previous attempt at laboratory rearing (Neumann *et al.* 2001, Murrle and Neumann 2004) no honey comb or bee brood was necessary. Adults could be kept for many months on sugar alone if high humidity was maintained, but required protein (eg. pollen) for reproduction. Ellis *et al.* (2002) reported that protein in the form of brood or pollen was needed for reproduction. High humidity and damp surroundings are required to prevent eggs from desiccating and for adult longevity. Soil moisture was also critical to pupal survival and for the emergence of vigorous, healthy adults. Emergence rates were highest when 15 cm of soil was provided and larvae were not disturbed. Pettis and Shimanuki (1999) reported that 80% of larvae in the field were found in the top 10 cm of soil but that some larvae burrowed to a depth of 20 cm. In the conditions described here emergence usually began after about 16 d in soil.

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