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Scientific note

A scientific note on quantitative diagnosis of small hive beetles, *Aethina tumida*, in the field*

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The small hive beetle, *Aethina tumida*, (= SHB) can cause considerable damage to apiculture. Regions with more damage have higher SHB population levels (Spiewok et al., 2007), creating demand for quantitative diagnosis. Several methods have been suggested (cf. Ellis, 2005a, b), but their applications are labour intensive (e.g. visual colony screenings: Spiewok et al., 2007; Neumann and Hoffmann, 2008). Here, we develop a less labour-intensive method for quantitative SHB diagnosis in field colonies.

In November/December 2006, experiments were conducted at five apiaries in Richmond, Australia with moderate to strong queenright European honeybee (*Apis mellifera ligustica*) colonies in Langstroth hives. We tested diagnostic strips made of corrugated plastic [75 × 500 × 4 mm], which created rows of narrow tunnels. These strips offered hiding places for adult SHB but prevented access of bees. Preliminary tests with thicker strips (6 mm), which allowed bees to enter, resulted in only a single captured SHB (N = 7 infested colonies). One strip was placed on the bottom board of each hive by sliding it through the flight entrance. Bottom boards were chosen because they appear to be suitable within-hive locations to capture adult SHB (Elzen et al., 1999; Neumann and Hoffmann, 2008). The strips were left in the hives over two nights to provide SHB time to find the refuges. To avoid a potential impact of ambient temperature (since adult SHB seek shelter in bee clusters during cool weather; Pettis and Shimanuki, 2000), the strips were quickly removed when temperatures exceeded 20 °C. Then, the lured SHB were shaken into bright trays and counted. Directly afterwards, all colonies were visually screened using routine protocols (Spiewok et al., 2007; Neumann and Hoffmann, 2008). Strip efficacy was tested by comparing total SHB numbers in the hives with the numbers in the strips. We investigated colonies with single (N = 32) and double Langstroth brood chambers (N = 37) to test for potential differences in strip efficacy due to hive design and/or colony size.

Seven single-chamber colonies with burr comb on the bottom boards were not included because SHB were found underneath the strips, suggesting that even bottom boards are crucial. One double colony with no SHB was also excluded. The mean SHB number in all colonies (N = 69) was 22.4±13.7 (all values ± SD; Min: 0; Max: 84). There was no significant difference between single (23.8 ± 19.9) and double (21.1±14.4) colonies (Mann-Whitney U Test: U = 591.0, $P > 0.99$). Likewise, the efficacy of the diagnostic strips was not significantly different between single (37.1 ± 20.5%, N = 18) and double (34.5 ± 20.8%, N = 36) colonies (Mann-Whitney U Test: U = 291.5, $P > 0.55$). The overall strip efficacy was 35.4 ± 20.6% (N = 54 colonies) and SHB numbers in the traps correlated with total numbers in the hives (Fig. 1).

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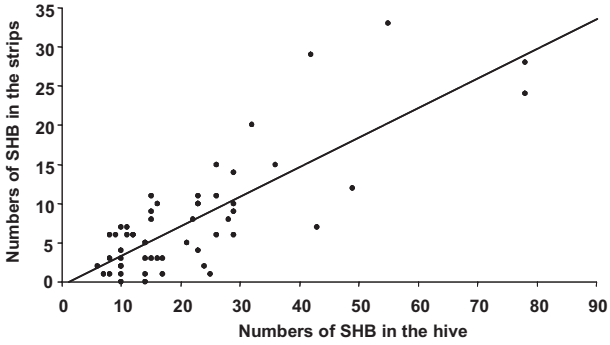

Figure 1. Efficacy of 4 mm diagnostic strips (N = 54 colonies). The numbers of small hive beetles (= SHB) found in the strips correlates significantly with the total numbers of beetles in the hives (Spearman's rank correlation: $r_S = 0.70$; $P < 0.01$).

The similar infestation levels of single and double hives suggest that colony size is less relevant (Spiewok et al., 2007; Neumann and Hoffmann, 2008). Moreover, there was no significant difference in efficacy between the two hive sizes, probably because similar SHB proportions are seeking shelter on the bottom boards. This supports that bottom boards are suitable for diagnosis (Elzen et al., 1999; Neumann and Hoffmann, 2008). The underlying reasons for the variation in efficacy remain unclear, which is however less relevant, because apiary-wide treatments are recommended due to high SHB mobility (Neumann and Hoffmann, 2008). We suggest that our method should be further tested over a wider range of infestation levels and weather conditions. In conclusion, diagnostic strips provide a fast, cheap, and easy quantitative diagnosis for SHB in the field, which is necessary for pest management decisions and especially suitable for large-scale beekeeping operations.

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Note scientifique sur la diagnose quantitative du Petit coléoptère des ruches, *Aethina tumida*, au champ.

Eine wissenschaftliche Notiz zur quantitativen Diagnose des Kleinen Beutenkäfers, *Aethina tumida*, im Freiland.

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