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Authors: Arbogast, Richard T., Torto, Baldwyn, Van Engelsdorp, Dennis, and Teal, Peter E. A.

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AN EFFECTIVE TRAP AND BAIT COMBINATION FOR MONITORING THE SMALL HIVE BEETLE, *AETHINA TUMIDA* (COLEOPTERA: NITIDULIDAE)

RICHARD T. ARBOGAST[1], BALDWYN TORTO[2], DENNIS VAN ENGELSDORP[3] AND PETER E. A. TEAL[1]
[1]USDA/ARS-CMAVE, 1600/1700 SW 23rd Dr., Gainesville, FL 32608

[2]IFAS, University of Florida, Gainesville, FL 32611

[3]Pennsylvania Department of Agriculture, Harrisburg, PA 17110

The small hive beetle (SHB), *Aethina tumida* Murray (Coleoptera: Nitidulidae), is a pest of European honeybees *Apis mellifera* (L.) in the United States. Surveys in the US in 2004 indicated that the beetle had spread to 30 states (Hood 2004). The beetle is weakly attracted to bucket traps baited with a combination of honey, pollen and adult bees, but not to traps baited with honey and pollen, or brood alone (Elzen et al. 1999). The beetle is also attracted to bumblebee colonies, suggesting that these may serve as alternative hosts (Spiewok & Neumann 2006). This paper reports field tests of an effective trap and bait combination for monitoring flying SHB.

The bait consisted of pollen dough (a mixture of pollen and honey) conditioned by allowing male SHB to feed on it for 3 d. Its attractiveness was tested by trapping at 2 beeyards in north-central Florida and 7 in Pennsylvania, all with previous histories of SHB infestation. The traps were 25.5-cm sections of black PVC pipe (7.5 cm ID) with a removable cap at each end. Two openings (8×13 cm) covered with 4-mesh aluminum screen allowed entry of SHB, but not honey bees. An inverted 18-mesh-screen cone (8 cm deep), located just below the windows, funneled beetles into the bottom cap through a small hole at the apex. Three pin holes in the bottom allowed for drainage of rainwater. The bottom cap of each baited trap contained 100 g of pollen dough tied in a cotton stockinette. Two 15-ml plastic vials of water with dental wicks inserted through the caps gradually moistened the dough. The control traps contained only vials of water.

Three groups of 6 baited and 6 control traps were placed in one of the Florida beeyards. In 2 of the groups, the traps were suspended 1 m above the ground on T-shaped metal poles, with a baited trap on 1 arm and a control trap on the other (about 1 m apart). The poles were placed 7.5 m apart in 2 parallel rows, 1 row in full sun in front of the hives and the other in the shade of trees behind the hives. Traps in the third group were placed on the ground and attached to platforms supporting the hives, with 1 baited and 1 control trap on each of 6 platforms. Trapped beetles were removed and counted, and the water vials were topped up every 3 d for 12 d. Comparisons of numbers captured were made between hanging traps in the sun and those in the shade, and between hanging traps in the sun and traps on the ground, which were also in the sun.

The baited traps captured 90 beetles, mostly in the shade. The proportion of beetles captured in the shade (0.90) was significantly greater than 0.5 (binomial test, normal approximation, $z = 7.59, P < 0.01$) (Zar 1999), suggesting a preference for traps in the shade. There was no difference in trap catch between traps on the ground and those hanging in full sunlight; that is, the proportion captured on the ground (0.78) was not significantly greater than 0.5 ($z = 1.67, P = 0.096$).

Seven beeyards in Pennsylvania, each in a different county, were used to compare baited and control traps. One baited and 1 control trap was placed at each location. These were suspended about 30 cm apart from tree limbs at a height of about 1.5 m and at least 90 m from the beeyards. Trapped beetles were counted and the bait replaced weekly for 6 weeks. The total number of SHB captured was 419. Of these, 350 (83%) were caught at 1 location in Bucks County. A second trial done the following year also showed a preponderance of captures in Bucks County, 219 out of 265. These results suggest that SHB infestation in Pennsylvania was highly localized.

A second Florida beeyard was used to study the spatial distribution of trap catch, and to determine the effect of shade and distance from bee colonies on numbers captured. The hives were located in a sparse pine plantation with scattered clumps of oaks that provided the only shade of any significance. Baited traps were scattered over an area of about 9 ha at various distances from the hives (Fig. 1A); some were in shade and others in full sun (Fig. 1B). A total of 46 SHB were captured during an 18-week trapping period, suggesting a low level of infestation. Of this total, 39 were captured by 7 traps shaded by oak canopy, 5 by 2 traps in partial shade, and 2 by 10 traps in full sunlight. The spatial distribution of trap catch is illustrated in Fig. 1B. The proportion of captures in full shade (0.85) was significantly greater than 0.5 ($z = 4.72, P < 0.01$), suggesting a preference for shaded traps, consistent with results for the first Florida location. Most of the beetles (23) were captured in trap 2 (Fig. 1B), which was in deep shade and close to the hives. Overall, however, there was no significant relationship

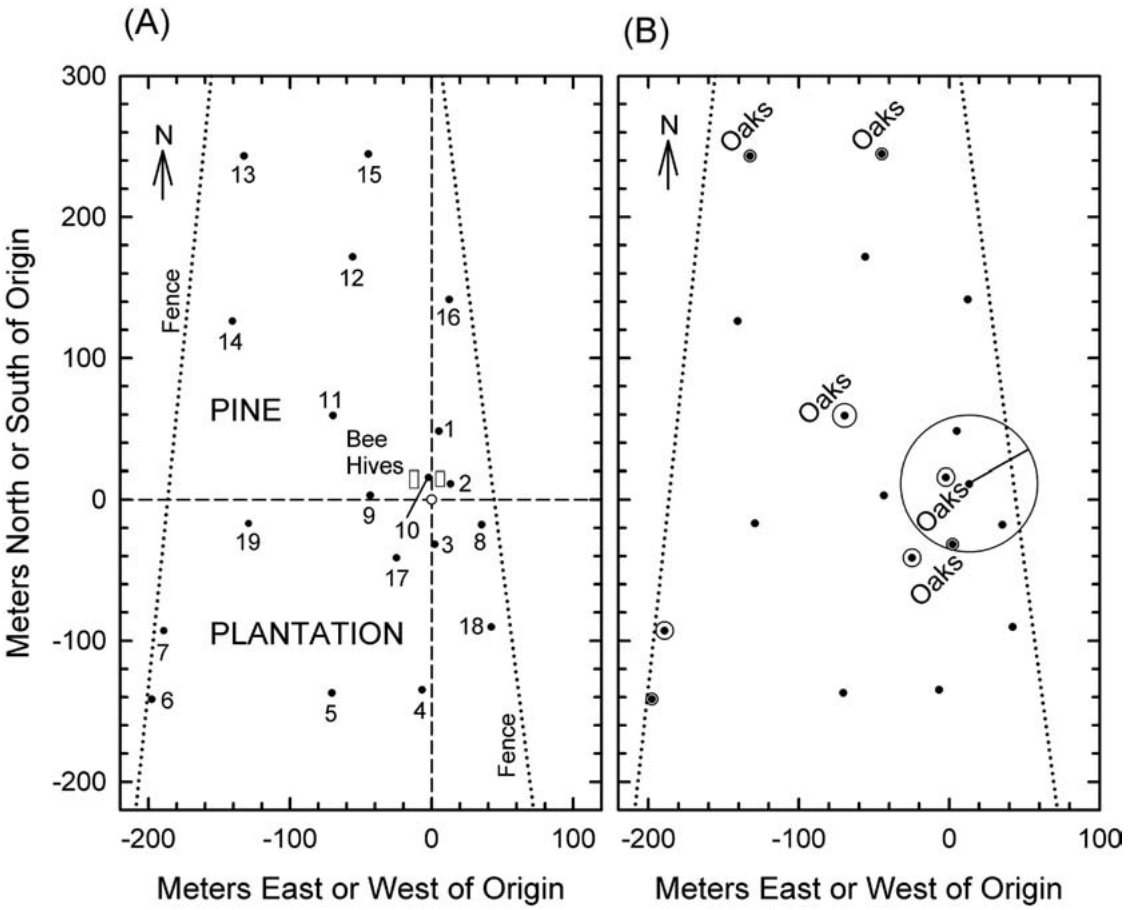

Fig 1. Trapping adult *A. tumida* in a sparse pine plantation with scattered clumps of oak trees, north-central Florida. (A) Dots with numbers 1-19 indicate trap positions. The open circle and dashed lines indicate the origin and axes of the coordinate system used to specify trap positions. The 2 open rectangles indicate groups of bee hives. (B) Spatial distribution of beetles captured in baited flight traps between Jun 15 and Oct 26, 2005. The areas of the circles are proportional to the total trap catch at each trap position.

between trap catch and distance from the hives (Spearman's rank correlation coefficient $r_s = 0.03$, $P = 0.89$). The lack of correlation may reflect the nearly equal distribution of traps between shady and sunny locations, together with the spatial distribution of trees (Fig. 1A) and the preference of the beetles for shade.

No SHB were captured by the control traps in any of the beeyards. The difference between control and baited traps clearly establishes the effectiveness of conditioned pollen dough in attracting the beetle, which contradicts the statement by Spiewok & Neumann (2006) that free-flying SHB cannot be trapped in the field with bee products unless adult bees are present. However, because of the marked preference for shade, baited traps placed in full sunshine captured very few beetles. Future studies are planned to examine the relationship between the intensity of incident solar radiation and numbers of beetles captured in baited traps.

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Summary

Traps baited with pollen dough conditioned by allowing male SHB to feed on it for 3 d were effective in capturing SHB if the traps were located in shade. Traps placed in full sunshine captured very few.

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