Short communication

Pheromone and volatile lures for detecting the European house borer (*Hylotrupes bajulus*) and a manual sampling method

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Summary

We evaluated commercially available cross-vane traps ('Intercept'), loaded with either synthetic pheromone or a combination of (+)-$\acute{\alpha}$-pinene and (-)-verbenone in terms of their ability to detect European house borer (*Hylotrupes bajulus*, 'EHB'), and compared their effectiveness with a manual search method. We employed pairs of traps at 45 sites, 28 of which had previously been identified as infested using manual search methods. In a four-month trapping period, a total of only six female adult EHB were detected from three sites, all of which had previously been identified during the manual survey. We suggest that the general sedentary behaviour of the beetle and its tendency to reinfest the same individual host tree limits the probability of it being intercepted by chemical lure traps in the field. Although labour-intensive, manual search methods remain the most reliable means of identifying local EHB infestations.

Keywords: trapping; attractants; pheromone traps; insect pests; wood borers; Coleoptera; *Hylotrupes bajulus*

Introduction

European house borer (*Hylotrupes bajulus* L., Cerambycidae) (EHB) is a native of northern Africa, but is now widespread, with a range which includes Europe, North and South America, South Africa, Asia Minor, China and Russia (Dürr 1954; Duffy 1968). EHB is a pest of seasoned softwood, with larvae having a developmental stage of up to a decade. Adults are capable of reinfesting the same host timber and do not require an adult diet. The flight season occurs in the warmer months (Dürr 1957). The species was detected in New South Wales, Queensland and Victoria in the 1950s following the importation of prefabricated houses from Europe. This incursion was eradicated about 20 y later.

Beginning in January 2004, EHB was detected in several dead pine trees throughout a 75 km × 35 km region surrounding Perth, Western Australia (31°57'S, 115°52'E). This is the first record of EHB in Western Australia. These initial detections were made by the sighting of distinct oval exit-holes (about 5–10 mm long, running with the grain), and subsequent splitting of timber samples to obtain larvae. To improve our surveillance capability, we investigated the use of chemical lures and cross-vane traps during the EHB flight season of 2004. Much research has been undertaken to test the attractiveness of sex pheromones and monoterpenoids to EHB (Fettköther *et al.* 1995, 2000; Reddy *et al.* 2005a,b) within laboratory or similar enclosed conditions. Here we present results of the first test of the ability of these chemicals to attract wild EHB in the field.

Materials and methods

Upon initial discovery of EHB in Western Australia in January 2004, we found that the exit holes of newly emergent adult beetles had a distinct shape and alignment: a hole of 5–10 mm long and 2–4 mm wide, running with the wood grain. Consequently all dead pine trees (*Pinus pinaster* Aiton and *P. radiata* D. Don) within the general Perth area (and subsequently more widely) were manually surveyed. Where likely exit holes were sighted, dead trees were dissected. This involved cutting sections of branch or trunk which contained exit holes into bolts 300–500 mm long which were then split into sections 10 mm in diameter. All larvae present were identified using Duffy's monographs (1957, 1963). While exit holes were identified prior to the trapping, tree dissection occurred after trapping unless otherwise stated (below).

In mid-November 2004, 45 pairs of cross-vane traps ('Intercept', IPM Technologies, Oregon, USA) were placed in the field, covering an area 70 km (N–S) × 35 km (E–W) around the Perth area. The cross-vane trap has been shown to be more effective than other trap designs for trapping woodborers (McIntosh *et al.* 2001). Twenty-three pairs were placed in sites known to be infested with EHB, based on the survey method described above.

In these sites, traps were placed within 20 m of infested material. Eighteen pairs were placed at sites not found to be infested by previous manual surveys. The remaining four pairs were placed at sites that had been infested but were cleared of all material known to be infested before or during the trapping period. Traps were placed with the lures 1.2 m above ground.

The pheromone-based trap consisted of a synthetic pheromone lure based on pheromone isolated from male EHB (3R-hydroxy-6-2Kt, Fettköther *et al.* 1995, 2000), which has been shown to attract male and female beetles in laboratory and glasshouse trials (Fettköther *et al*. 2000; Reddy *et al.* 2005a,b). The other trap consisted of a host-plant volatile lure, which contained both an (+)-$\acute{\alpha}$-pinene and (-)-verbenone lure. Verbenone is a constituent of EHB larval frass known to attract and stimulate ovipositioning in EHB females (Evans and Higgs 1975; Fettköther *et al.* 2000). $\acute{\alpha}$-pinene effectively attracts EHB under laboratory conditions (Fettköther *et al*. 2000; Reddy *et al.* 2005b) and is often used in trapping programs for wood-boring beetles (e.g. Byers *et al.* 1989; McIntosh *et al.* 2001; USDA-APHIS-PPQ 2003). Release rates were $\acute{\alpha}$-pinene, 300 mg day^{-1}; verbenone, 1.5 mg day^{-1}; OHB pheromone 3 mg day^{-1}. The traps forming each pair were no less than 10 m apart, as recommended by Bashford (2003).

The sampling period was between November 2004 and March 2005, during the beetle's flight season. Lures were replaced at the end of two months and traps were serviced every two weeks. Adult EHB were identified using Bense's key (1995).

Results

A total of six adult EHB, all females, were trapped with chemical lures at three sites. Four were caught in a single pheromone trap, and one individual was captured in each of two host-plant volatile traps. All three of these sites were found to be EHB-infested, following dissection of dead pine wood. Chemical lures did not detect EHB at the other 20 sites known to be infested, nor did they detect any new sites of infestation.

Based on emergence from laboratory-housed timber, female : male ratio was 0.602 (97/161, n = 258). The EHB pheromone trap had, as expected, a clear bias towards detection of females ($P = (0.602)^4 = 0.020$). Although verbenone may select towards the sampling of females, the low trapping number (n = 6) means we cannot comment further on any potential bias.

Discussion

Although the pheromones and monoterpenoids used in this study have previously demonstrated attractiveness to EHB adults (Fettköther *et al.* 1995, 2000; Reddy *et al.* 2005a,b), we have performed the first test of such chemicals in field conditions with wild beetles. The numbers of beetles caught in chemical traps during the sampling period were very low compared to other similar trapping regimes for other beetle species (e.g. Byers *et al*. 1989; Turchin and Odendaal 1996; de Groot and Nott 2001, 2004; McIntosh *et al.* 2001). We believe that this is due to infrequent long-distance flight by female EHB and the high frequency with which adult EHB reinfest the same host timber. Fettköther *et al.* (2000) have described the beetle as having 'a very sedentary behaviour using already successful breeding sites' and therefore adult flight is not always essential. We therefore suggest that the probability of intercepting the beetle in flight is limited.

The range of effectiveness of lures is also an important issue, as all previous EHB-luring trials have been performed with the release of beetles only a few metres from the lures, and effectiveness has been recognised as decreasing significantly after only 3.5 m (Reddy *et al.* 2005a). Given the density of conspecifics and potential host trees, and the suitability of the current host tree in an infested pine plantation, for example, any chemical trap needs to compete with substantial chemical noise not present in laboratory trials. The combination of both male sex pheromones and monoterpenes has recently been shown to be more attractive to female adults than pheromones or plant volatiles alone (Reddy *et al.* 2005a).

Apart from manual surveys of wood from which wood-boring beetles have emerged, chemical lures and flight intercept traps are the only means of early detection of colonising beetles. Although manual surveys are labour intensive, our results show that they are effective in the detection of EHB-infested sites when the beetle is well established in a region. Manual survey methods also have the advantage that they can be carried out during the entire year — not just during the flight season. Given that EHB spends most of its lifetime as larvae, the likelihood of detection at this life-cycle stage is particularly high.

As we did not employ control traps (i.e. traps without any chemical lure) in this study, we cannot quantify precisely the effectiveness of the chemical lures versus the trap itself. However, given that all six adults trapped were females, we suggest that the trapping is not due simply to beetles colliding with the trap panes during flight, particularly given that male : female ratios in the population at large are male-biased and that males are responsible for discovery of new hosts (Fettköther *et al*. 2000). Although the number of sampled individuals is very low (n = 6), complete dominance by female beetles is statistically significant. Although the small size of this sample is undesirable, this was a direct consequence of the ineffectiveness of the trapping regime.

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