A MULTIPLE FUNNEL TRAP FOR SCOLYTID BEETLES (COLEOPTERA)

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Abstract

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The multiple funnel trap, an efficient, collapsible, non-sticky trap for scolytid beetles, consists of a series of vertically aligned funnels with a collecting jar at the bottom. The trap compared favorably with sticky traps and Scandinavian drainpipe traps for three species of ambrosia beetles and the mountain pine beetle. Minimum maintenance required for this trap allows for high efficiency in pheromone-based research, survey, and mass trapping of scolytid beetles.

Résumé

Le piège à entonnoirs multiples, un piège à scolytes non collant et escamotable, est fait d'un ensemble d'entonnoirs alignés verticalement avec un bocal collecteur à la base. Le piège s'est comparé avantageusement aux pièges collants ou aux pièges scandinaves à tuyaux de drainage, pour la capture de trois espèces de scolytes du bois et du dendroctone du pin ponderosa. Le peu d'entretien requis pour ce piège lui confère une efficacité élevée en recherche sur les phéromones, pour la surveillance des populations ou la capture en masse des scolytes.

Hardware cloth, insect screening, and various other materials, coated with a sticky material are widely used in research and trapping programs for scolytid beetles (e.g. Browne 1978; McLean and Borden 1979). These traps are effective, but require time-consuming and laborious maintenance. Thus, many attempts to design alternative traps have been made.

Drainpipe traps (Bakke and Sæther 1978) and other non-sticky traps based on the hypothesis that an optical stimulus, i.e. a prominent, vertical silhouette, is important for the orientation of scolytid beetles to their brood material (Kerck 1972) have recently gained prominence in pheromone research (e.g. Vité and Bakke 1979; Borden *et al.* 1982). Commercially available drainpipe traps (Borregaard A/S, Sarpsborg, Norway) have been utilized in a mass trapping program for *Ips typographus* L. initiated in 1979 (Lie and Bakke 1981).

The multiple funnel trap was developed within a 3 year study on pheromone-based management of ambrosia beetles in dryland sorting areas (Lindgren 1982). The initial two designs had various limitations. The funnels of the 1979 prototype (Fig. 1) were stapled to a wooden frame. The trapping surface was 0.19 m^2, determined as the surface area of a cylinder with the diameter of the upper opening of the funnels, and the height measured between the top edges of the top and bottom funnels. This trap was too fragile for transportation and storage. The 1980 prototype (Fig. 2), with a trapping surface of 0.41 m^2, had an aluminum frame, which had to be disassembled for transportation and storage. Material costs, weight, and difficulty in assembling and disassembling of this prototype made it less desirable than the 1981 trap.

The 1981 prototype trap (Fig. 3) consists of 8 vertically aligned funnels (upper diameter 20 cm, lower diameter 3.5 cm, height 16 cm) made from 0.2 mm vinyl sheets and stapled 7.5 cm apart to three 16 mm wide twill tapes, making the trap collapsible (Fig. 3) for transportation and storage. An inverted 30 cm diameter nursery flower pot drainage tray (Listo Products, Vancouver, B.C.) protects the pheromone bait, and to a certain extent the trap, from rain. A 500 ml (12 cm high × 8 cm diam.) collecting jar (Ampak, Ltd., Vancouver, B.C.), with a lateral drain hole for excess rainwater is suspended from the bottom of the trap by its screw lid, which is tied to the bottom funnel

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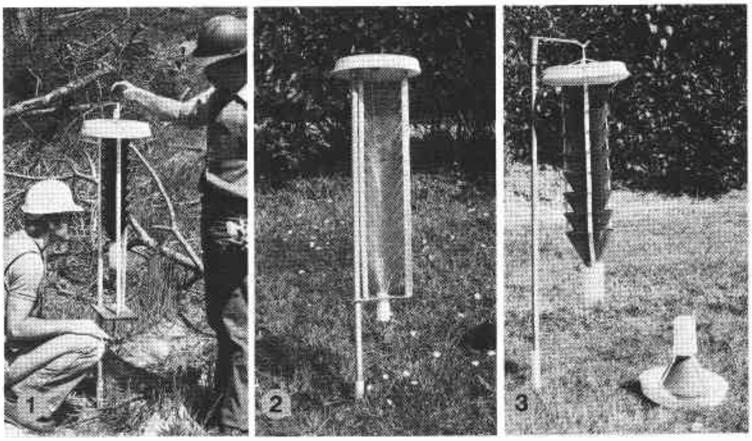

FIGS. 1–3. Prototype multiple funnel traps used in 1979 (Fig. 1), 1980 (Fig. 2), and 1981 (Fig. 3). Collection of sample at 1979 model is shown in Fig. 1, and the 1981 model is shown in operational and collapsed position (Fig. 3).

with the twill tapes (Fig. 3). The jar contains ca. 250 ml of water with 0.25 ml non-scented detergent added to reduce surface tension, and an antibiotic agent (sodium azide at 40 mg/l. water) to prevent mould and bacterial growth. For trapping live insects, the collecting jar can be filled with shredded paper or other suitable material to keep insects apart. The trap is suspended from an iron hook, made from construction iron rod welded to a 2.5 cm inner diameter iron pipe, which is placed over a 150 cm long dowel ca. 2.5 cm in diameter (Fig. 3). The effective trapping surface of this prototype is 0.33 m^2 which can be increased or decreased by changing the size or numbers of funnels.

Wind tunnel studies (N. P. D. Angerilli[2] and J. A. McLean[3], pers. comm.) at 1.2 m/s wind speed suggested that the pheromone should be released simultaneously from two positions in the trap (Fig. 4D). These release positions ensure that the pheromone plume is well dispersed, which presumably simulates that of an attacked tree, and provides optimal odor dispersion regardless of horizontal wind direction. In preliminary tests in a wind tunnel, *T. lineatum* responded better to a dispersed pheromone plume than to a concentrated one (N. P. D. Angerilli[2], pers. comm.).

To date, pheromone placement has been suboptimal as in Fig. 4A–C, and increased efficiency of the funnel trap is expected when its aerodynamic properties are utilized correctly. Field tests to compare bait placements as in Fig. 4, using a commercially available multiple funnel trap (PMG/Stratford, Ltd., 545 W. 8th Ave., Vancouver, B.C. V5Z 1C6) are planned for 1982.

All three prototypes effectively caught ambrosia beetles. In Vancouver Island field tests in 1979 to 1981 *Trypodendron lineatum* (Olivier), *Gnathotrichus sulcatus* (LeConte), and *G. retusus* (LeConte) were caught in pheromone-baited funnel traps. Maximum catches for a 2 week period were 15,000, 3,500, and 700 in single 1981 prototype traps for the respective species. The traps were competitive with Scandinavian drainpipe traps and two types of sticky traps (Lindgren *et al.* 1983). In another field experiment in 1981, modified 1981 prototype traps with one extra funnel and longer spacing between funnels (0.57 m^2 trapping surface) caught 219 mountain pine beetles, *Dendroctonus ponderosae* Hopkins, whereas identically baited Scandinavian drainpipe traps caught only 5 (J. E. Conn and J. H. Borden[4], pers. comm.).

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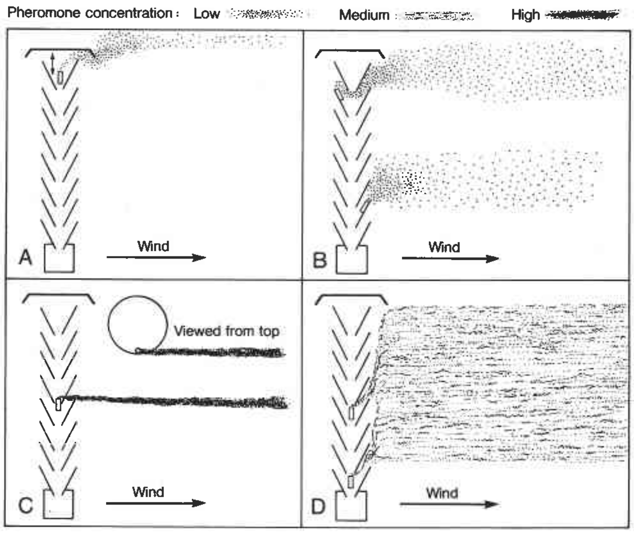

FIG. 4. Schematic representations of 1981 trap showing odor plumes (titanium tetrachloride smoke) produced in a wind tunnel at 1.2 m/s wind speed with bait in various positions. (A), movement of bait vertically (double-pointed arrow) will vary release rate. (B), upwind (upper) and downwind (lower) plumes from bait attached to twill tape. (C), bait placement as in (B) but rotated 90° relative to wind direction as in top view. (D), double-baiting, utilizing trap aerodynamics for optimal pheromone dispersion, with baits suspended in center of trap.

The multiple funnel trap combines the advantages of some other traps and eliminates some disadvantages. Incoming beetles have been observed at the traps. When attempting to land, most beetles hit a funnel and repeatedly contacted other funnels as they fell into the collecting jar, because they could not normally land on the slanted funnels. The principle of this mode of action is similar to that of window flight traps (Chapman and Kinghorn 1955). Some did land on the outward slanting funnel below the entry point. However, the funnel above impeded the resumption of flight as the beetles took off at about 90° from the funnel wall. These beetles folded their wings and fell into the collecting jar after contacting the overhead funnel. Thus, resumption of flight, a problem with window and drainpipe traps, is largely avoided with funnel traps. As with sticky traps, any beetles attempting to land are normally caught, but without having to enter holes as in the drainpipe traps. Captured beetles can be quickly collected and processed immediately without the need to remove sticky material.

Some problems did arise. Spiders occasionally webbed over the funnels. The same problem has been noted for other non-sticky traps (Wilkening *et al.* 1981). If the trap is placed in the vicinity of deciduous trees in the fall, leaves may plug individual funnels.

Insects of numerous orders were caught in the funnel traps, but Coleoptera predominated. The impact of the funnel trap on nontarget species was small. Clerid beetles were caught occasionally, and in low numbers (1–10) similar to catches in drainpipe traps.

Although the initial investment ($10 to $15 + labor) for this trap may be higher than for sticky traps, the traps are reusable for many seasons. Moreover, considerable savings are realized in handling time, making possible a substantially greater trapping effort.

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