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A Phloem Sandwich Unit for Observing Bark Beetles, Associated Predators, and Parasites[1]

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SUMMARY

This paper describes a phloem sandwich that allows observation of parent beetles, their brood, and associates within the inner bark, and permits observation of predator and parasite behavior on the bark surface. The construction of the unit permits the introduction of multiple pairs of beetles into a single sandwich.

Additional keywords: Bark beetle rearing, Scolytidae.

The behavior of bark and engraver beetles in their galleries has traditionally been studied using an "observation plate" or "phloem sandwich." Originally, this device consisted of a thin, flat section of inner bark placed between two plates of glass held together by elastic bands (Bedard 1933). Moist cotton packed between the two plates prevented dessication of the bark. Kaston and Riggs (1937) ensured the inner bark's intimate contact with the glass, a necessity for successful brood development, by using tightly bolted wooden clamps. Reid (1958, 1962) and Yu and Tsao (1967) used similar devices with friction tape binders to study the behavior of *Dendroctonus ponderosae* Hopk. and *D. frontalis* Zimm. Hopping (1961) used Lucite plastic sandwiches sealed with adhesive tape to study *Ips* spp. Whereas with the earlier sandwiches beetles had to be introduced at one end of the unit, Hopping's design permitted them to be introduced through a hole in the center of the face plate. The beetles could thus excavate galleries in any direction. Nagel and Fitzgerald (1975) used this type of sandwich to study behavior and prey consumption of *Medetera aldrichii* Wheeler. Unfortunately, adult bark beetles can etch acrylic plastic and bore through it, making observation difficult. Bushing (1967) improved the design by replacing the lower glass with a plywood base to hold the inner bark between the glass and wooden base by means of U-shaped metal clamps. The unit was sealed by filling the space between the wooden base and glass with paraffin, and beetles were introduced through a hole drilled in the center of the base.

A disadvantage of all these designs is that they do not allow beetles or associates access to the outer bark surface. Many parent bark beetles construct air holes, which probably control humidity in their galleries (Melnikova 1964, Gaumer and Gara 1967). The phloem sandwich constructed by Beanlands (1966) from a plastic petri dish and a mason jar ring provided an air space above the outer bark surface into which the beetles could void their boring dust.

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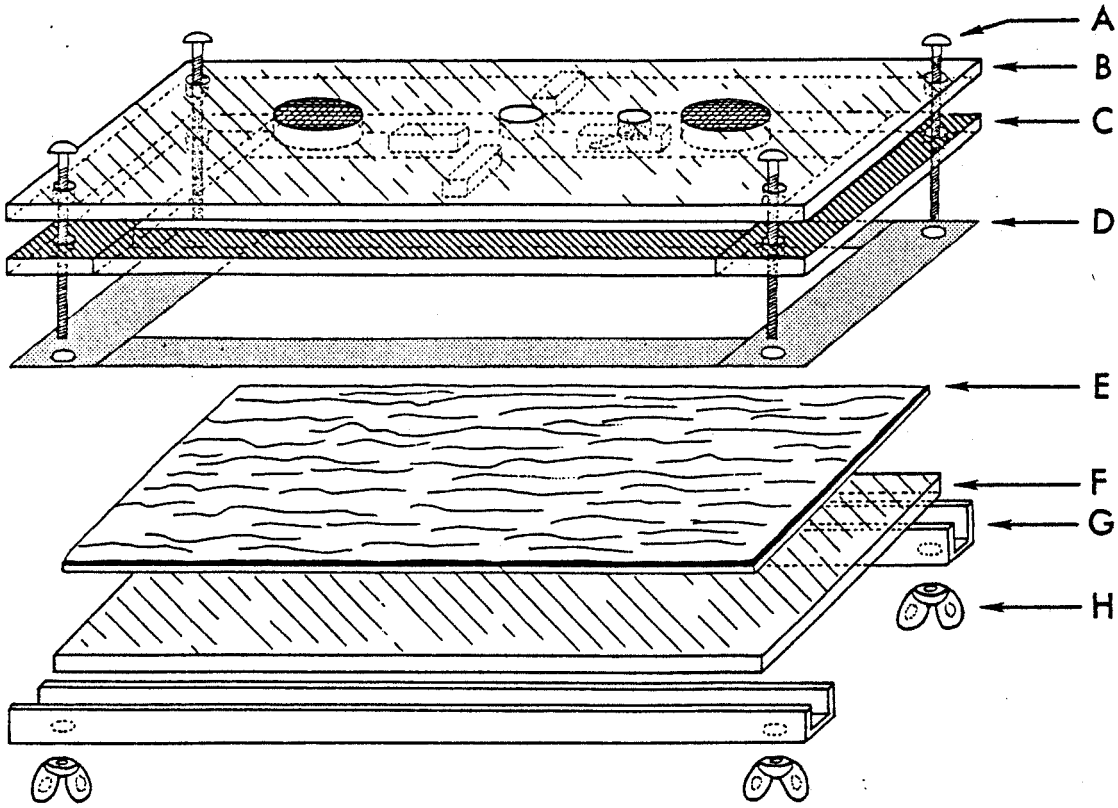

Figure 1—*Open bark surface phloem sandwich. A = 4.76-mm bolt, B = plastic upper surface with one introduction and two ventilation holes, C = plastic spacer blocks, one with entrance shaft, D = aluminum foil, E = inner bark, F = glass lower surface, G = U-clamp, H = 4.76-mm wingnut.*

However, the upper portion of this sandwich had no holes to allow gas exchange between the unit and ambient air.

To facilitate studies of the insect and mite predators and parasites of scolytid beetles, investigators at the Southern Forest Experiment Station devised a phloem sandwich unit incorporating the best features of previous designs. This unit (fig. 1) consists of a plate glass lower surface (0.64×15.24×19.05 cm), a bark phloem section (14.60×18.42 cm planed to uniform thickness), and a plastic top plate (0.64×15.24×22.80 cm). Edges of the bark section are sealed with paraffin. Plastic spacers (0.64×2.54×15.24 cm on sides and 0.64×3.81×15.24 cm on ends) are glued to the outer edges of the top plate to keep it from touching the bark surface. To discourage beetles from tunnelling into the plastic spacers, their lower surfaces are laminated with household aluminum foil using double-sided carpet tape. Four or more plastic spacers (0.64×0.64×2.54 cm), glued uniformly around the center of the top plate's inner side, exert pressure in the center to prevent warping of the bark section and its loss of contact with the lower glass surface. The unit is held together with clamps made of 16-gauge steel shelf standards.

The top plate has two 2.54-cm screened ventilation holes. Moisture can escape from the unit through functional vent holes constructed by beetles. Large predators and parasitoids can be introduced through the 1.27-cm access hole located between the screened ventilation holes. This opening can be plugged following introductions. Adult beetles, phoretic associates, and small parasitoids are introduced through a hole slightly larger than the diameter of the beetle. The hole is drilled at an angle of less than 45° in one or more of the short spacers, making multiple introductions possible. Franklin (1967) found that a hole drilled in the bark at less than 45° facilitated southern pine beetle penetration. Pairs of southern pine beetles placed

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in the entrance shaft have penetrated the bark of sandwiches in less than 30 minutes. Forced attacks of adult southern pine beetles can be facilitated by screwing similar entrance blocks to wood slabs or bolts.

Ips beetles have completed normal development in this sandwich, but success with the southern pine beetle has been limited. The phloem unit should remain usable for 5 to 6 weeks, providing intimate contact of the inner bark and the lower glass plate is achieved and maintained. Each unit costs approximately $4 and, barring accident, should be reusable indefinitely.

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