SCIENTIFIC NOTES

Modified Car-Top Insect Trap Functional to 45 mph[1]

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The car-top insect trap described by Sommerman and Simmet (1965), which diverts the insects from their flight path into a small cage attached to the sunshade inside the vehicle, has been slightly modified to function at speeds up to 45 mph. It has not been tested beyond this limit because that was the maximum speed recommended for the vehicle being used. However, it has been driven at this speed into a rather strong breeze and almost all specimens were still coming through alive and in good condition. In fact, the mayflies and large crane flies came through then in better shape (with all appendages still attached) than at 25 mph, when 1 or 2 appendages often were missing. Occasionally a large, robust fly was ruptured or decapitated, apparently on impact with the edge of the metal cross-pieces at the front of the trap. At 45 mph, 4 of the vent holes at the base of the concentrating funnel were open. When the humidity was low, the cages needed changing at shorter intervals to prevent desiccation of the more fragile insects.

In 1963 when the trap was first constructed, and again in 1964 when the tubing was added, the trap was tested at 35 mph, but the faster air flow produced a bagging effect at the rear of the cloth funnels, which prevented some insects from passing into the mylar funnels. It was thought that a constantly varying, rebounding air flow, toward the rear of the cloth funnels might move the insects along, so 36 little flags were mounted between the cloth funnels toward the rear of the trap. The surface of a flag was parallel with the bottom or side surface of a funnel. Flags were not mounted above the funnels because it seemed likely that the combination of gravity and the varying currents otherwise produced would prevent specimens from lodging on the top surface.

The symmetrical flags were made from windproof nylon material such as is used for waitress' uniforms. The finished widths were: front 5 in., back 3 in., and length 2¾ in. An additional ½ in. was allowed for the front hem which was turned under, making a total of 3 thicknesses at the finished hem, which was ¼ in. wide. Triple stitching was done for ½ in. at the ends of each hem; the rest was single-stitched. It was desirable to have a rather "stiff" hem because the flag was supported only by a string run through the hem, and the upright flags might otherwise tend to "wrinkle down." The sides and rear margins of the flags were not hemmed, but were cut with pinking scissors to prevent excessive fraying, yet retain flexibility.

To install the flags, pencil lines were drawn on the outside of the trap, outlining the limits of the funnels. The lines extended from the front corner of each peripheral funnel to the corresponding rear corner, as indicated by the string holes. Then a line (A) was drawn around the shell of the trap connecting the string holes. Another line (B) was drawn parallel to and 3 in. forward of (A). On line (A) a dot was placed 2 in. from each string hole. A perpendicular line was then drawn forward from this dot until it intersected line (B). At these intersections, 8 small string holes were bored through the top and also through the bottom of the trap shell, and 6 through each side. Fourteen pieces of string, 4–6 ft long, were temporarily tied to the supporting frame behind the string holes, then threaded through the new holes. Three flags were strung on the vertical strings and 4 on the horizontal strings beneath the funnels, then the strings were threaded out through the holes in the opposite surface of the trap shell. The adjacent strings were tied to one another on the outside of the shell on 2 surfaces, then drawn taut, and the same procedure followed on the opposing surfaces. On the inside of the trap, a short piece of string was used to tie the flag strings together at each intersection to prevent rubbing and wear. To prevent damage to the exposed strings on the outside of the shell, a piece of 1-in. adhesive tape was wound completely around the shell to cover the string.

[1] Accepted for publication September 21, 1966.

REFERENCE CITED

Sommerman, K. M., and R. P. Simmet. 1965. Car-top insect trap with terminal cage in auto. Mosquito News 25: 172–82.

A Technique for Inducing Attacks and Mating of the Mountain Pine Beetle, *Dendroctonus ponderosae* (= *monticolae*) (Coleoptera: Scolytidae)[1]

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Studies of population dynamics within the laboratory depend largely upon known population densities for experimentation. This fact requires the development of techniques that insure successful attack and mating by the parent adults.

METHOD

Log billets, or slabs, of lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.), were used as food and habitat for the mountain pine beetle, *Dendroctonus ponderosae* Hopkins. These billets, 12 in. diam, 14 in. long, were cut in the fall and stored under outdoor temperature (32°–50°F) and humidity (60%–90%). When needed for experiments, slabs were cut longitudinally with a 12-in. face. The exposed sides were sealed with paraffin after each cutting to reduce loss of moisture.

A cork borer (¾-in. diam) was used to cut through the outer bark and phloem layers to the sapwood. Removal of this plug formed an attack chamber.

Beetles were sexed by using measurements of overall length, overall width, width of scutellum, and based on the discriminant function analysis. This technique does not harm the insect.

Successful matings were increased by allowing the female to start gallery construction. The male was introduced headfirst into a cleaned entrance 24 hr later. The chamber was examined after 24 hr to determine if the attack was successful; if so, the frass was removed from the entrance hole and nuptial chamber made by the female. Frequently, the stridulations made during the mating procedure could be heard within minutes after introduction of the male.

The chamber then was covered by tightly stapling a 2×2-in. square of heavy-duty plastic to the surrounding bark. The plastic proved superior to either paper or aluminum foil in preventing escape, probably because of its pliable nature and tight fit to the bark. The plastic permitted examination of the beetles without disturbance and allowed light to enter the chamber.

[1] Accepted for publication October 3, 1966.

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The cover was removed 24 hr later. If additional frass was found, a successful mating was assumed.

This induced-attack method was 90% successful in the first introductions. Of the unsuccessful attacks, 85% were successful upon the second attempt. Thus, 98.5% of the attacks were successful within the 72-hr period required for 2 attempts. The number of progeny depends upon several other factors, such as proximity of attack and competition. Using single gallery per face, one can expect from 3 to 6 new adults/single gallery.

This technique has been proved reliable by repeated experiments and has been adopted as our standard procedure in establishing stock and known brood densities for laboratory use.

Vanillin and Syringaldehyde as Attractants for *Scolytus multistriatus* (Coleoptera: Scolytidae)[1]

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Beetles of the family Scolytidae attack certain individual trees of their host species for oviposition. Although Person (1931) suggested that *Dendroctonus brevicomis* LeConte was attracted initially to weakened individuals of *Pinus ponderosa* Lawson by aldehydes or esters produced in the abnormal trees, a chemical understanding of this initial host selection by bark beetles still is largely lacking.

Much recent research on attractants for bark beetles has emphasized pheromones associated with attacking beetles in their host trees (Silverstein et al. 1966, Pitman et al. 1965, Rudinsky 1963). This emphasis on bark beetle-produced pheromones apparently has been predicated on the hypothesis that the initially attacking beetles are not attracted to the host tree. However, Meyer and Norris (1967) and Goeden and Norris (1964) have proved conclusively that weakened *Ulmus* and *Carya* trees, respectively, attract *Scolytus multistriatus* (Marsham) and *S. quadrispinosus* Say for oviposition. This paper reports findings on the chemotactic responses of newly emerged *S. multistriatus* to pure chemicals.

MATERIALS AND METHODS

The behavioral responses of the beetles to the candidate chemicals were determined in the forced-air olfactometer described extensively by Meyer and Norris (1967).

In each assay (replicate), 100 highly active beetles were released into the olfactometer. The air temperature was 75°F, and the assay chamber was darkened. The equal rate of air flow (5000 ml/min) through each of the 2 inlets into the olfactometer was regulated by flow meters. An equal total volume of air per minute was exhausted from the opposite end of the chamber by a flow meter-measured vacuum. The response of the beetles to the test chemicals was measured as beetles present in each side of the pit-fall after 1 hr.

The pure vanillin and syringaldehyde used in these studies were obtained from K & K Laboratories, Inc., Plainview, N.Y. The concentration of each test solution was 5 mg of chemical (either vanillin or syringaldehyde) per milliliter of chloroform solvent. For each assay, 5 ml of the test solution (i.e., 25 mg of test chemical) were absorbed into a standardized elderberry-pith filter (Meyer and Norris 1967), and 5 ml of solvent were absorbed into the control filter. The solvent then was evaporated from the filters with nitrogen and vacuum. The treated and control filters then were placed in separate standard holders (Meyer and Norris 1967), and 1 of the loaded holders was placed in each inlet line into the olfactometer. One line thus contained a control filter; the other, a treated filter.

RESULTS AND DISCUSSION

The differences between the mean numbers of beetles trapped while responding to treatment with vanillin or with syringaldehyde as compared to controls were significant at the 0.05 or the 0.01 probability level, respectively (Table 1).

Vanillin and syringaldehyde are among the major products of oxidative degradation of hardwood lignin (Zimmermann 1964). Vanillin and related chemicals also are products of wood deterioration by microorganisms (Becker 1964). Syringaldehyde and vanillin thus should be released by abnormal, dying, hardwood tissues. Such tissues are needed by bark beetles seeking substrates for oviposition, and by subsequently developing brood. Vanillin and similar compounds have proven attractive to subterranean termites (Lund 1965).

Further research may reveal that attractants more species-specific than vanillin and syringaldehyde emanate from weakened trees. However, specificity between the weakened host tree and a given species of insect may result from (1) a rather fixed, characteristic ratio of concentrations of several chemicals that jointly constitute the chemotactic stimulus produced by the weakened host tree; and/or (2) a lack of repellents to the insect in the composite chemical stimulus produced by a weakened host, and a presence of repellents in the case of weakened nonhost trees. These aspects of host selection by insects are presently being investigated.

[1] Approved for publication by the Director of the Wisconsin Agricultural Experiment Station. This study was supported in part by a research grant, GB-1495, from the National Science Foundation, and by funds from the Wisconsin Conservation Department. Cost of printing this paper was met by the authors. Accepted for publication April 10, 1967.

Table 1.—Numbers and percentages of *Scolytus multistriatus* adults responding to the chemotactic stimulus of vanillin or syringaldehyde in a forced-air olfactometer.

Replicate	Site 1 Treatment	Site 1 Responding beetles No.	Site 1 Responding beetles %	Site 2 Treatment	Site 2 Responding beetles No.	Site 2 Responding beetles %
1	Vanillin, 25 mg	22	70.9	Solvent, 5 ml	9	29.1
2	Solvent, 5 ml	19	39.6	Vanillin, 25 mg	29	60.4
3	Vanillin, 25 mg	31	67.4	Solvent, 5 ml	15	32.6
				$t_{.05} = 4.30$; $t = 7.51$*		
1	Syringaldehyde, 25 mg	29	72.5	Solvent, 5 ml	11	27.5
2	Solvent, 5 ml	12	27.9	Syringaldehyde, 25 mg	31	72.1
3	Syringaldehyde, 25 mg	28	75.7	Solvent, 5 ml	9	24.3
				$t_{.01} = 9.92$; $t = 45.75$**		