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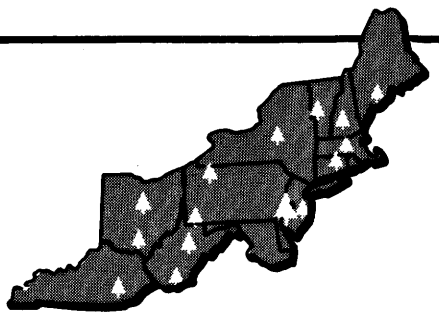

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EVIDENCE FOR A PHEROMONE IN THE LOCUST BORER

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Abstract.—Laboratory studies have suggested the existence of a pheromone in the locust borer. Male beetles spent more time on bolts of wood exposed to virgin females than on control bolts. The females apparently deposited the pheromone on the bolts of wood and filter paper.

KEYWORDS: *Megacyllene robiniae*, Cerambycidae, wood borers, pheromone

Little is known about the manner by which most cerambycid adults locate each other for mating. Pheromones that function over long distances could be involved in some species *(Duffy 1953)*. Direct contact by the sexes on the host plant, on flowers, or at other aggregation points may be the means by which some species succeed in mating.

During the summer of 1975, attempts were made in the field to attract the red oak borer, *Enaphalodes rufulus* (Haldeman) to various combinations of caged virgin females, males, and mating pairs. No beetles were caught, even by accident, indicating that they were not attracted over long distances by a volatile pheromone. An attempt was then made to attract another cerambycid, the locust borer, *Megacyllene robiniae* (Forster), with virgin females, but the results were again negative.

However, field observations of locust borer adults indicated that they did aggregate; it was not unusual to find several adults on one tree, while neighboring trees had none. Laboratory studies were thus begun to determine if this aggregation was pheromone-related.

This paper reports a female-produced pheromone that causes males to search intensively the substrate on which it is deposited.

Materials and Methods

The beetles in this study were reared artificially by the methods used by Galford (1974) to rear the red oak borer, except that the artificial medium was as follows: alphacel: 105 g; agar: 12 g; wheat germ: 45 g; vitamin diet fortification mixture: 2 g; riboflavin: 15 mg; folic acid: 10 mg; lysine: 400 mg; tryptophane: 200

mg; sorbic acid: 600 mg; methylparaben: 400 mg; chloramphenicol: 150 mg; and water: 345 ml.

Ten-gallon aquariums with five 3/16" bolts fastened through the bottom were used as test chambers. A bolt was placed near each corner and one in the middle. Holes were drilled in the bottoms of freshly cut sticks of black locust, *Robinia pseudoacacia* L., and the sticks were placed on the bolts. Five sticks of wood were cut from the same tree for each test. Four sticks unexposed to any adult beetles were used as controls; one stick was exposed for 24 hours to five virgin females 7 to 10 days old. A test consisted of releasing five virgin males into the aquarium, then recording the amount of time spent on each stick during 1 hour.

The position of the test stick was changed each time to allow for any possible effect of the laboratory ceiling lights on the adults' behavior. A total of six tests was conducted.

Three more tests were conducted with four sticks of American elm, *Ulmus americana* L., as controls and one stick of elm exposed for 24 hours to five virgin females 7 to 10 days old.

A tenth test used four strips of filter paper about 50 mm wide and 200 mm long, taped to the underside of the glass plate used to cover each aquarium. One of the four strips was cut from filter paper exposed for 72 hours to five virgin females 7 to 10 days old. The other three strips were controls.

An eleventh test used one stick of black locust exposed to five virgin females for 24 hours and, as controls, four sticks of unexposed American elm. In this test, five males with excised antennae were tested for 1 hour, then five males with intact antennae were added and observed for a second hour.

Results

In all tests, initial visits to any piece of wood or paper appeared to be entirely random. The beetles crawled up the sides of the aquarium and onto the glass covers. When two males encountered each other, one often fell to the bottom of the aquarium and then usually crawled up the nearest object. Sometimes, by chance, one or two sticks of wood would be visited more often than others.

The average amount of time males spent per visit on each stick of female-exposed black locust wood was 2 to 25 times longer than that spent on control sticks (table 1). In five of the six black locust wood tests, the female-exposed stick was occupied continuously by at least 1 male from the time of the first visit. When another male came to a female-exposed stick already occupied by a male, a fight always resulted and only one male occupied the stick for extended periods. Sometimes all five males climbed onto the treated stick, but the largest usually expelled the others. In only one test was the treatment stick not occupied continuously,

Table 1.—Results of bioassays using sticks of black locust, *R. pseudoacacia*, or of American elm, *U. americana*

Replicate	Average time per visit (seconds) on control sticks				Average time per visit (seconds) on female-exposed stick
	Stick No. 1	Stick No. 2	Stick No. 3	Stick No. 4	Stick No. 5
			BLACK LOCUST		
1	30	50	10	20	725
2	50	60	10	180	910
3	120	30	30	40	1200
4	300	30	40	20	600
5	60	0	10	0	1205
6	5	10	30	30	1020
			AMERICAN ELM		
1	10	20	20	30	2400
2	15	10	0	10	630
3	20	5	10	10	425

and that occurred when two fighting males fell from the bolt, which was not revisited during the remainder of the test. Long visits to treated sticks were of a "search-rest-search" type, in which the beetle made many trips up and down the stick for several minutes, rested, then made several more trips up and down the stick. Long visits to untreated sticks were of a "resting" type, in which the beetle did not move but just sat on the stick.

Table 1 also shows that the males could detect elm sticks exposed to females and spent more time on those sticks than on control sticks.

In the test with filter paper, the average stay on female-exposed filter paper was about 60 seconds and on control paper, about 10 seconds. Males usually walked across the untreated paper, whereas males approaching the treated paper usually turned right or left and followed the treated paper to the end. Males on treated paper were able to "track" the paper, constantly returning to the paper if they walked off it.

When a black locust stick exposed to virgin females was used with four American elm control sticks, for males without antennae the average stay was 80 seconds on the locust stick and 30 seconds on elm control sticks; for males with intact antennae, the average stay was 600 seconds on the locust stick and 20 seconds on elm control sticks. Removal of the males' antennae had apparently reduced their ability to detect the female-exposed stick.

The locust borer has a chemical means of communication that causes males to search extensively a substrate on which a female has been active. Further laboratory and field tests are needed to determine if males as well as females of this species produce a pheromone.

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