

マツノマダラカミキリ *Monochamus alternatus* Hopeに誘引活性を有する松生丸太の揮発物質

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短 報

**Volatiles from Pine Logs as the Attractant for the
Japanese Pine Sawyer *Monochamus alternatus*
HOPE (Coleoptera: Cerambycidae)***

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I. Introduction

The Japanese pine sawyer (*Monochamus alternatus* HOPE) is a well-known and destructive pest on Japanese red and black pines (*Pinus densiflora* S. et Z. and *P. thunbergii* PARL.) respectively. A serious pine infestation, fostered by the co-operation of the Japanese pine sawyer and the pine wood nematode (*Bursaphelenchus lignicolus* MAMIYA et KIOHARA) has spread widely in Japan mandating the development of effective integrated control methods.

It has been observed that both female and male adults of the pine sawyer congregate on felled logs and on trees physiologically weakened by destructive forest pests and diseases in addition to the pine wood nematode.

YAMANE *et al.* (4) first reported that the odor from Japanese red pine logs attracted pine sawyers in an experiment conducted with field cages. In the present experiments it was found that volatiles collected from logs by means of the cold trap method showed a strong attractiveness for both sexes of the pine sawyer.

II. Materials and Methods

1. Collection of log volatiles

Japanese red pine trees were felled and bucked at the Chiyoda Experimental Station, Ibaraki Prefecture, on June 16, 1978. Four days later, the logs were cut into about 5-cm-thick disks and put into plastic containers to collect the wood volatiles (Fig. 1). From 60 kg of wood materials 52.4 ml of volatiles were obtained by the treatment in 3 days (8 hr/day), and 116 ml in 7 days.

2. Insect used

The pine sawyers used in the experiments came from naturally infested pine trees from Shirai-cho, Chiba Prefecture, that overwintered outside in cages. They were reared in small plastic containers

(5 cm high and 11 cm in diameter) with freshly cut red pine twigs.

3. Bioassay in the laboratory

Eight females, more than four weeks after their emergence, were placed in the central chamber of the olfactometer (A in Fig. 2). A small glass vial containing 2 ml of test materials adsorbed on cotton was set up in chamber C as an odor source, whereas the controls in the chambers of the other three inlets consisted only of cotton and water. Bioassay was conducted at 27°C at all times under light from 1 p.m. to 6 p.m. when the light was turned off until the following morning. Observations were made hourly from 1 to 6 p.m. and once the next morning by counting the number of sawyers trapped in chamber B.

4. Bioassay in the field cage

Six potted 5-year-old red pines were arranged in a field cage (11×5.5×3 m³, Fig. 3). Down the middle of the cage were arranged three traps (Fig. 4) as odor sources—the wood disks (8 kg) for A, the volatiles (100 ml) for B, and the water soluble components (500 ml, 10%) for C. Sixty five sawyers (31 females and 34 males) were released on the pines at 3 p.m. on August 16. Observations were made every hour for approximately 15 minutes until 9 p.m.

III. Results and Discussion

To investigate the biologically active components that attracted the Japanese pine sawyer, it was necessary to confirm the attractiveness of the volatiles obtained from the pine logs. ODA (3) had identified the volatile components, particularly those produced under anaerobic conditions. The main components are ethanol, acetaldehyde, acetone, *n*- and iso-propanol, and methanol. Some of these components were found also in freshly felled trees of other coniferous species like Douglas-fir (*Pseudotsuga menziesii* (MIRB.) FRANCO), western

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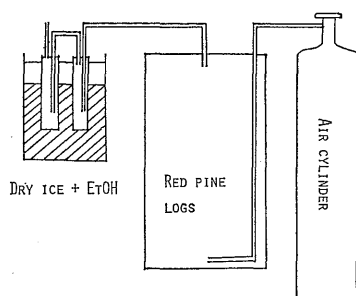


Fig. 1. Collection method of felled log volatiles

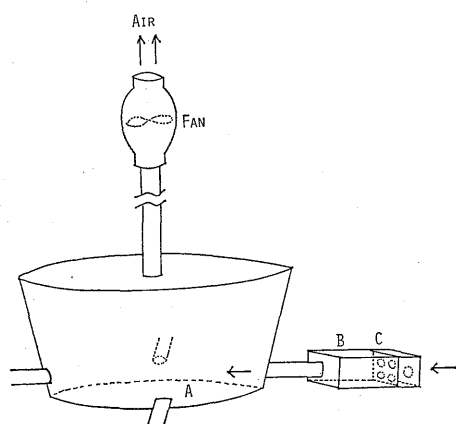


Fig. 2. A rough sketch of the olfactometer

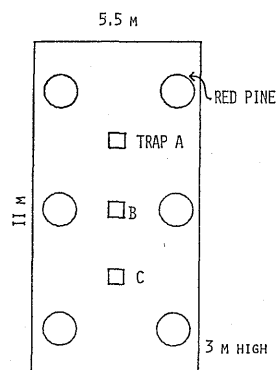


Fig. 3. Arrangement of the traps and pine trees for field cage bioassay

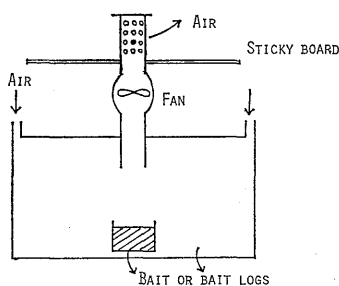


Fig. 4. Diagram of the sticky trap

Table 1. Response of *Monochamus alternatus* (female) to log volatiles

Treatment	No. of females responding								Total No. in 8 replications	Average No. of females caught in one chamber
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)		
Volatiles	1	5	3	2	0	1	4	2	18	2.25
Control	{ 0 0 0 }	{ 0 1 0 }	{ 1 0 1 }	{ 0 0 1 }	{ 0 0 0 }	{ 0 1 0 }	{ 0 0 0 }	{ 0 1 0 }	6	0.25

Table 2. Response of *Monochamus alternatus* to the sticky traps baited with wood disks and their volatiles

Test material	Sex	Response								Total
		Time elapsed (hr)								
		1	2	3	4	5	6	17	18	
Wood disks	♂	0	1	0	0	1	2	0	0	4
	♀	0	0	0	0	0	1	0	0	1
Volatiles	♂	0	2	1	0	1	2	0	0	6
	♀	0	1	0	0	0	0	0	0	1
Water soluble components*	♂	0	0	0	0	2	0	0	0	2
	♀	0	0	0	0	0	0	0	0	0

* Mixtures combined with ethanol (100equiv.), acetaldehyde (100), acetone (3), *n*- and iso-propanol (2 and 4), *n*-butanol (4), methanol (1), acetic acid (0.1), *n*-butyric acid (0.1), methyl formate (0.4), methyl acetate (0.4), *n*-butyric acid (0.1), and propenal (1 drop)

hemlock (*Tsuga heterophylla* (RAFN.) SARG.), and Pacific silver fir (*Abies amabilis* (DOUGL.) FORB.) which have an attractiveness for the ambrosia beetle (*Trypodendron lineatum* OLIV.) (2). In the preliminary experiment it was found that the volatiles consist of monoterpene hydrocarbons, including α and β -pinene, as the major components and a few unidentified water solubles under aerobic conditions.

The volatiles obtained, including both oily and water soluble components, showed strong attractiveness to walking female sawyers (Table 1). Although the significant difference of the attractiveness between the test material and the control was obvious, many repetitions of the test were required. This is mainly because of the interference among the sawyers, particularly the males, in the central chamber A of the olfactometer prevent normal attraction behaviors. Only females which had emerged at least four weeks previously were used for the bioassay because the females reared in plastic containers for at least two weeks showed a constant attractiveness to the pine logs (1).

In the field cage, the volatiles showed more than equal attractiveness to that of the log disk odors (Table 2). However, the amount (100 ml) of volatiles used, which corresponds to 60 kg of log disks treated for one week, obviously was much more than the volatiles released for one day from 8 kg of log disks. In fact, the odors of monoterpene compounds in the volatiles disappeared in one day. In this bioassay it might be thought that a greater number of responding sawyers should be observed

to confirm the attractiveness of the test materials. In later experiments (1) however, a strong response of sawyers to the logs themselves which were hung from the ceiling of the cage, was not obtained (7 sawyers out of 40 in one day and 11 in two days).

Removing the potted pines from the cage where they served as a food source and place to live stimulated the sawyers to move during the present experiments. There were 26 sawyers (8 females and 18 males) out of 50 (23 females and 27 males) that were attracted to the odors of the logs. This result also indicates a similar extent of attractiveness of log volatiles. The quantitative analyses for the volatile attractiveness could not be performed in the present experiments, but it has been clearly shown that the volatiles from pine logs attract the Japanese pine sawyers.

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