IDENTIFICATION OF A SEX PHEROMONE PRODUCED BY FEMALE VELVETBEAN CATERPILLAR MOTH\textsuperscript{1,2}

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(Received July 6, 1982; revised October 3, 1982)

Abstract—A sex pheromone produced by female velvetbean caterpillar moths, \textit{Anticarsia gemmatalis} Hübner, that attracts conspecific males was isolated and identified as a blend of (\textit{Z,Z,Z})-3,6,9-eicosatriene and (\textit{Z,Z,Z})-3,6,9-heneicosatriene in a ratio of ca. 5:3, respectively, when combined. The synthesized compounds elicited responses by velvetbean caterpillar moth males equivalent to those elicited by females in both laboratory wind tunnel bioassays and field trapping experiments.

Key Words—Sex pheromone, 3,6,9-heneicosatriene, 3,6,9-eicosatriene, velvetbean caterpillar, \textit{Anticarsia gemmatalis} Hübner, Lepidoptera, Noctuidae, attractant, hydrocarbons.

INTRODUCTION

The velvetbean caterpillar moth (VBC), \textit{Anticarsia gemmatalis} Hübner, is a major pest of soybeans in North and South America. It is presently classified as an underwing moth in the noctuid family, subfamily Catocalinae, Group 5 (Crumb, 1956), or Erebiinae, Group 2 (Forbes, 1954).

\textsuperscript{1}Lepidoptera: Noctuidae.
\textsuperscript{2}Mention of a commercial or proprietary product does not constitute an endorsement by the USDA.
\textsuperscript{3}Employed through a cooperative agreement between the Department of Entomology \\& Nematology, University of Florida, and the Insect Attractants, Behavior, and Basic Biology Research Laboratory, Gainesville, Florida 32604.
The response of VBC males to calling conspecific females in screen cages placed over soybean plants was first observed by Greene et al. (1973). Subsequently, Johnson et al. (1981) reported that calling females and ether extracts of calling females elicited upwind taxis and occasional clasper extension by males in laboratory assays. They also found that electric grid traps baited with virgin female VBC captured significantly more feral VBC males than those baited with mated VBC females in tests conducted in soybean fields. Thus there is substantial evidence for pheromone emission by virgin female VBC that attracts conspecific males.

We report here the isolation and identification of a sex pheromone from the female VBC and the response of conspecific males to the synthesized pheromone in the laboratory and the field. The pheromone consists of $(Z, Z, Z)-3,6,9$-eicosatriene and $(Z, Z, Z)-3,6,9$-heneicosatriene.

**METHODS AND MATERIALS**

*Pheromone Extraction and Bioassay.* Insects were obtained from a colony maintained at the Insect Attractants, Behavior and Basic Biology Research Laboratory (Greene et al., 1976) originally established with larvae obtained from Florida and infused annually with eggs from adults collected near Gainesville. Daily batches of pupae were sexed; the males and females were held for emergence in separate 16 × 16 × 16-cm Plexiglas cages housed in different controlled-temperature rooms. About 50 moths were maintained in each cage and provided with liquid food (50 g sucrose + 0.1 g ascorbic acid + 5 ml unprocessed honey dissolved in 1000 ml H₂O and dispensed in 60-ml cotton-filled paper cups). Conditions were 26 °C ± 2 °C and 65 ± 5% relative humidity with a 14 ± 0.2-hr photophase (lights on at 1900 hr EST, 4-F40 CWX and 4-F40 GRO lamps, 310-750 nm, ca. 500 lux). Everyday at 0830 the pupae accumulated from successive batches were transferred to new cages, leaving the moths that had emerged during the previous 24 hr. At 4 ± 1 day after emergence, the females were extracted to provide crude pheromone and the males were used for bioassay.

Typically, 50–100 virgin female moths were placed in a jar and sufficient ether was added to cover the moths. After 1 hr the bodies and other solid materials were removed, and washed with an additional 50 ml of ether. The combined ether rinses were filtered through a Whatman No. 1 filter paper and then concentrated to ca. 10 ml by distillation at atmospheric pressure. The concentrated crude extract was stored at −60 °C.

A laboratory bioassay was used to monitor all extracts and chromatographic fractions. Bioassays were conducted daily from 1300 to 1600 hr, 4–7 hr after the beginning of scotophase. A 2.4-m × 43.7-cm-diam Plexiglas observation tunnel was used to confine the moths. Conditioned and filtered