
P. ZAGATTI, M. RENOU, C. MALOSSE, B. FRÉROT, C. PAVIS, M. LETTERE, C. DESCOINS, A. PERMANA, Y. PIVOT, and F. LECLANT

1INRA Laboratoire des Médiateurs Chimiques
Domaine de Brouessy, 78114 Magny-les-Hameaux France
2U.F.R. d'Ecologie animale et de Zoologie agricole
ENSA-INRA, Place Pierre Viala, 34000 Montpellier France

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Abstract—Four components, (Z)-9-tetradecenal (8.6%), (Z,E)-9,12-tetradecadienal (4.8%), (Z)-11-hexadecenal (49.5%), and (Z)-13-octadecenal (37.1%), were identified in extracts of female pheromone glands of the European sunflower moth, *Homoeosoma nebulalellum* (Lepidoptera: Pyralidae) using GC and GC-MS analyses. EAG and single-cell recordings of male antennal receptors gave strong evidence for (Z,E)-9,12-tetradecadienal as the antennal key compound of sex pheromone detection in this species. This result was confirmed by field trapping; removal of (Z,E)-9,12-tetradecadienal from quaternary blends completely suppressed the male catches. The synthetic blends with this compound as a major component caught five times less males than the blends reproducing the ratio found in the female extracts [5% of (Z,E)-9,12-tetradecadienal only]. The occurrence of a minor component perceived as the most biologically relevant compound is discussed.

Key Words—Lepidoptera, Pyralidae, *Homoeosoma nebulalellum*, European sunflower moth, sex pheromone, identification, multicomponent blend, (Z,E)-9,12-tetradecadienal.

INTRODUCTION

The European sunflower moth (ESM), *Homoeosoma nebulalellum* (Den. & Schiff.) is a palearctic phycitid reported as a pest of sunflowers (*Helianthus* 

*To whom correspondence should be addressed.
annuus L.) in eastern Europe (Balachowsky, 1972). In western Europe, the larvae usually develop in the inflorescences of wild Compositae, such as Silybum marianum L. or Senecio jacobea L. (ragwort) in the southern and northern parts of Europe, respectively (Goater, 1986).

The first damage on cultivated sunflowers in southern France was reported in 1983 in late crops (Permana et al., 1991). *H. nebulellum* has not yet been found on sunflower in temperate Europe, but with the recent development of cold hardy sunflower cultivars, the importance of this pest species may increase. We therefore decided to develop an effective monitoring technique to be used in control programs for this potential pest.

In this paper, we report on the identification of the components of the female sex pheromone in the ESM, and we propose an efficient attractant for field trapping.

### METHODS AND MATERIALS

**Insects.** A laboratory colony was established on artificial diet for noctuids (Poitout and Bues, 1970), which was modified by addition of sunflower akene powder (100 g/5 liters) and sunflower oil (5 ml/5 liters). The colony was re-stocked annually using larvae collected near Montpellier (Hérault) and in the Camargue near St. Gilles (Gard) on *Silybum marianum* or sunflower. All rearing and testing were carried out at 23°C, 70% relative humidity under a 16:8 light–dark photoperiod.

Individuals were sexed as pupae and the two sexes held separately.

**Females.** Calling behavior was observed at 15-min intervals throughout the entire 24-hr period on 30 virgin 2- or 3-day-old females. Observations during the scotophase were made with a portable, incandescent red lamp.

The structure of the pheromone gland was examined histologically. The abdominal tips of 10 two-day-old virgin females were fixed for 22 hr in alcoholic Bouin’s and subsequently stained with Masson-Goldner trichrome (Martoja and Martoja-Pierson, 1967). Sections were made of both invaginated glands (noncalling position) or with the ovipositor extended by injecting the fixing agent into the abdomen before removing the last few abdominal segments.

**Pheromone Extraction and Analysis.** The VIII–IX abdominal segments of 323 two- or three-day old females were clipped 1 hr prior to the onset of photophase and soaked for 2 hr in 1 ml hexane at room temperature. The extract then was filtered through glass wool, reduced to ca. 100 μl under a N₂ flow and kept at −30°C until used.

The sex pheromone extract was analyzed by gas chromatography (GC) and gas chromatography–mass spectrometry (GC-MS). GC analyses were performed on either a Carlo Erba Fractovap 2900 with flame ionization detector