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Investigation of the Sex Pheromone of the Raspberry Bud Moth (Schreckenstenia Festaliella)

T. Jumaqulov [1]

M. N. Jumayev [2]

L. T. Yuldashev [3]

Abstract

method for isolating and identifying. the sex. pheromone of malinis Schreckenstenia festaliella, determination of female adults used methods, gas-liquid chromatography (GLS), mass-chromatography and selection of conditions for extraction with organic Solvents, the amount of biomaterial.

Keywords: pheromone, adult, extraction, codling moth, pest, Solvent, mass chromatography.

[1, 2, 3] *Almalyk branch of Tashkent state technical university named after Islam Karimov, 110100, Republic of Uzbekistan, Tashkent region, Almalyk city, Mirzo Ulugbek street, 45*

Introduction

The raspberry bud moth (*Schreckenstenia festaliella*), belonging to the family Schreckensteiniidae, is widely distributed in Uzbekistan and poses a serious threat to raspberry cultivation due to its significant negative economic impact. Infestation levels can reach 30–40%, causing considerable yield losses.

The larvae damage raspberry buds, which dry out during leaf emergence. Upon inspection, red-colored caterpillars with black heads can be found inside the buds. These larvae bore into the bud tissue and subsequently migrate to young shoots, further compromising plant development.

Adult moths emerge at the onset of raspberry flowering and lay their eggs directly into the flowers. Within 7 to 10 days, or up to 1.5 weeks, highly voracious larvae hatch and begin feeding on the floral receptacles. Approximately two weeks later, the larvae pupate.

During the fruit ripening phase, the caterpillars descend to the base of the stems, where they seek shelter beneath loosened bark or fallen leaves. There, they spin white cocoons in which they overwinter. Female moths exhibit high fecundity, laying between 150 and 200 eggs. Larvae that hatch after 10–14 days begin feeding on the inner tissues of the raspberry fruits. This species typically completes three generations per year under favorable environmental conditions.

Fig. 1. Raspberry bud moths laying eggs at the beginning of raspberry flowering

Fig. 2. Raspberry bud moths (Schreckenstenia festaliella)

Materials and Methods

Recent advances in microanalytical techniques over the past decade have significantly reduced the amount of biological material required for analysis. The use of high-resolution gas chromatography (GC), high-performance gas-liquid chromatography under pressure, gas chromatography–mass spectrometry (GC-MS), and mass fragmentography—especially when combined with computer-assisted data processing—has enabled the identification of pheromone components in certain insect species using extracts from just a few dozen individuals. This has greatly minimized the steps from the pheromone source to its final identification.

The major and minor components are isolated and identified, including geometric and positional isomers or structurally related compounds that differ in functional groups, carbon chain length, and the degree and position of unsaturation. It is also essential to consider the variation in pheromone composition depending on the geographical distribution of the population.

Active pheromone compounds can be extracted from insects using various methods, including steam distillation, collection of volatile compounds from the air, extraction from the paper on which the insects are reared, and solvent soaking of either the whole insect or specific body parts [1,2].

Solvents used for the extraction of sex pheromones are typically those that evaporate more quickly than the pheromone itself. Although most researchers use methylene chloride for soaking the abdominal tip or the whole insect, hexane extracts have demonstrated significantly higher biological activity.

The purified and distilled solvent is passed through a chromatographic column packed with neutral alumina prior to use.

Before pheromone collection, several thousand female codling moths were placed in mesh cages and maintained for two days under a controlled photophase–scotophase cycle. The females were then chilled, and the tips of their abdomens were excised into diethyl ether. The extract was dried over sodium sulfate (Na_2SO_4), and the solvent was evaporated using a rotary evaporator under atmospheric pressure. Each purification step was monitored using bioassay methods [3–5].

To collect GC fractions of the crude extract from *Sarrothrypus musculana* Ersch, 60 abdominal tips of female specimens were immersed in 1 mL of methylene chloride and applied to a chromatographic column (2 m × 2 mm) packed with 3% OV-1 on Chromosorb W-AW-DMCS (100–120 mesh). A Pasteur pipette cooled with dry ice was used for the fraction collection. Preparative gas chromatography (GC)

was employed as the final purification step for the extract, following either column chromatography or thin-layer chromatography.

Results of the Study: Mass fragmentography enables the detection of a target compound even in a complex mixture by analyzing several characteristic fragments, their intensities, and retention times. These parameters are predetermined and optimized by discrete changes in accelerating voltage using a reference standard and a computer-controlled MID (Multiple Ion Detection) interface. The use of fragmentography increases sensitivity up to 10^{-9}–10^{-12} grams.

The technique of mass fragmentography involves the prior selection of diagnostic fragments typical of the expected compound. The computer then calculates the appropriate accelerating voltages. The intensity of each fragment is recorded as a smooth curve at the moment the compound elutes.

The use of mass fragmentography allows for the identification of pheromone components using as few as two to five individual insects.

We investigated model compounds and GC fractions of the extract obtained from female raspberry bud moths (*Schreckenstenia festaliella*). To confirm the activity of specific fractions, mass fragmentograms were recorded by focusing the detector on m/z 184 (M–80) at 23 eV, using a partially purified extract equivalent to a single female. The m/z 184 fragment, selected as a compromise between specificity and intensity, proved to be optimal for detection, even when analyzing as little as 1.6 ng of the compound (see Fig. 3).

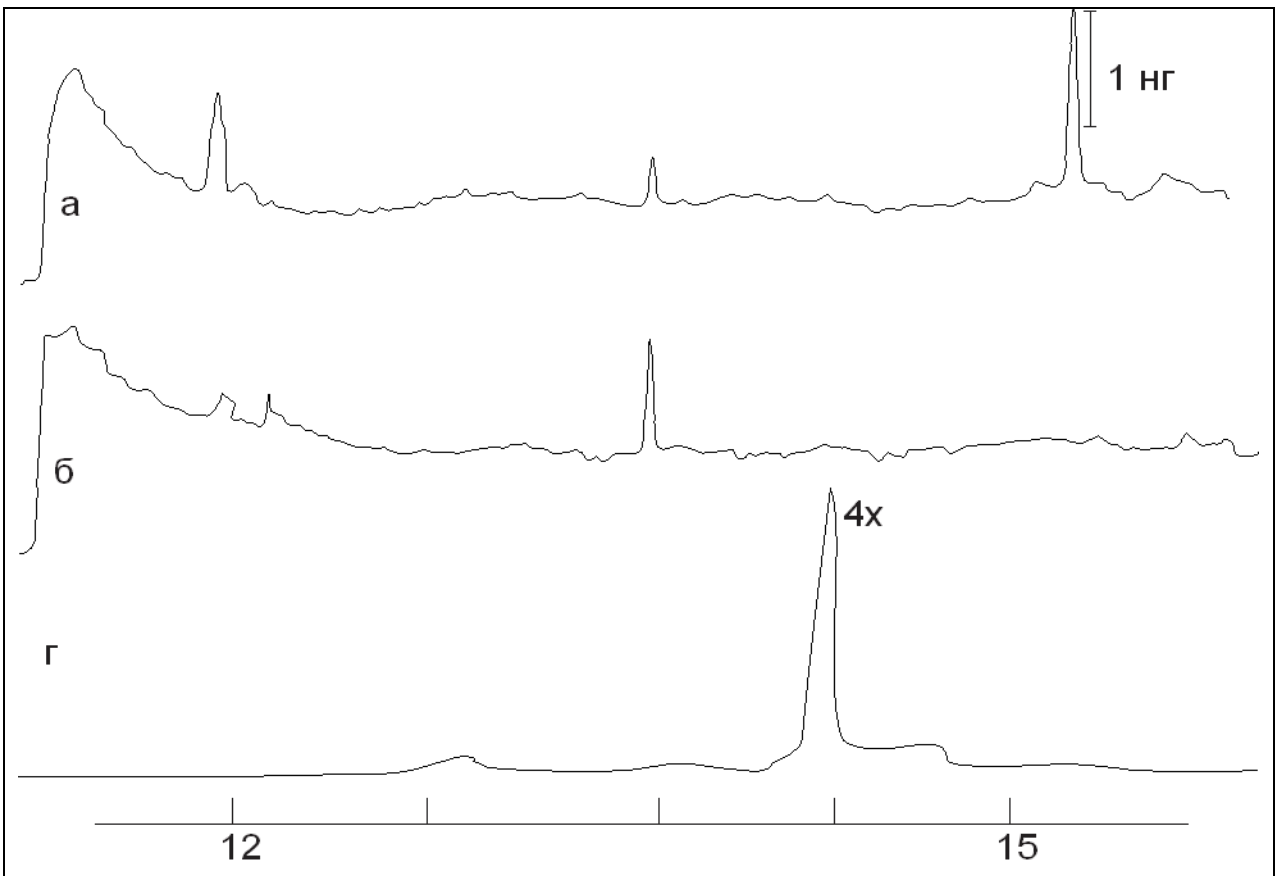

Fig. 3. Mass fragmentogram of partially purified extracts of the raspberry bud moth. A – aliquot from a female; B – aliquot from a male; C – enlarged scale: equivalent to 10 females.

Thus, the use of chromatographic–mass spectrometric techniques allows the identification of pheromone components from as few as two to five individual insects.

Imago scanning was programmed to detect only those ions characteristic of saturated and mono-

unsaturated C14 carbon atom acetates: m/z 196 (M−60), 194 (M−60), 166 (194−28), and 61 $(CH_3COOH_2)^+$. (Z)-7-Tetradecenyl acetate is one of the components of a complex mixture of tetradecenyl acetates.

Conclusion

The investigation of model compounds and GC fractions of the female raspberry bud moth (*Schreckenstenia festaliella*) extract was carried out. The active fractions of the sex pheromone were analyzed and studied using mass fragmentograms.

The conducted research demonstrated the feasibility of mass trapping of *Sch. festaliella* in field crops over three seasonal periods. A comparative evaluation of traps and dispensers was also presented, highlighting those with high insect-attracting efficiency.

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