SEASONAL AND DIEL PATTERNS OF SEX ATTRACTION OF
MALE HARRISINA AMERICANA AND
ACOLOITHUS FALSAURI (LEPIDOPTERA: ZYGAENIDAE)

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ABSTRACT

Seasonal and diel patterns of sexual activity of Harrisina americana (Guerin) and Acolothus falsarius Clemens males were determined with traps baited with the sex attractant R-(−)-2-butyl-(Z)-7-tetradecenoate. Analysis of weekly trap catches indicated three generations of H. americana and two generations of A. falsarius per year with broad overlap in the seasonal activity patterns of both. During May, male H. americana were attracted shortly after sunrise, while A. falsarius were attracted in mid afternoon. Sexual interactions between the two species appear then to be precluded by asychrony in their respective diel activity rhythms.

RESUMEN

Se determinaron los patrones ambientales y de “dial” de la actividad sexual de los machos de Harrisina americana (Guerin) y de Acolothus falsarius con trampas cebados con el atractante sexual R-(−)-2-butyl-(Z)-7-tetradecenoate. Análisis semanales de capturas en las trampas indicaron que hubieron tres generaciones de H. americana y dos generaciones de A. falsarius por año, con amplios solapes en los patrones de actividad ambiental de ambos. Durante Mayo, machos de H. americana fueron atraidos poco después del amanecer, mientras que A. falsarius fueron atraidos a media tarde. La interacción sexual entre las dos especies parece ser precluida por la sincronía de sus respectivas actividades rítmicas de “dial”.

Enantiomers of the optically active 2-butyl-(Z)-7-tetradecenoate have been found to be sex pheromones or sex attractants (and presumed sex pheromones) of ovoval species of Zygaenidae. Myerson et al. (1982) first identified 2-butyl-(Z)-7-tetradecenoate as a sex pheromone of the western grapeleaf skeletonizer (WGLS), Harrisina brilliana (Barnes and McDonough). Soderstrom et al. (1985) demonstrated that the S-(−) enantiomer (d isomer) was active in attracting male WGLS and the K-(−) enantiomer was not. Subsequently, Landolt et al. (1986) reported the stereospecific attraction of males of the grapeleaf skeletonizer (GLS), Harrisina americana (Guerin) and Acolothus falsarius Clemens to the R-(−) enantiomer of 2-butyl-(Z)-7-tetradecenoate. Eight additional species of Zygaenidae have since been found to be attracted to either the S-(+) or R-(−) enantiomer (Landolt & Heath, unpublished data).

The observed stereospecific responses of these species to enantiomers of 2-butyl-(Z)-7-tetradecenoate suggest a possible role in preventing or minimizing intersexual sex pheromone interactions and maintaining behavioral reproductive isolation among sympatric synchronous species of New World Zygaenidae. For all species documented, male attraction is to only one enantiomer. In the case of A. falsarius, the WGLS, and the GLS, the nonattractive enantiomer is also somewhat inhibitory (reduces trap catches) (Landolt et al. 1986, Curtis et al. 1988). In Florida, however, both the GLS and A. falsarius are attracted to R-(−)-2-butyl-(Z)-7-tetradecenoate at the same dosages and
in the same trape (Landolt et al. 1986). These two Zygaenidae are sympatric over much of their respective distributions in eastern North America (Holland 1983). Clearly, other mechanisms prevent sexual interactions between these two species.

Sympatric species are known to utilize seasonality and diel activity rhythms, as well as differences in sex pheromone chemistry and courtship interactions to maintain reproductive isolation (Greenfield & Karandinos 1979). We report here comparisons of the seasonal occurrence of male GLS and A. falsarius and the diel periodicities in male sexual activity of both species as indicated by catches in traps baited with R-(-)-2-butyl-(Z)-7-tetradecenanoate. The sexual isolation of these two sympatric species by temporal factors would preclude interspecific sex pheromone interactions.

MATERIALS AND METHODS

Experiments were conducted to monitor GLS and A. falsarius sex pheromone activity throughout the year and throughout the day. In both experiments, Pherocon IC traps (Zoeecon Corp., Palo Alto, CA) baited with R-(-)-2-butyl-(Z)-7-tetradecenanoate were used. The chemical was synthesized and purified as described in Landolt et al. (1986). Enantiomeric purity was >99%. The R-(-) enantiomer was formulated in rubber septa at a 500 μg dosage for both tests.

Seasonal activity was monitored with traps placed at two sites, both in Gainesville, Alachua County, Florida. Site A was along a heavily wooded stream bank and site B on the edge of a wood lot. Both areas had abundant Vitis sp., a host plant of both species. Traps were first baited on 13 January 1986. Septa were pinned to a 2 X 2 X 1 cm piece of styrofoam placed in the center of the sticky bottom of the trap liner and were replaced approximately every 30 days. Traps were checked 2 to 3 times each week during periods of moth inactivity and daily during periods of moth activity. Trap liners were replaced when necessary and traps were maintained until 13 January 1987. Trap catch data were summarized as weekly trap totals.

Diel activity rhythms were monitored with a trap placed along the wooded stream bank. Trap catches were recorded hourly from 5:30 a.m. to 7:30 p.m., well before sunrise to well after sunset. Temperatures were recorded when traps were checked from a calibrated laboratory thermometer hung in the shade of a shrub near the trap. Such hourly recordings of trap catches were made on 8 different days during May and June 1986.

RESULTS

Male GLS were caught in pheromone-baited traps every week from 21 March to 10 October. Peak flight periods occurred, however, from 4 April to 9 May, 13 June to 18 July and 8 August to 12 September, with abrupt activity minima between these periods (Fig. 1). Patterns of trap catch data were similar for both trap sites with coincident maxima and minima in trap catches. Male A. falsarius were trapped most weeks from 4 April to 3 October, with none caught during June and very few in July and August. Peak flight periods were 18 April to 16 May and 5 to 26 September (Fig. 1).

The diel periods of sex pheromone activity of male GLS and A. falsarius were separated clearly (Fig. 2). Most male GLS were caught before 7:30 a.m. and none were caught in traps before 5:30 or after 11:30 a.m. Male A. falsarius were caught in the same traps during the afternoon, primarily between 1:30 and 4:30 p.m. None were caught before 12:30 or after 6:30 p.m. (Fig. 2). Temperatures recorded during periods of GLS activity ranged from 15 to 27°C, while those recorded during A. falsarius activity ranged from 26 to 33°C.
Fig. 1. Weekly catches at two sites (dashed and solid lines) of male (A) *Harrisina americana* (GLS) and (B) *Acolothus falsarius* in traps baited with 500/μg R-(−)-2-butyl-(Z)-7-tetradecenoate in 1986.

**DISCUSSION**

Results of the year-long trapping study show broad overlaps in the seasonal occurrence of the GLS and *A. falsarius*. The first and second flight periods of *A. falsarius*, most likely corresponding to the emergence of distinct generations, coincided roughly with the first and third flight periods or generations of GLS. At least in North Florida, the patterns of seasonal occurrence of these two species would not result in reproductive isolation. Holland (1903) reported two generations per year (double-brooded) for the GLS. While our data indicate three broods per year, this may be characteristic only in the southernmost areas of the species distribution. The generation time observed (flight to flight) was 10 weeks between the first and second flights and 8 weeks between the second and third flights.

The GLS and *A. falsarius* are isolated sexually by time of day, assuming that male response to the sex attractant coincides with male response to calling females and that
the observed diel rhythms of the two species is similar throughout the season. The GLS was active primarily around dawn, while *A. falsarius* was most active in the heat of mid-afternoon. Since no temporal overlap was observed (Fig. 2), this presumably would be sufficient to minimize or preclude sexual interactions between the species despite their responsiveness to the same enantiomer of 2-butyl-(Z)-7-tetradecenoate, their broad area of sympatry, and the observed seasonal synchrony (Fig. 1). As with other moth species, however, additional pheromone components may further preclude sexual interactions by providing species specificity to the chemical signal emitted by calling females.

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**REFERENCES CITED**
