

Diel Activity Patterns of the Squash Bug Egg Parasitoid *Gryon pennsylvanicum* (Hymenoptera: Scelionidae)

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ABSTRACT Mated, 1-d-old female *Gryon pennsylvanicum* (Ashmead) exhibit a diel pattern of activity and rest. Daily activity (e.g., oviposition, walking, grooming, flying, feeding) is greatest during morning hours (0815-1215 hours CST). Two forms of resting behavior occur. "Motionless" is a temporary state occurring mostly during afternoon hours. The more pronounced resting phase, "tucking," occurs in aggregated individuals of both sexes and is a form of rest previously undescribed in the parasitic Hymenoptera. The period of tucking persists from before lights go off to about 1 h after the lights go on. In individual wasps, activity resumes abruptly at about 0830 hours; by 0930 hours, all adults become active. Observations of a field population show a similar pattern of diel activity. The significance of these data for biological control programs is discussed.

KEY WORDS Insecta, *Gryon pennsylvanicum*, diurnal behavior, biological control

ALTERNATING CYCLES OF activity and rest are common among invertebrates (see Brady 1981 for review). Within the Insecta, quantitative studies of this type of behavioral periodicity have been made for a wide range of taxa (Lewis & Taylor 1964; Barbosa & Frongillo 1977; Cerna 1978; Ekbohm 1982; Tobler 1983; Lockwood & Story 1984, 1986; Hu et al. 1986; Chadee et al. 1987; Walter 1988; Chadee et al. 1989). However, there are few investigations of diel activity-resting patterns in parasitic hymenopterans (but see Barbosa & Frongillo 1977, Ekbohm 1982, Hu et al. 1986, Walter 1988).

Gryon pennsylvanicum (Ashmead) is an indigenous egg parasitoid of the squash bug, *Anasa tristis* (DeGeer), and very little is known about its behavior. Furthermore, diel activity has not been reported for any scelionid despite the family's importance in biological control (Orr 1989). Therefore, our objectives were to describe and quantify aspects of *G. pennsylvanicum*'s diel behavior in the laboratory and field.

Materials and Methods

Insect Cultures. Our squash bug colonies originated from eggs, nymphs, and adults from squash and pumpkin fields outside Manhattan, Kans., in July 1988. Cultures were maintained in large, mesh-covered cages at a 16:8 (L:D) photoperiod (Cool White and Grow Lux fluorescent lamps), $27 \pm 2^\circ\text{C}$, and RH about 75%, on potted *Cucurbita pepo* L. squash, cultivar Early Prolific Straightneck (Wilhitte Seed Company, Poolville, Tex.).

Parasitoid colonies were initiated in August 1988 with field-collected adults. They were maintained in Plexiglas boxes in growth chambers at $26.7 \pm 0.5^\circ\text{C}$, about 75% RH, and 16:8 (L:D). Every other day, 12-16 squash bug egg masses of 10-20 eggs

each (<1 d old) were glued with honey to strips of index cards and added to the colony together with free water and honey for food.

Description and Quantification of Diel Behavior. We observed male and female adult *G. pennsylvanicum* of mixed ages in colony boxes throughout five mornings over a 2-wk period in July 1989. Also, each afternoon, we observed colonies once an hour for 5 min, beginning at 1600 hours and ending at 2200 hours (CST). These observations were aided by the use of a hand-held 10 \times magnifier. Adults also were inspected in glass shell vials with a 10-70 \times binocular microscope at the same times.

To quantify diel behavior in *G. pennsylvanicum* in the laboratory, pairs of newly emerged male and female wasps were placed in 15 cotton-plugged, 14.8 cc (4 dram) shell vials with honey streaks at 1000 hours. The vials were illuminated by fluorescent lamps suspended about 0.5 m above the vials. To diffuse the light, a sheet of corrugated plastic was placed just under the lamps. Light intensity was 600 lux, temperature was 26-27 $^\circ\text{C}$, and the ambient relative humidity about 20%. Photoperiod was 16:8 (L:D) with lights on between 0700 and 2300 hours. At 2100 hours, when mating was assumed to have occurred, females were transferred individually to clean shell vials. Each female then received a squash bug egg mass (18 eggs <1 d old). Vials within the arena were given a number randomly from 1 through 15 and arranged in a row. This arrangement permitted a rapid scan sample of all vials in numerical order. Scan sampling enables data to be taken on a relatively large group of individuals (Martin & Bateson 1986). Females were chosen for tests because preliminary data revealed that wasps of both sexes exhibited very similar resting behavior, and because we planned to relate diel periodicity to daily oviposition.

