

Observations on Some Aspects of the Biology of *Cyrtorhinus lividipennis* Reuter¹ (Heteroptera: Miridae)

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ABSTRACT

The mirid predator *Cyrtorhinus lividipennis* was observed in the laboratory for eclosion, molting, mating, and egg deposition behavior. The nymphs, through peristalsis movement of the body, pushed the operculum outward. A bimodal molting rhythm was observed with peaks at 6:00–8:00 a.m. and 4:00–6:00 p.m. The sexually receptive adults communicated by visual signals and mated in opposed position. Eggs were usually laid either singly or in pairs in the upper surface of the midrib. The flight activity of *C. lividipennis* was investigated in corn fields and found to occur during sunrise and sunset periods.

The biology of the different geographic populations of *Cyrtorhinus lividipennis* Reuter, the corn delphacid predator, on varied species of prey has been studied (Reyes and Gabriel 1975; Tanangsnakool 1975, Pophaly et al., 1978, Liquido and Nishida 1984) and its ecology in rice and corn agroecosystems well investigated (IRRI 1973, 1974, Kenmore 1980, Liquido 1982). Despite this information on the bio-ecology of *C. lividipennis*, some aspects of its life history are not available in the literature. In this paper, we describe the eclosion, molting, mating, and egg deposition behavior of *C. lividipennis* as observed in the laboratory. The flight activity of the predators in corn fields is also reported.

MATERIALS AND METHODS

Laboratory Studies

The test insects were obtained from laboratory stock cultures established from adults collected in "Hawaiian Super Sweet Corn #9" fields at the Waimanalo Agricultural Research Station, University of Hawaii. Both the stock cultures and test insects were reared on eggs of the corn delphacid, *Peregrinus maidis* (Ashmead) (Homoptera), at $24.0 \pm 2.0^\circ\text{C}$, $70.0 \pm 5.0\%$ relative humidity, and a 12-hour photoperiod. Unless otherwise indicated, the test insects were kept inside 3.5 (inside diameter) \times 20.0 (height) cm test tubes.

Eclosion. Well-developed eggs with a very conspicuous "red eye spot" were dissected out from the corn plant tissue and individually placed on wet filter paper in a petri dish. The eggs were observed for 12 hours at one-hour intervals for the emergence of nymphs.

Molting. Fully developed fifth instar nymphs were kept in test tubes; each tube contained 10 nymphs and was replicated 25 times. The number of nymphs molting into adults was recorded at two-hour intervals for 48 hours.

Mating. Twenty pairs of two-day-old virgin males and females were confined in test tubes. The mating behavior of the predators was observed and the number of pairs in copula during observation periods recorded. Observations were done at hourly intervals for a period of 24 hours.

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Egg Deposition. Gravid females were kept individually in test tubes. A corn leaf cutting of 15 cm length was provided in each tube for oviposition. The behavior of the predators just prior to, during, and after oviposition was observed at one-hour intervals for 12 hours.

Field Observations

The flight pattern of *C. lividipennis* was studied in 8-week-old "Hawaiian Super Sweet Corn #9" fields in Kahuku, Oahu on July 30–31, 1981. Two techniques were employed in determining the movement of the predators: (1) by remove-count method, and (2) by ultraviolet light trapping.

In the remove-count method, 50 corn plants along the border of the field were selected and marked by colored flags. Adult predators on marked plants were aspirated into a clean glass vial and then counted later. This procedure was repeated every two hours starting from 6:00 a.m. up to 6:00 p.m. The number of *C. lividipennis* on corn plants at various sampling times was used as an indicator of its diurnal pattern of movement.

A Texas-type ultraviolet light trap (Southwood 1978) was used to monitor the flight activity of *C. lividipennis* at night. It was positioned at 1.5 m above the ground and covered with a 541 cm² plastic sheet which had been coated with a thin film of Tanglefoot®. The sticky plastic sheet was changed every two hours; trapping started at 7:00 p.m. and terminated at 7:00 a.m., sunrise was at 6:30 a.m. The number of predators caught on Tanglefoot was counted and used as an indicator of the nocturnal pattern of movement.

RESULTS

Ecdision

The emerging nymph pushed the operculum outward. The operculum was either dislodged or remained partially attached to the egg shell. The nymph emerged head-first by a continuous peristalsis of the body. After emergence from the egg shell, the nymph spread its appendages and remained motionless near the egg shell for 2–4 minutes and then slowly became active.

Molting

Results show a very distinct bimodal pattern of molting (Fig. 1). The number of nymphs molting into adults was highest from 6:00 to 8:00 a.m., decreased toward noon, peaked again from 4:00 to 6:00 p.m., and then decreased towards midnight. The frequency of molting appears to be a response to change in light conditions associated with dawn and dusk.

Mating

The excited male flapped its wings and walked briskly around the female and the latter reacted with similar movements. The male grabbed the female's abdomen with its forelegs while continuing vigorous wing movements, quickly slipped back, turned around, positioned its abdomen below that of the female and inserted its genitalic armature into the female's terminalia. Aedeagal insertion in opposed position was achieved by pushing their terminalia against each other (Fig. 2). These coordinated movements of the mating pair lasted for 10 seconds. While in coitus, the pair was usually stationary, without wing, leg or antennal movements. The coition lasted for up to 15 minutes. The pair in coitus disengaged by slightly moving their abdomen up and down while vigorously flapping their wings. The male and female walked in opposite directions after copulation.

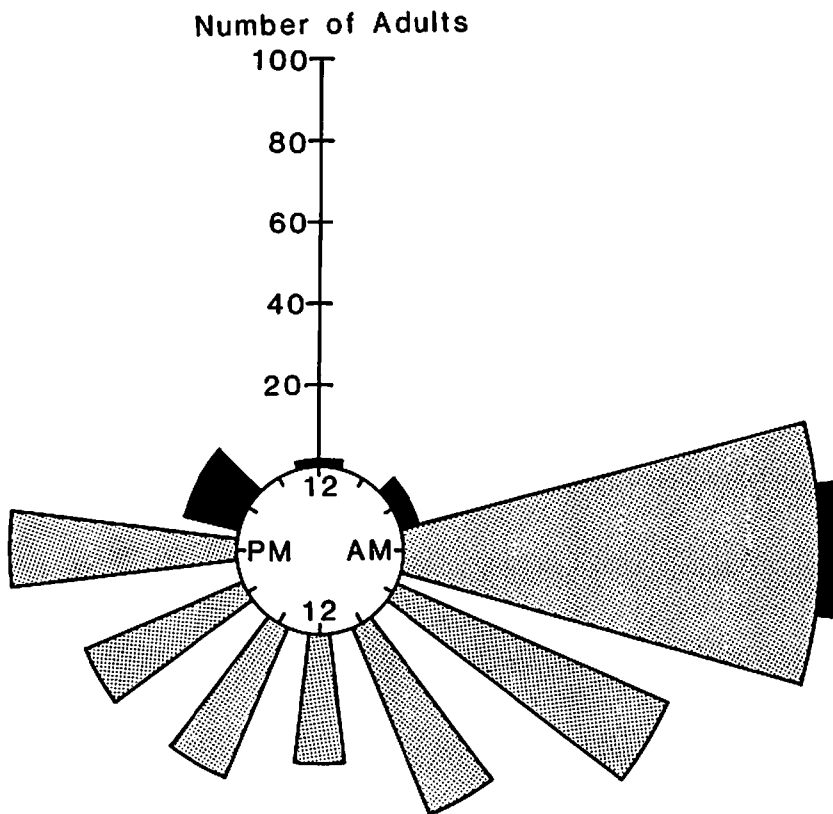


FIGURE 1. Molting rhythm of *Cyrtorhinus lividipennis* Reuter. (N = 250).

Egg Deposition

During oviposition, *C. lividipennis* curved its body dorsally with the forelegs stretched out in front of the head while the mid- and hindlegs were fully extended posteriorly behind the abdomen. The curved abdomen was in between the well extended pairs of meso- and metathoracic legs. This position seems to provide sufficient pressure to thrust the ovipositor into the leaf tissue. Insertion of the ovipositor into the leaf tissue was accomplished by a slight up and down lacerating movement and the thrusting force exerted by the abdomen. The female located new oviposition sites in two ways: (1) by changing its body orientation sideways without altering the position of the front legs; and (2) by slowly walking away from the former oviposition site, with its curved body slightly relaxed and dragging the ovipositor on the surface of the leaf. After withdrawing the ovipositor from the leaf tissue, the female either maintained its body curvature or assumed its normal upright position. The former indicates that the female will lay more eggs; the latter, no further egg laying.

C. lividipennis laid eggs only in the upper surface of the midrib. Eggs were generally laid either singly or in pairs; eggs laid in batches of 3 or more were also observed, though in relatively less frequency.

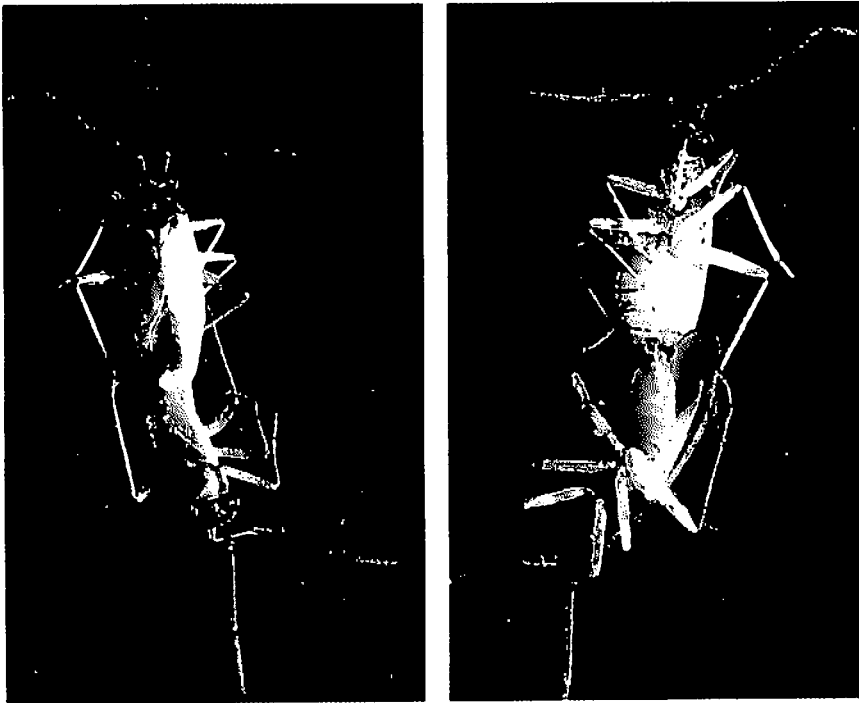


FIGURE 2. Copulating pairs of *Cyrtorhinus lividipennis* Reuter: left, dorsal view; right, ventral view; lower, male; upper, female.

Flight Patterns

The number of predators alighting onto marked plants decreased from sunrise towards noon, and then increased toward sunset. The ultraviolet light trap catch was relatively low throughout the night, but was comparatively high between 5:00 and 7:00 a.m. Based on the combined results of the remove-count and ultraviolet light trapping methods, the peaks of flight activity of *C. lividipennis* was bimodal and occurred mostly during dawn and dusk (Fig. 3).

DISCUSSION

Since *C. lividipennis* belongs to a family which is predominantly phytophagous, it has been conjectured that it may also be feeding on plant sap. In several studies conducted at the International Rice Research Institute, it was observed that *C. lividipennis* could not survive on rice seedlings in absence of eggs of the brown planthopper (Delphacidae), *Nilaparvata lugens* (Stål) (Dyck, V.A., personal communication)*. *C. lividipennis*, therefore, does not feed on the host plant of its prey even when the prey population was scarce. Although *C. lividipennis* is mainly an egg predator (Yasumatsu et al., 1981), it also feeds on nymphs and adults of its prey (Chiu 1979).

Tanangsnakool (1975) studied the feeding rate of the different nymphal instars of *C. lividipennis* fed with eggs of *N. lugens*. His results showed that the older instar nymphs preyed on more eggs than the younger nymphs. We analyzed Tanangsnakool's

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Number of Nymphs Molting into Adults

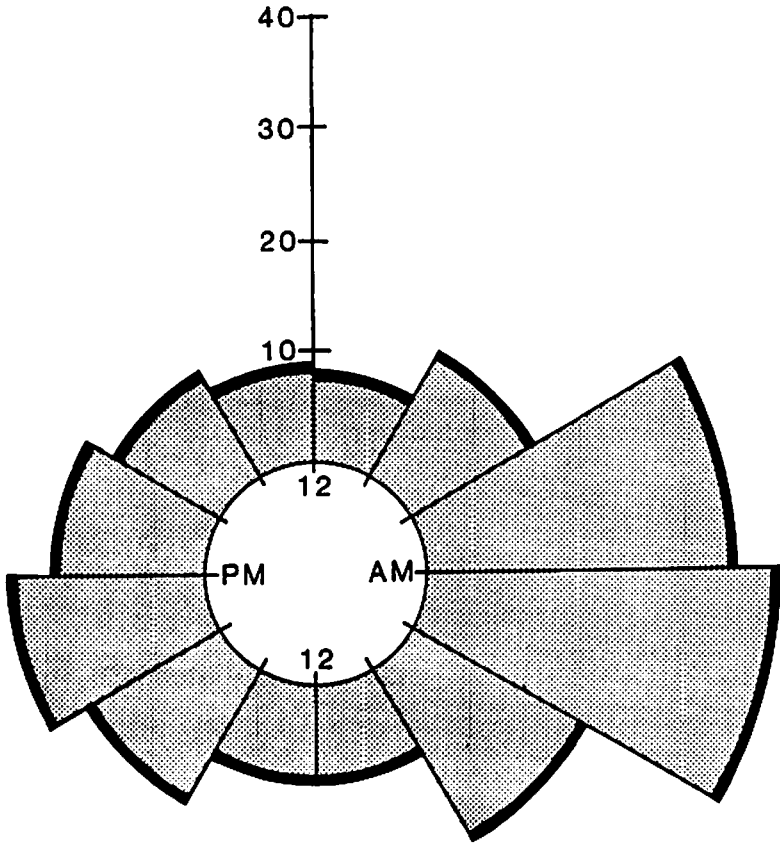


FIGURE 3. Flight activity pattern of *Cyrtorhinus lividipennis* Reuter in a corn field. Darkened bars represent adults trapped by ultraviolet light, while mottled bars represent adults which alighted onto corn plants.

kool data and found a very significant regression fit between age of nymphs in days (X) and the consumption rate (Y): $Y = 2.73 + 6.12 X$, $r^2 = 0.86$, $P \leq 0.01$. Pophaly et al. (1978) reported that nymphs and adults of *C. lividipennis* prefer to feed on early instar nymphs more than on late instar nymphs. However, it could be argued that fewer older nymphs were preyed upon because they were more able to escape the predators than the smaller, younger nymphs.

In addition to *N. lugens*, *C. lividipennis* preys on the cicadellids, *Nephotettix virescens* (Distant), *N. nigropictus* (Stål), and *Recilia dorsalis* (Motschulsky), and the delphacid, *Sogatella furcifera* (Horvath) in rice growing regions of Asia and the Pacific. It prefers to prey on *N. virescens* but may "switch" (*sensu* Murdoch 1969) to a more abundant suitable prey (IRRI 1973). In Hawaii, *C. lividipennis* "switches" to *Draeculacephala minerva* Ball (Cicadellidae) during corn fallow period (Napom-peth 1973). *D. minerva* is abundant on *Sorghum halapense* (L.) which grows densely in the border of corn fields.

Results on mating behavior suggest that visual signals elicit sexual responses between the two sexes leading to copulation. Whether chemical communication is involved in sexual excitation was not determined.

The oviposition behavior of *C. lividipennis* is well adapted to that of its prey. On corn plants, *C. lividipennis* lays eggs in the midrib and leafsheath where *P. maidis* also oviposits (Liquido 1982). On rice plants, *C. lividipennis* and *N. lugens*, the most abundant prey, lay their eggs only in the leafsheath (Bae and Pathak 1966). The eggs of the mirid predator are usually interspersed with those of the delphacid prey; thus, the emerging predator nymphs have available prey near the sites of their eclosion.

The flight activities of *C. lividipennis* mostly occurred during dawn and dusk. This pattern of flight rhythm was also observed among prey species of *C. lividipennis*: in *N. lugens* by Ohkubu and Kisimoto (1971), Kisimoto (1979), and Saxena and Justo (1982); and in *P. maidis* by Takara (1981) and Takara and Nishida (1983). Combination of low light intensity, relatively lower temperature and correspondingly higher relative humidity, and low wind velocity during sunrise and sunset induce flight in *N. lugens* (Kisimoto 1979, Saxena and Justo 1982). The same environmental factors may also be determining the flight activity of *C. lividipennis*.

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