Biology and Behavior of *Panchlora irrorata*, a Cockroach Adventive on Bananas (Blattaria: Blaberidae)[1]

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ABSTRACT

Panchlora irrorata Hebard extrudes its ootheca during formation and then transfers the ootheca into a brood sac where the embryos develop. Eight females produced 1 or 2 oothecae during adulthood. The average number of eggs per ootheca was 31 ± 4.7 (N = 7). Living nymphs hatched from eggs in 1 ootheca produced by a female which had mated 63 days earlier. Nymphs matured in 196 ± 18 days (9 males) and 207 ± 14 days (13 females). Adults survived for 108 ± 16 days (7 males) and 130 ± 16 days (7 females). The male of *P. irrorata* courts the female by rocking his body sideways in a series of brief oscillations. Just prior to copulation the male rushes behind the female, where he assumes a linear position in which they are opposed tail to tail; from this position the male rapidly backs up to the female to make genital connection. Copulation lasts from 20 to 25 minutes.

Biological information on the pale-green cockroaches (*Panchlora* spp.) is scarce. Roth and Willis (1958) reviewed the literature and presented observations on the biology of *Panchlora nivea* (L.). The following observations on *Panchlora irrorata* Hebard supplement this information. Gurney[2] has stated that *P. irrorata* is frequently intercepted in this country on Ecuadorian bananas. At least 5–7 other species of *Panchlora* also have been taken as adventives on bananas in the United States and Europe (Roth and Willis 1960).

In April 1963, Mrs. Harry D. Rounds captured an adult female of *P. irrorata* on bananas in Normal, Ill. Mrs. Rounds kept the insect alive for her children. On May 26, 1963, the insect gave birth to more than 40 living nymphs; 6–8 nymphs were apparently aborted dead. Cockroaches of this genus are ovoviviparous (Roth and Willis 1954, 1958). Jeff Rounds fed the insects dry dog food and water until June 11, 1963, when they were given to me. On June 13, 18 days after parturition, the original female formed another ootheca. When she had completed the ootheca, the female rotated it, apexes of the eggs to her left; similar behavior has been observed in *P. nivea* (Roth and Willis 1958) and other ovoviviparous cockroaches (Roth and Willis 1954). The female was unsuccessful in transferring the ootheca to her brood sac; about 7 hr after starting to oviposit, the female aborted about half of the ootheca, a portion containing 19 eggs. She died August 7, 1963, about 4 months after capture, without giving birth a second time.

RESULTS

Development and Longevity.—On receiving the insects, I isolated 20 of the nymphs individually in ½-pint jars with water and Purina dog chow; 19 nymphs were kept in a group in a 1½-pint jar with similar food. All were held at uncontrolled room temperature until they died. The isolated nymphs survived poorly. During the week following isolation several died, and none fed, or at least none defecated; whereas the grouped nymphs fed and deposited many fecal pellets on the moist cotton plug in the water vial. To prevent further loss of the isolated individuals, I returned the survivors to the group jar, abandoning my attempt to secure data on the number of moults and instars.

The dark-brown nymphs (Fig. 1) were unable to climb the sides of the glass rearing jar, but the grayish-green adults of both sexes could climb the vertical glass walls and were restrained by a band of petrolatum at the top of the jar. The first adult appeared in the colony 141 days after birth; the last adult appeared 310 days after birth; both were males. The adult males flew readily, but I did not see females fly in the laboratory. The mean length of nymphal development for the 9 ♂ that reached maturity was 196 ± 18[3] days, and for the 13 ♀ was 207 ± 14 days. Longevity records were obtained for only 7 ♂ and 7 ♀. The males survived as adults for an average of 108 ± 16 days and the females for 130 ± 16 days.

Oviposition.—Eight ♀ were set up individually in 1-pint jars for oviposition. Four of these I had seen mating. Each of the other 4 was placed with a male of approximately the same age; these presumably mated later. Two ♀, known to have mated, died without giving birth; I preserved these for identification, so I do not know whether or not they were carrying oothecae in their brood sacs at death. The other 2 mated ♀ aborted their first and only oothecae 63 and 103 days, respectively, after mating. Seven nymphs hatched from eggs in the ootheca that was aborted at 63 days. The remaining 4 ♀, presumed mated, aborted their first oothecae 14, 18, 88, and 110 days, respectively, after having been placed with males. The second of these females aborted a second ootheca 66 days after the first.

I examined the 7 oothecae for dead embryos and undeveloped eggs. The ootheca of *P. irrorata* is thin and nearly colorless, similar to that of *P. nivea* (Roth and Willis 1958), and the condition of the eggs can readily be determined. The mean number of eggs per ootheca was 31±4.7 (max 48, min 12). The mean number of dead embryos was 15±6.0 (max 39, min 0). The mean number of undeveloped eggs was 15±3.3 (max 24, min 1). Seven nymphs hatched

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[2] I thank Dr. Ashley B. Gurney, U. S. National Museum, for identifying this species and for information about its occurrence in the United States.
[3] Standard error of the mean.

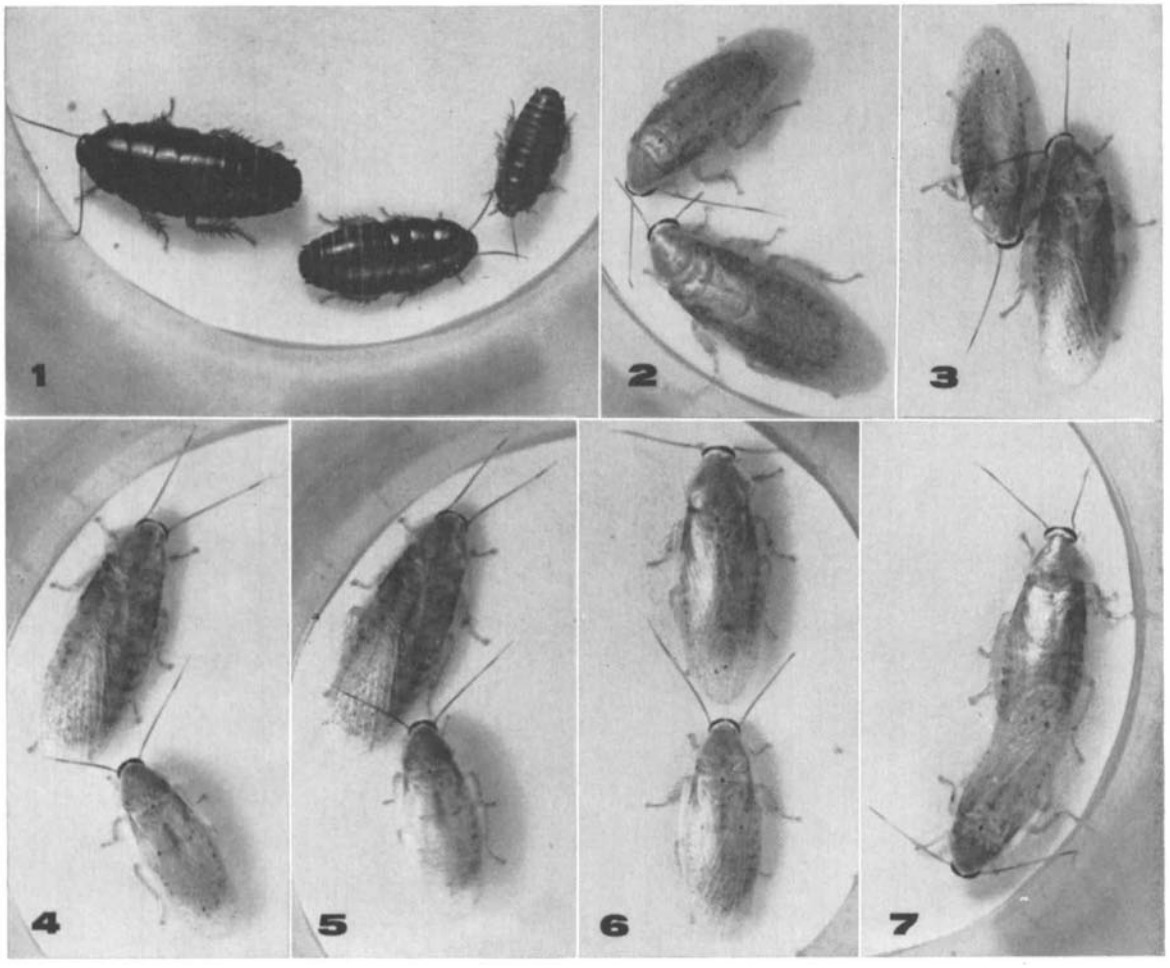

FIG. 1–7.—*Panchlora irrorata* (×2). FIG. 1.—Nymphs. FIG. 2.—Male (top) and female fencing with antennae. FIG. 3.—Male (left) and female pressing toward each other after initial encounter. FIG. 4.—Male (bottom) in precopulatory position beside receptive female during an interval between successive oscillations. FIG. 5.—The same pair as in Fig. 4; the image of the male's body is blurred by his oscillations. FIG. 6.—Male (bottom) in alternative precopulatory position behind female between oscillations. FIG. 7.—Copulatory position assumed by a male (bottom) which had backed up to the female. The male's wings overlap the female's tegmina.

from an ootheca which also contained 13 dead embryos and 19 undeveloped eggs; these nymphs were the only second-generation offspring born alive, and none survived beyond the first instar.

Mating Behavior.—I observed the mating behavior of *P. irrorata* 10 times, from the start of courtship through the male's attempt at copulation. Mating behavior in this species is similar to that observed in *P. nivea* (Roth and Willis 1958) in that the male backs up to the female to make genital connection; this rear-to-rear approach is in marked contrast to the mating behavior of most other blattids (Roth and Willis 1954).

When 5-day-old, or older, adult virgin females were placed with adult virgin males of the same age, or older, the following sequence of events occurred. In 4 encounters the male approached the female directly until he made antennal contact; the other 6 encounters seemed to be accidental. On contact both insects engaged in antennal fencing (Fig. 2). Five of the males moved close to the side of the female, pressing against her thorax or tegmen; frequently the females pressed back (Fig. 3). If the female was receptive, she remained relatively motionless while the male courted her. Unreceptive females decamped when the male pressed too closely.

Prior to copulation all but 1 of the males courted the female for several minutes to ½ hour. The 1 ♂ wasted no time on preliminaries, but rushed behind the female and completed his attempt (unsuccessful) at copulation within 1 min. The other males raised their bodies slightly and rocked sideways, 3–5 oscillations every few seconds, or in some instances at longer intervals (Fig. 4, 5). Two males rocked periodically for 10–15 min; another rocked intermittently for 30 min. Most males spent less time in this activity. Although some males remained beside the female while rocking (Fig. 5), others moved directly behind her, where each stood with his head near the apex of the female's tegmina (Fig. 6). After a period of rocking,

the male either ran rapidly to a position behind the female, or turned 180° in his position behind her, assuming a linear position in which the insects were opposed tail to tail. The male then raised his wings slightly, depressed his abdomen, and backed up to the female, thrusting the apex of his abdomen beneath her wings to make genital connection (Fig. 7). In 4 encounters, the males fluttered their wings just before running behind the female. During courtship the movements of both sexes were slow and unhurried until the male made his final rush to back up to the female.

During copulation the male's wings overlapped the female's tegmina (Fig. 7). Both insects remained very quiet while the spermatophore was being transferred, scarcely moving their antennae. At the completion of successful copulation, the male moved forward slightly until free of the female, then rubbed his posterior abdominal segments with his hind legs. The female, after copulation, held her genital valves separated for 2–3 min, then closed them around the spermatophore. Finally, both insects moved apart and showed no further interest in each other. Four successful matings were timed from genital contact until the pair separated. One mating lasted about 20 min; each of the other 3 lasted exactly 25 min.

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Feeding Responses of Some Noctuid Larvae[1] (Lepidoptera) to Plant Extracts[2, 3]

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ABSTRACT

An arrestant-feeding stimulant obtained from lyophilized plant material was tested on filter paper for preference by larvae of the corn earworm, *Heliothis zea* (Boddie); the fall armyworm, *Spodoptera frugiperda* (J. E. Smith); and the tobacco budworm, *Heliothis virescens* (F.). The response varied among the 6 species of plants tested, the plant portion used, and the species of insect. The ratios of feeding on plant extract to feeding on the untreated controls demonstrated that the preference of all 3 insect species was for extracts of plant fruiting bodies rather than for vegetative parts, an indication that more arrestant was present in the fruiting body than elsewhere in the plant. Although the sugar content in plant material seemed to influence feeding somewhat, in many instances larval preference for some plants and plant parts was due to factors other than presence of sucrose. In general, plant and insect feeding relationships were close to those reported from field observations.

In the past few years, after the discovery that measurable concentrations of a substance or substances in host plants elicited a feeding response or responses in certain insects, several possible areas of investigation in the field of host-plant resistance to insect attack have been suggested. The most notable results have been achieved with the European corn borer, *Ostrinia nubilalis* (Hübner) (Beck 1956); the Mexican bean beetle, *Epilachna varivestis* Mulsant (Lippold 1957); and the boll weevil, *Anthonomus grandis* Boheman (Keller et al. 1962).

A plant extraction technique, modified from that of Maxwell et al. (1963), was used at this laboratory late in 1963. A bioassay of fractions produced by this technique demonstrated that a potent arrestant-feeding stimulant for larvae of the corn earworm, *Heliothis zea* (Boddie), was contained in water-soluble residue of lyophilized corn plant tissue.

The research reported herein is a continuation of 1 phase of the host-plant resistance project at the Southern Grain Insects Research Laboratory. The main objective of this research is to determine the existence and concentration of the arrestant-stimulant, as defined by Dethier et al. (1960), in primary and alternate host plants of several insects. This information about plant preference can possibly be used as one of the criteria in a screening program for plant resistance, as well as to provide valuable information in relation to insect behavior and biology. Ultimately, chemical identification of such materials might enable geneticists and entomologists to breed plants with less of this stimulus to larval feeding.

METHODS AND MATERIALS

In brief, the extraction technique was: (1) 400 g of freshly harvested plant material was blended for 5 min in a Waring Blendor(®),[2] along with 1000 ml of distilled water; (2) the blend was then filtered and the filtrate centrifuged for 15 min at 3000 rpm; (3) the supernatant fluid was decanted into 2000-ml flasks, which were immediately swirled in a dry ice-acetone bath at −70°C; (4) when the contents were frozen, the flasks were lyophilized at an atmospheric pressure of 0.2 mm Hg; and (5) after the contents of the flasks were dry, the residue (water-soluble) was transferred to ½-pint mason jars and stored in a deep freezer until needed.

[1] *Heliothis zea* (Boddie), *Spodoptera frugiperda* (J. E. Smith), *Heliothis virescens* (F.).

[2] In cooperation with the Georgia Coastal Plain Experiment Station. Accepted for publication September 17, 1965.

[3] Mention of a proprietary product does not necessarily imply endorsement of this product by the USDA.