BIOLOGY OF THE COCONUT TWO-COLORED BEETLE, *PLESISPA REICHEI* CHAPUIS

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ABSTRACT

The coconut two-colored beetle, *Plesispa reichei.* Chapuis, underwent 4 developmental stages, namely; egg, larva, pupa and adult. The larval stage had 4 instars with a total developmental period of 49.66 days for the females and 45.11 days for the males. An adult female laid an average of 64.28 eggs at the rate of 1 to 2 eggs per day. The egg is elongate and rounded at both ends. The larva is carabiform while the pupa is exarate. The adult male and female beetles can be differentiated through the depression at the center along the margin of the last abdominal segment which is more prominent in the male than in the female. The beetle can complete its development on the alternate hosts *Borrasus flabellifera, Adonidia merilli* and *Caryota cumingii.*

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KEY WORDS: *Plesispa reichei.* Coconut insect pest. Development. Morphology. Host range.

INTRODUCTION

The coconut two-colored beetle, *Plesispa reichei* Chapuis, inflicts serious damage and consistently causes losses in coconut production (Fandialan and Salisi, 1977). It is a leaf-mining beetle which belongs to the family Hispidae and feeds on both young and mature coconut palms. Chile (1962) reported that the coconut two-colored beetle is an important pest in Malaysia and Indonesia. In the Philippines particularly in Davao City, Davao del Sur, Zamboanga City, Bugsuc Island and Palawan, this insect has long been considered a serious pest of seedlings and young coconuts (Mordeno, 1975).

PCA (1979) and Gabriel (1976) mentioned that both the larvae and adults of *P. reichei* Chapuis are destructive. They feed on both sides of the leaves of young palms. The larvae attack the tissues on the basal half of the leaflets causing blotches while the adults feed on the distal half of the partially folded leaves. Feeding activities of the adult result

in browning of leaves as if scorched by fire. By the time the leaves open, the tissues are already dead and shriveled further decreasing the photosynthetic capacity of affected palms. Affected leaves are easily torn by wind.

In order to develop and implement control procedures, knowledge on the biology of the pest is necessary. Information about its life history, behavior and feeding preferences or host range will be very useful in the formulation of control measures.

MATERIALS AND METHODS

Collection and Mass Rearing of Beetles. — Coconut two-colored beetles in various developmental stages were collected from unsprayed coconut (Baybay Tall variety) seedlings to start a stock culture. Excised coconut leaflets containing eggs and larvae of the insect were placed in plastic bags. Since adult beetles were motile and quite resistant to mechanical damage, they were either hand-picked or collected using insect nets. These were then paired and allowed to mate and oviposit. Eggs were collected, incubated at room temperature and allowed to hatch. The larvae that emerged from the eggs were used for biological studies.

The different stages were reared using excised coconut (Baybay Tall variety) leaflets as food substrate. The leaflets were cut into 7.62 cm (3 in) long pieces and a piece was placed in each rearing jar (10 cm H x 7 cm D). A moistened cotton wad was placed on one end of each leaflet to keep it fresh for a few days. This provided a fresh supply of food for the insect. Each rearing jar was covered with nylon mesh and was secured with a rubber band to prevent escape of the insect.

Life Cycle and Behavior. — The life cycle of *P. reichei* was studied for 2 successive generations. Eggs collected from the stock culture were placed individually on coconut leaflets and were incubated at room temperature. Incubation period, per cent hatchability and changes in appearance from oviposition to hatching of the eggs were recorded.

The larvae were reared individually and were allowed to develop up to the pupal stage. Changes in appearance, number of instars, duration of each stadium, pupal period and total developmental period as well as mortality of the insect were noted.

Newly emerged male and female adults were paired and each pair was placed in a separate rearing jar to determine their feeding and mating behaviors. Male to female ratio and fecundity of females were also determined.

The different developmental stages of *P. reichei* were examined and described with the aid of a stereoscopic microscope.

Determination of Alternate Hosts. — Plants related to coconut or found to be growing in coconut plantations, namely: *Caryota cumingii* (pugahan), *Borrasus flabellifera* (palmyra), *Adonidia merilli*,

Areca catechu (bunga), Corypha elata (buri), *Nypa fructicans* (nipa) and *Leptochloa chinensis* (sprangletop) were tested to determine the alternate hosts of the coconut two-colored beetle.

Twenty-five eggs obtained from the stock culture were placed on pieces of leaflets of plants to be tested. Upon hatching, the first instar larvae were placed in rearing jars provided with leaflets. If the insects were found to feed on the test plants within 24 hours, tests were further carried out to determine whether the insect would complete its life cycle on this particular plant. Biological data obtained when beetle was reared on the alternate hosts were compared with those on coconut.

RESULTS AND DISCUSSIONS

Life Cycle.

The total developmental period of both male and female beetles slightly varied with a mean of 49.66 days for females and 45.11 days for males (Table 1). This observation falls within the life cycle range reported by Lever (1969) which is between 40-64 days.

Oviposition and Incubation Period of Egg.

The female beetle started to lay eggs 33-48 days after emergence. The eggs which were elongated and round at both ends were laid singly on the inner surface of the rearing jar or on the grooves of feeding

Table 1. Duration (days) of the developmental stages of the coconut two-colored beetle, *Plesispa reichei* Chapuis, reared on coconut leaflets.[1]

Developmental Period	Males (46 individuals)		Females (56 individuals)	
	Range	Mean*	Range	Mean*
Incubation Period	6-10	7.61 ± 0.90	7-10	8.10 ± 0.05
Larval Period				
First Stadium	5-9	6.14 ± 0.94	5-10	7.13 ± 1.14
Second Stadium	5-8	6.15 ± 0.81	5-8	6.33 ± 0.86
Third Stadium	5-9	6.59 ± 0.91	6-9	6.92 ± 0.83
Fourth Stadium	5-7	6.47 ± 1.26	6-10	6.85 ± 1.17
Prepupal Period	3-6	4.47 ± 0.61	4-6	4.92 ± 0.94
Total Larval Period	23-39	29.82 ± 3.21	26-43	32.15 ± 2.89
Pupal Period	6-10	7.68 ± 0.83	7-10	7.10 ± 4.82
Total Developmental Period (Egg-laying to adult emergence)	35-59	45.11 + 3.46	40-63	49.66 + 3.46

[1] Data based on 180 individuals successfully reared for 2 generations.

*Mean ± standard deviation.

Fig. 1. Eggs of the coconut two-colored beetle, *Plesispa reichei* (2x).

streaks made by the female beetle on either surface of the leaflets. This shows that females are not always particular about the choice of oviposition substrate.

The egg was coated with a white sticky substance which made it stick to the leaf surface (Fig. 1). When newly laid, it was light golden brown then turned to rust color 2 to 3 days after.

Incubation period lasted for 6-10 days for males and 7-10 days for females (Table 1). Constant movement of the larva caused the egg shell to split at one end. Emergence was accomplished by wiggling motion with the head emerging first followed by the rest of the body.

Larval Development.

The newly hatched larva was

Fig. 2. Different larval instars, i.e., 1st instar, 2nd, 3rd and 4th instar (left to right) of coconut two-colored beetle, *Plesispa reichei* Chapuis (20x).

light yellow, very transparent and delicate. It did not feed immediately after hatching but started crawling over the leaf surface. It started to feed the following day.

The larva was carabiform with a dorso-ventrally flattened body (Fig. 2). Spine-like protuberances were found along its sides. The last segment of the abdomen bore a forcep-like process. The first instar larva was hyaline, transparent and yellowish white. The second instar larva was lemon colored while the third and fourth instar larvae were pale yellow and light golden brown, respectively. The fully grown larva was golden brown, relatively inactive and ceased feeding when it entered the prepupal stage. The head capsule was slightly retracted into the thorax and the abdomen expanded due to the retraction of segments into each other, thus giving the prepupa a shrunken appearance (Fig. 2).

In all instars, the larva ceased feeding for a few hours prior to molting. The whole body rhythmically expanded and contracted until a longitudinal slit was made on the dorsothoracic region. The newly molted larva did not feed immediately. It took a few hours before the cuticle hardened and sclerotized.

Pupation.

Pupation was initiated when a slit was made on the dorsothoracic region of the prepupa. The old cuticle was shed off by a wiggling motion. Only the anterior portion of the exuvia was separated from the body. The rest of the exuvia remained attached to the posterior

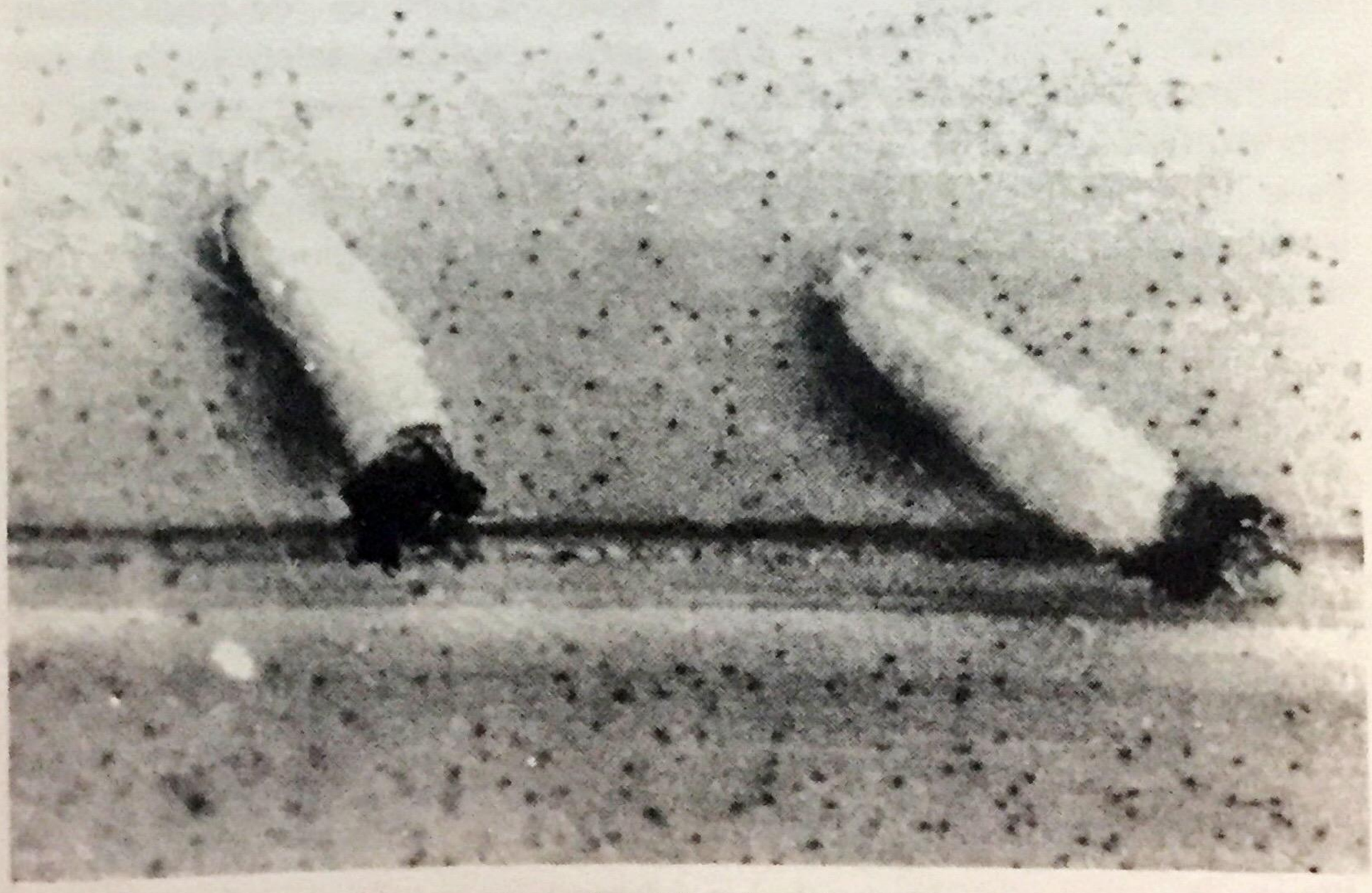

Fig. 3. Pupae of the coconut two-colored beetle, *Plesispa reichei* Chapuis (2x). Note remains of the exuvia on one end of pupa.

portion of the abdomen until adult emergence.

The pupa of *P. reichei* was exarate (Fig. 3) and its total length ranged from 8.0 to 9.5 mm. When newly emerged, the color was pale yellow but turned brown after one day until adult emergence. The head which bears the mouth parts, compound eyes and antennae became black and very prominent 2 days prior to adult emergence.

The average duration of the pupal period was 7.68 and 8.64 days for males and females, respectively.

Adult Emergence and Sex Ratio.

The constant movement of the mature beetle caused the anterior portion of the pupal case to split allowing the adult to emerge. The head emerged first followed by the antennae, middle and hind legs, then the rest of the body.

Upon emergence, only the mouthparts, antennae and the tarsal segments were blackish while other parts of the body were pale golden brown. During this time, the beetle was inactive and soft but the

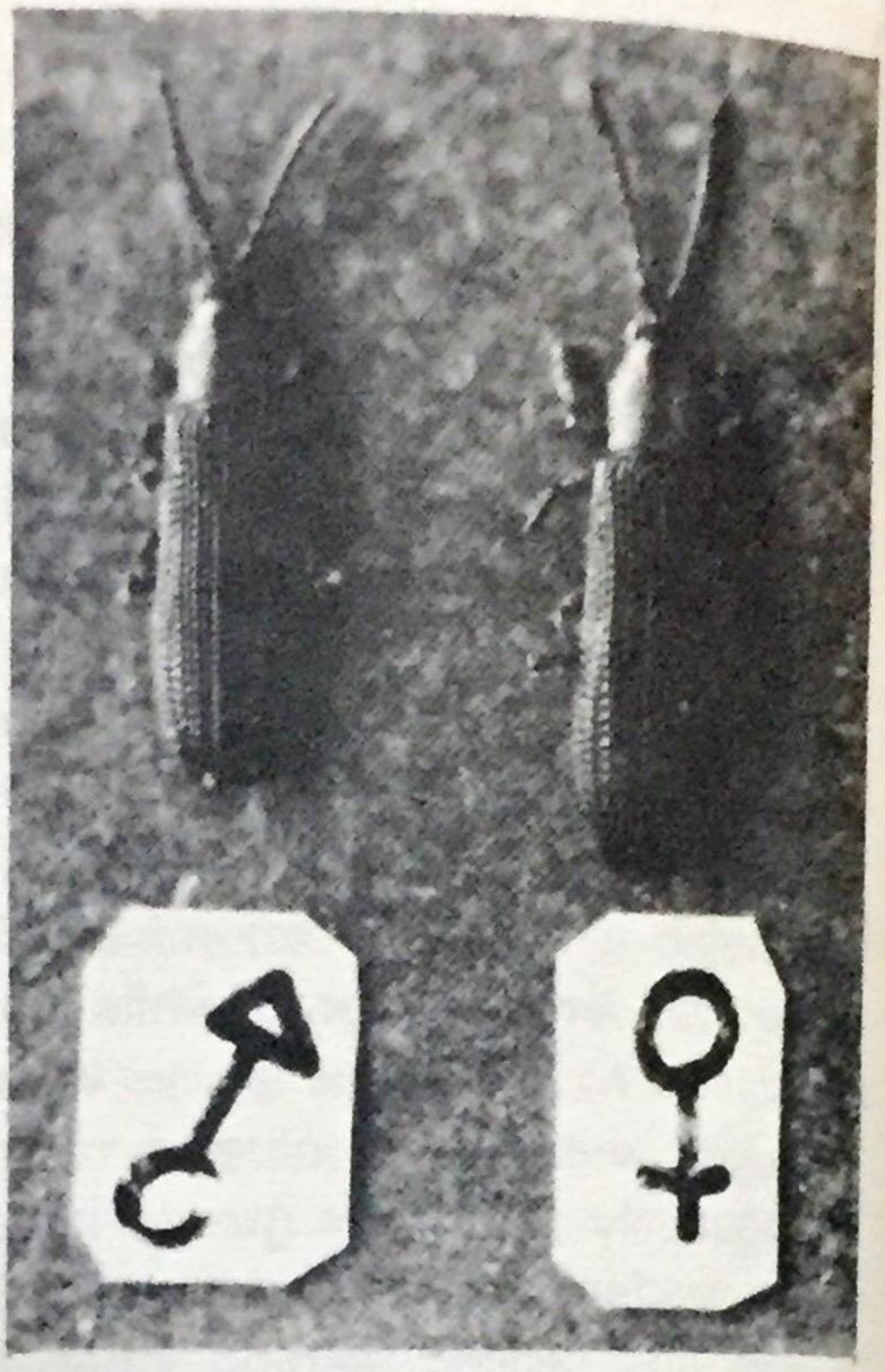

Fig. 4. Male (A) and female (B) adults of coconut two-colored beetle, *Plesispa reichei* Chapuis (5x).

antennae kept on moving as if orienting itself to the environment until completely sclerotized. A few hours later, the head capsule, elytra and the ventral abdominal portion turned blackish brownish leaving the thoracic region, femora and tibias yellow.

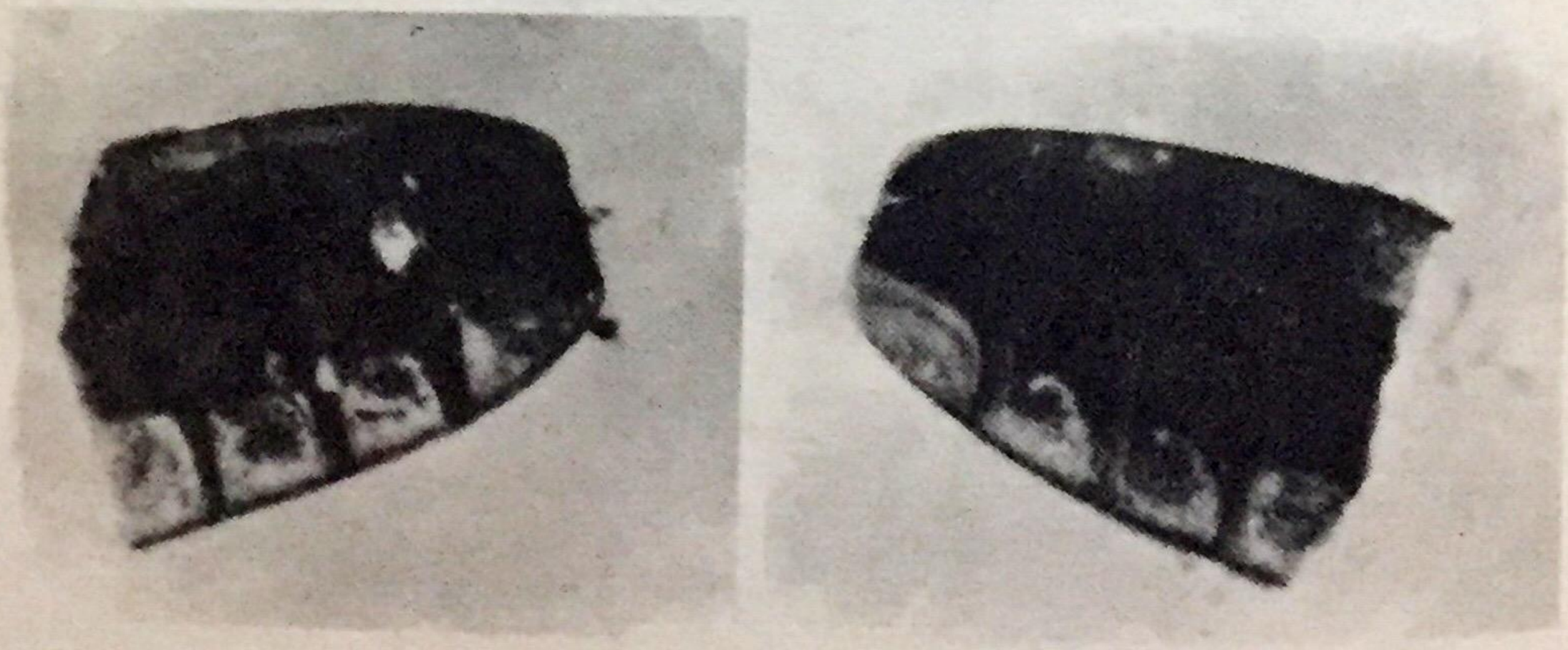

Fig. 5. Photomicrograph showing the last abdominal segment of male and female (left to right) coconut two-colored beetle (100x).

The adult female was generally bigger than the male (Fig. 4). Both male and female adults had filiform 11-segmented antennae. The abdomen had 5 distinguishable segments visible on the ventral side. The depressions at the center of the last abdominal segment was more pronounced in the male than in the female (Fig. 5).

Out of the 160 larvae reared individually, only 102 or 61.15% reached the adult stage. There were 56 females and 46 males giving a male to female ratio of 1:1.21, the usual sex ratio among insects.

Feeding Behavior.

Adults started feeding on the coconut leaflets a few hours after emergence. They fed on either surface of the leaf by making vertical grooves or streaks. The beetles fed on the entire leaf but had a preference for that portion of the leaflet distal to the cotton wad.

Fecundity of Females.

Female beetles laid 1 to 2 eggs per day. However, egg laying was not continuous since there were days when no eggs were laid. The number of eggs laid per female beetle varied from 26 to 115 with an average of 64.28 eggs (Table 2).

Mortality.

A total of 23.54% mortality of the beetle was recorded (Table 3). Since the first instar larvae were less sclerotized and more delicate, they were prone to mechanical damage, thus causing high mortality. As growth progressed, the insects became more sclerotized and were less prone to mechanical injury thus showing lower percentage mortality than the earlier instars.

Alternate Host Plants.

Only 3 plant species all belonging to Family Palmae proved to be alternate hosts, namely: *C. cumingii, B. flabellifera* and *A. merilli*.

The beetle reared on *C. cumingii* had the longest life cycle followed by those reared on *C. nucifera, B. flabellifera* and *A. merilli* (Table 4). Fourth instar larvae of beetles reared on *C. cumingii* had longer develop-

Table 2. Average fecundity and per cent hatchability of the coconut two-colored beetle, *Plesispa reichei* Chapuis, reared on 4 host plants.

Host Plant	Fecundity (No. of Eggs/Female)	Per cent Hatchability
Cocos nucifera	64.28	88.89
Caryota cumingii	36.91	91.67
Adonidia merilli	28.42	72.22
Borrasus flabellifera	24.66	82.61

*Data based on 2 successive generations.

Table 3. Mortality (%) of the coconut two-colored bettle reared on 4 host plants.

Developmental Stage	Mortality (%)			
	*C. nucifera***	*A merilli**	*B. flabellifera**	C *C. cumingii**
First Larval Instar	13.12	15.79	15.38	13.04
Second Larval Instar	7.81	0	0	10.52
Third Larval Instar	0.86	6.25	10.00	6.25
Fourth Larval Instar	0.87	0	0	7.69
Prepupa	0	0	0	0
Pupa	0.91	0	0	0
Adult	0	0	0	0
Total	23.54	22.04	25.38	37.50

*Data based on 25 insects reared per host plant.
**Data based on a total of 180 insects for 2 successive generations.

mental period. Such results could have been due to the presence of certain substances or chemical constituents in the host plant that might have retarded the development of the beetle.

Beetles reared on *B. flabellifera* had a longer total developmental period than those reared on the primary host, *C. nucifera*. On the other hand, *A. merilli* seemed to favor faster development of the beetle than its primary host. This may indicate that the presence of some chemicals in *A. merilli* slightly favors faster development of the beetle especially during the larval period. However, *P. reichei* was not found to attack *A. merilli* in the field. This may be because *A. merilli* does not possess a feeding attractant which compels attack by the pest.

No exuviae were observed when second instar larvae feeding on *B. flabellifera* and *A. merilli* developed into the third instar. However, there was an observed increase in size of the larvae. This is a good indication that the larva underwent another molting since insects could only increase in size after molting. The larvae might have eaten their own exuviae.

The highest fecundity was obtained in females reared on *C. nucifera* followed by those reared on *C. cumingii, A. merilli* and *B. flabellifera* (Table 3). Per cent hatchability was highest in eggs laid in *C. cumingii*, followed by those on *C. nucifera, B. flabellifera* and *A. merilli.*

Beetles reared on *C. cumingii* had the highest mortality rate. As in the primary host, the per cent mortality of the beetles decreased as

Table 4. Comparison of the average duration (days) of the different developmental stages of the coconut two-colored beetle, *Plesispa reichei*. Chapuis reared on 4 host plants.

Developmental Stage	Duration (days)			
	C. nucifera *	*C. cumingii***	*B. flabelliferа***	*A. merilli***
Incubation Period	8.09	8.89	8.33	8.75
Larval Period				
First Stadium	6.94	7.33	5.75	4.62
Second Stadium	6.38	6.78	7.08	7.75
Third Stadium	6.89	8.44	3.71	3.73
Fourth Stadium	6.67	16.44	8.07	6.50
Prepupal Period	4.48	4.30	5.67	5.12
Total Larval Period	31.36	43.29	30.17	27.72
Pupal Period	7.96	7.22	9.08	9.12
Total Developmental Period (Egg-laying to adult emergence)	46.96	59.40	47.83	45.59

*Data based on 2 successive generations.

** Data based on 25 insects reared per host plant.

development progressed. The later instars were more resistant to damage due to handling than the earlier instars. There were abnormalities observed in some adults that emerged from individuals reared on *B. flabellifera*. This may indicate that *B. flabellifera* lacks the essential food requirements for normal development of the insect. Hence, this plant could be considered the least favorable alternate host among the plants tested.

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