THE PRESENT STATUS OF COCOA BEE BUG, *Platyngomiriodes apiformis* GHAURI, IN SABAH AND ITS LIFE CYCLE STUDY.

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Introduction

Cocoa (*Theobroma cocoa* L.) is still a comparatively new crop to Sabah. In the beginning of 1950 a few small cocoa trial plots were introduced and established in Sabah on various soil types by the Department of Agriculture. The first commercial planting only began sometime in 1956 in Tawau. The first cocoa research station was then established in 1957 by the Department of Agriculture. For the next two decades there was little interest expressed in the crop and by 1975 only about 24,000 acres had been planted with cocoa. In the last 4 years, the unusually high price of cocoa beans had stimulated a great interest in the crop and the commercial planting acreage increased rapidly, now totalling about 95,000 acres.

Normally, a new crop planted in a new area especially adjacent to the forest would be subjected to a wide range of pest attack. The majority of them will be indigenous, occurring naturally in the primary forest. Bee bug, *Platyngomiriodes apiformis*, is one example.

Platyngomiriodes apiformis was first recorded on cocoa in Sabah in 1962. The species was described by M.S.K. Ghauri (CIE) as a new species in 1963. The adult bug looks like a small bee and hence the common name: "Bee Bug". It is now a cocoa pest of considerable importance. However, it has not been reported as a cocoa pest elsewhere in Malaysia.

Distribution and infestation

Platyngomiriodes apiformis was found feeding on cocoa pod in the first cocoa estate (Borneo Abaca Ltd.) in Tawau in 1962 and the following year at the Cocoa Research Station in Quoin Hill, Tawau. An investigation had been made on the infestation and distribution of bee bug in cocoa plantations in 1979 and 1980 which indicated that the bee bug is fairly well distributed in the Tawau district but is absent in other areas or districts. (See Fig. 1). In some fields at Quoin Hill, sometimes the bee bug becomes more abundant than the other mirid species, *Helopeltis clavifer* Wlk., which has generally spread throughout Sabah.

The infestation is usually confined to pods under dense, shady and older cocoa trees. The bee bug occasionally attacks the fan branch and chupon. As in the case of *H. clavifer* the infestation tends to be localized. The number of bee bugs fluctuates from season to season, and they are usually more abundant in the field between April to May and September to October. (Fig. 2).

The damage caused by *P. apiformis* to cocoa pod is usually more severe than that caused by *H. clavifer*. Besides the feeding which causes bigger lesions, the secondary infestation of fungus may cause the pod to turn brown and further decay which would result in the destruction of the inner beans. Young pods, especially those in the early cherelle stage are most susceptible to the bee bug attack. If the field is left untreated, it may cause serious damage and result in lower yield of cocoa.

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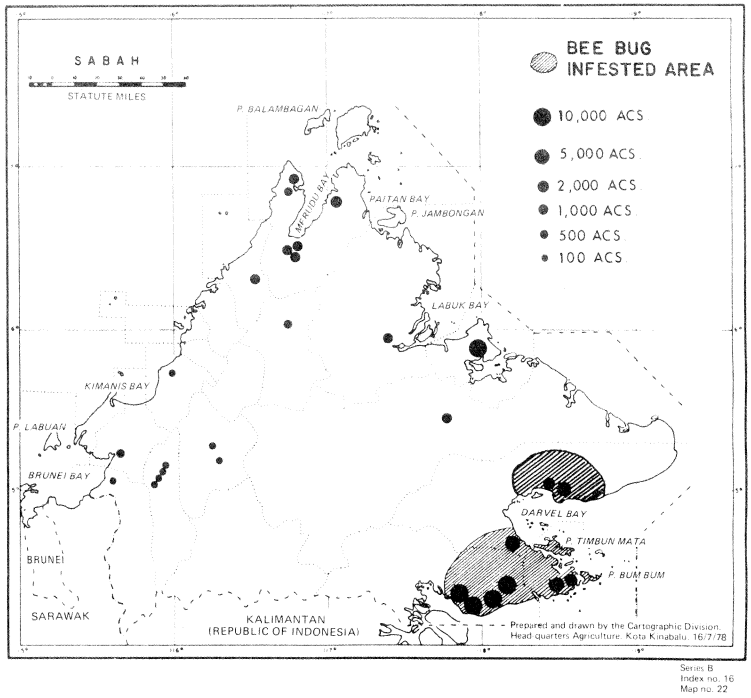

Fig. 1 Distribution of *P. apiformis* and cocoa planting area

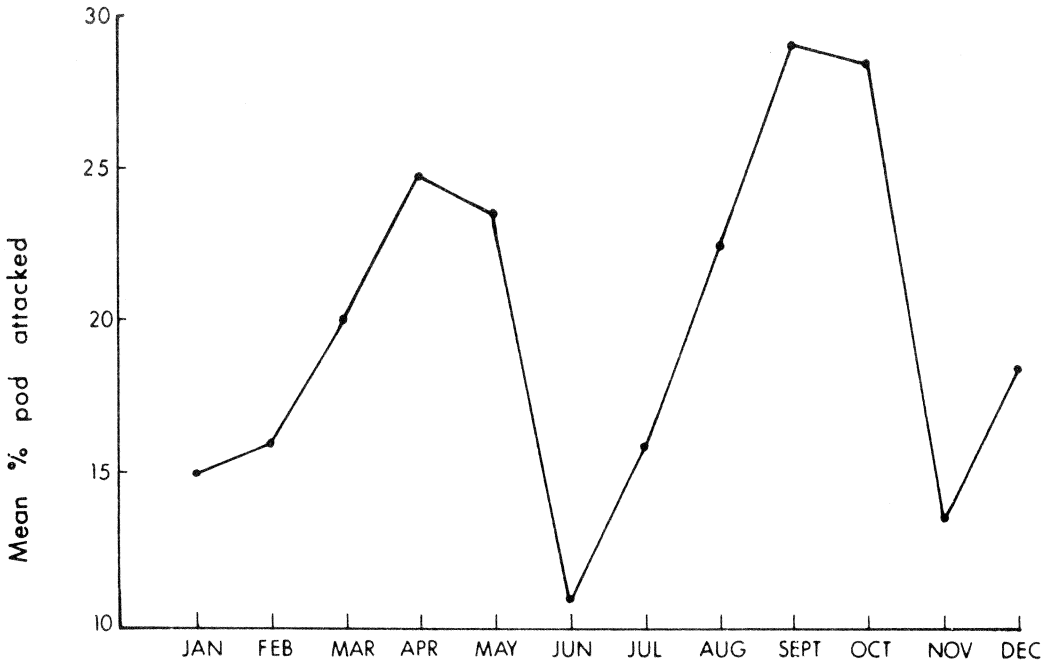

Fig. 2 Population fluctuation of *P. apiformis*

Materials and methods

Breeding works were carried out in Cocoa Research Station, Quoin Hill.

1 Laboratory

Mature cocoa pod was submerged with the stalk in water in a beaker and then put into a screened cage measuring 30 cm × 30 cm × 51 cm (Fig. 3 (a) and (b)). Bee bugs (the 5th instar nymph or adult) collected from the field by hand or captured by glass tube were transferred into the screened cage. The cocoa pods in the cage were changed every three days. If eggs were laid on the pod, they would be taken out of the cage for observation until the first instar larva hatched out. Another fresh mature pod would be arranged and attached to the old pod. After the young larvae crawled over to the new pod they would be caged for further observation later on.

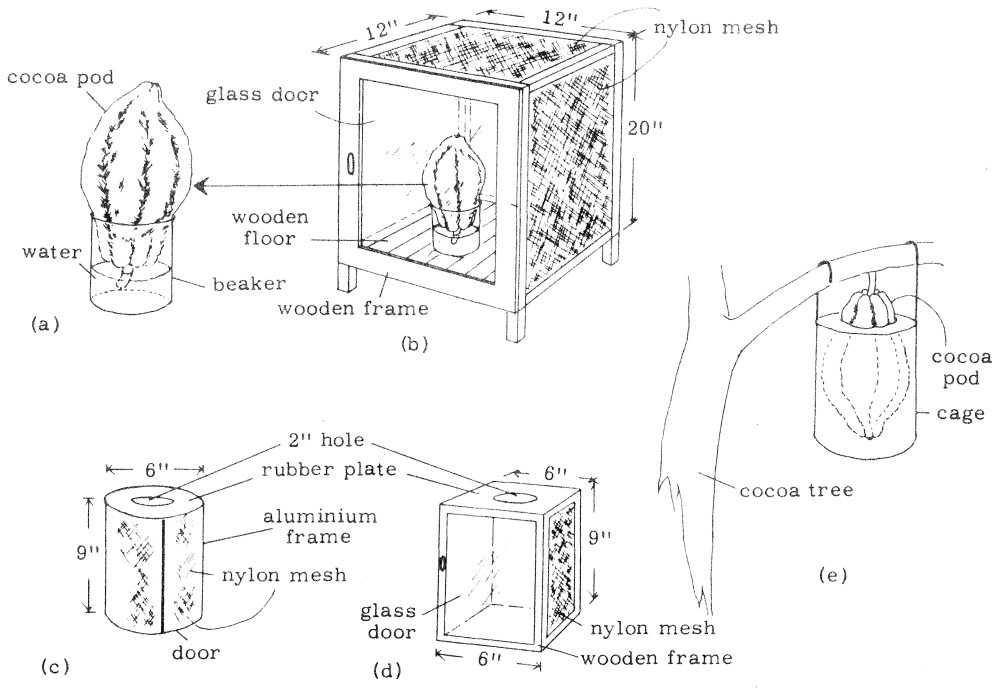

Fig. 3 Breeding cages

2 Field

Mature cocoa pod still attached to the tree was caged inside the screened or nylon-meshed cage hung on the tree. (See Fig. 3 (c), (d) and (e)).

Two types of cages were used for rearing in the field. Both types of cages (15 cm × 15 cm × 23 cm in size and a cylinder of 15 cm diameter and 23 cm in height) are covered by a nylon mesh except for the upper side which is covered by a rubber plate with a 5.1 cm diameter hole in the center.

The mature cocoa pod was pushed into the cage through the rubber hole. In order to prevent the insects from escaping or crawling in from outside, the cocoa pod was only about 3/4 inside the cage, so that the expansion of the rubber hole could hold tight around the cocoa pod at the 1/4 level. The cage would also be hung on the branch by a string.

Adult of *P. apiformis* captured from the field would be released into this nylon-meshed cage for observation, egg-laying and other breeding purposes.

Results

1 Egg (Fig. 4)

The egg is somewhat cylindrical in shape, about 1.5 mm in length. It is sharp and hard at the end which normally protrudes above the pod tissue. One week after the egg has been laid, 2 hair-like processes can be seen protruding out of the hard end.

The egg is laid singly and perpendicularly into the cocoa pod tissue with spines protruding above

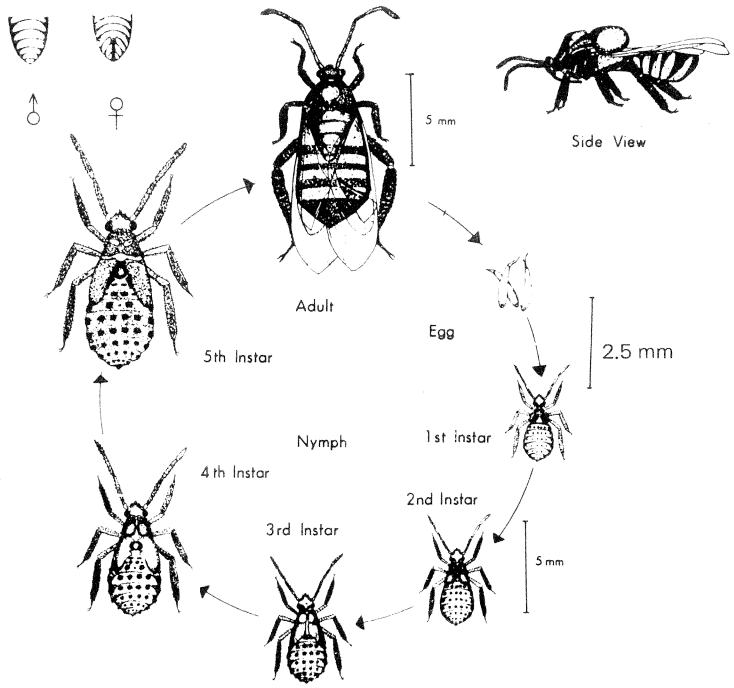

Fig. 4 Life cycle of *P. apiformis*

the surface. These fine spines can easily be felt by slipping the finger across the pod surface and they can also be seen with the naked eye under favorable conditions. Results obtained have indicated that the incubation period of the egg stage ranges from 14 ~ 15 days with a mean of 14.35 days. (Table 1).

Table 1 Results of life cycle study of *P. apiformis* in laboratory & in the field cages

Stage	Egg (day)		Nymph (day)		Adult (day)		Total (day)	
	Range	Average	Range	Average	Range	Average	Range	Average
Laboratory cages	14–16	14.56	18–25	20.75	6–21	13.80	38–62	49.11
S.E.		0.17		0.06		1.48		
Field cages	14–15	14–35	19–26	21.34	17–39	26.86	51–80	62.56
S.E.		0.17		0.49		1.87		

2 Larva (Fig. 4)

The newly hatched larva is reddish in colour and will gradually turn darker. The body is covered with a series of large red tubercles from which clear, liquid droplets are excreted. Normally the hatching process would take 6 to 10 minutes to be completed. Before hatching takes place, the egg slowly wriggles to the surface of the pod. This movement will continue until most part of the egg has protruded out of the pod tissue. Soon afterwards, the egg will split and the young larva crawls out. It will rest for 1 to 2 minutes before moving around. The body length of the newly hatched larva measures about 0.3 mm to 1.2 mm. Each newly moulted larva is reddish in colour and will rest for 1 to 2 minutes before crawling away.

The larva is like the adult, feeding gregariously on the base of the pod, in shallow or any protected dark places. It is quite active during the day. When disturbed, it will quickly run to the back of the pod or crevices or between pods for hiding. Due to the above habit, the feeding area is concentrated on the upper part of the pod which is shaded or attached to other pods or leaned on the trunk or branch.

The results obtained for the duration of each instar are summarized in Table 2. The larva passed through 5 instars before reaching the adult stage. In the laboratory, the first 3 instars normally take more or less the same length of time i.e. 3.24, 3.29 and 3.72 days respectively. The fourth and fifth instars take 4.9 and 5.6 days. In the field, the first 3 instars take a slightly longer period than in the laboratory but the last 2 instars take less time.

Table 2 Duration of each instar of *P. apiformis* both in laboratory and in the field

INSTAR	1st INSTAR (day)	2nd INSTAR (day)	3rd INSTAR (day)	4th INSTAR (day)	5th INSTAR (day)	1–5th INSTARS (day)
Laboratory cages	3–4	3–5	3–5	4–5	5–6	18–25
(mean)	(3.24)	(3.29)	(3.72)	(4.9)	(5.6)	(20.75)
Field cages	4–6	3–5	3–4	4–5	5–6	19–26
(mean)	(4.56)	(3.76)	(3.4)	(3.96)	(5.44)	(21.34)

The results also indicated that the larval stages in the field are about one day longer than in the laboratory as shown in Table 1 and Table 2.

The change in dimensions of the different instars is summarized in Table 3. It is shown that the growth of the body occurs both in length and width. The average size of the first instar larva was about 1.67 mm in length and 0.94 mm in width while the 5th instar nymph was about 6.4 mm in length and 3.54 mm in width.

Table 3 Change in dimensions of different nymphal instars of *P. apiformis*

	Length of body (mm)		Width of body (mm)	
	Range	Average	Range	Average
1	1.3–1.9	1.67	0.6–1.4	0.94
2	2.0–3.5	2.92	1.4–2.1	1.9
3	4.0–4.5	4.18	2.3–3.0	2.64
4	4.5–5.5	5.20	3.0–3.8	3.52
5	6.0–7.0	6.4	3.5–3.8	3.54

3 Adult (Fig. 4)

(1) The bee bug is a delicate insect. The adult is about 8 mm long and the wing span is 12 mm wide. The hairy four-segmented antenna is filiform and measures about 6 mm. The body of the adult is robustly built with prominent eyes, hairy stripes on the abdomen and a humped scutellum at the base of the wings. The general colour is reddish black. Because of its general shape and the hairy body, especially the hind tibiae, it resembles an ordinary small bee.

The male bee bug is smaller in size than the female. The abdomen of the male is more flat while that of the female is swelled and usually becomes oval in shape. The aedeagus of male is concealed in the body and not easily seen by the naked eye. On the other hand, as part of the ovipositor is appended to the abdomen, the male and the female are easily differentiated.

(2) General feeding habit

The feeding habit is similar to that of the nymph which normally feeds gregariously at the back of the pod or any shallow places. It is active throughout the day.

When disturbed while feeding, it usually drops instantly and flies around but will in most cases come back to the same place where it has fed before, if it is not disturbed again. It usually feeds continuously on one spot for 4 to 6 minutes. The portion of the cocoa pod on which the bee bug has been feeding is marked by small fluid-soaked spots which change to brown and then black lesions. The sunken lesions eventually may be invaded by secondary fungal infection, producing large patches of cracks and very often powdery scab and raised to black and rotten pods. Occasionally the adult bee bug attacks the chupon and fan branch as well.

(3) Mating and egg-laying

Mating usually begins 5 to 6 days after emergence, mainly in the morning, but it is not necessarily restricted to that time of the day. While mating, the male mounts the female and after the aedeagus is locked in position, the male and female will turn round, facing away from each other. Mating seems to take place more than once in a life span. It has been recorded twice during the observation period. The time of copulation varies from 12 ~ 24 minutes. They mate several times during the period and mating has been observed to take place 3 times within two hours.

Two to three days later (about 8 days after emergence), the female starts to lay her first egg using the ovipositor which penetrates directly into the pod tissue but sometimes, before doing so, she uses her mouth part to pierce or make a puncture to the pod first before inserting her ovipositor into the same portion to lay the egg. To lay one egg usually will take about 45 to 60 seconds. The majority of the eggs laid have been found to be more concentrated in the infested parts or lesions of the pod. This is probably due to their being more visible in the position or perhaps this portion becomes the site of the typical lesion caused by puncture and feeding by the female before the ovipositor is inserted into the tissue for egg-laying.

(4) Duration

As indicated in Table 1, the adult stage usually lasted for about 17 to 39 (26.86) days in the field cage and for about 6 ~ 21 (13.80) days in the laboratory cage. This is about a 13-day difference between the two conditions.

(5) Fecundity and fertility

The results of the fecundity and fertility study have indicated that individual female (in the cage) may lay between 13 to 180 eggs with a mean of 71.6 eggs and 15% to 97.8% were fertilized with 10% to 70% hatched. (See Table 4).

(6) Sex ratio

The results show that the ratio of male and female is almost equal (1 : 1).

Table 4 Number of eggs laid per female and percentage of fertilization

No. of females	No. of eggs laid per one female		% of fertilization		% Hatched
	Range	Average	Range	Average	
20	13–172	71.6	15–95	68.1	10–70%

Discussion and conclusion

P. apiformis has not spread throughout Sabah probably due to the slow development of the cocoa industry in the past (before 1975) and most of the cocoa plantations are developed in isolated and newly cleared areas. At the present rate of development of the cocoa industry, especially in the East Coast of Sabah, this pest is likely to spread in the future.

P. apiformis can be more easily reared in a cage with the cocoa pod on the tree in the field than in the laboratory. The adult can have a much longer life span in the field cage. This is probably due to the food supply not being always fresh and being disturbed or removed too frequently while changing pod in the laboratory. Further studies are needed to clarify this point.

At present, the extent of economic damage caused by the bee bug is difficult to assess. However the other mirid species in other countries in Africa, because of their large numbers, are generally considered as serious pests. It was reported in Papua New Guinea that a similar species (*Pseudodoniella laensis*) could cause 60 ~ 80% of crop loss through the damage mainly to pods. At present in Sabah, the damage is not so extensive because the population is low and not yet widespread. Nevertheless, in order to minimize the damage, chemical control is generally applied whenever the insect number is considered high.

Lindane is still being used in Sabah. Resistant strains of mirids have not yet been reported. This may be due to the very limited use of Lindane spraying (the integrated control measure is always encouraged by the Department of Agriculture in Sabah).

Spraying is usually carried out by using Lindane (0.1% active ingredient) applied by mist-blower, or motorized sprayer, at a rate of about 135 litres of water mixture (0.1% ai.) for one hectare.

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Discussion

Kiritani, K. (Japan): 1) I would like to know if there are other host plants in addition to cocoa 2) Could you define the relationship between the length of the life cycle and the fluctuations in the insect population?

Answer: 1) So far no natural host plants other than cocoa have been identified. Although the cocoa fields are located near the jungle, the insect has not yet been recovered on any of the plants so far examined there. 2) It is very difficult to define the relationship between the length of the life cycle and the fluctuations in insect population owing to the overlapping of generations due to the absence of seasons, the fluctuations in fecundity possibly related to the fruiting season of cocoa, the weather conditions and the activity of natural enemies such as predators and parasites.

Kajiwara, T. (Japan): Do you have any information on the kinds of fungus which attack the pod after the insect injury? Judging from the symptoms, it seems that the damage by the fungus is more severe than that caused by the insect itself. Could *Phytophtora* be transmitted by the insect?

Answer: Several fungi have been isolated, among which are *Phytophtora* (possibly *P. palmivora*).