CRYPTOPHLEBIA ENCARPA (MEYRICK) (LEPIDOPTERA:TORTRICIDAE) AS A PEST OF CACAO PODS IN THE NORTHERN PROVINCE OF PAPUA NEW GUINEA

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ABSTRACT

Cryptophlebia encarpa *is a minor pest of cacao pods in the Northern Province of Papua New Guinea. The damage caused by this species has however become increasingly conspicuous in recent times following the control of other pod-damaging insects through the use of insecticides.*

The larvae feed on the epicarp and less frequently penetrate the mesocarp and feed on the endocarp of the cacao pod. Death of an attacked pod may result from penetration of the mesocarp by the larvae and subsequent fungal infection of the endocarp and seeds.

High infestation levels are positively associated with increased abundance of large, maturing cacao pods, the abundance of which is characteristically seasonal.

Under laboratory conditions, the duration of the larval stage is 13 *to* 15 *days and the pupal stage* 8 *to* 11 *days. Mean adult longevity is* 4.3 *days.*

INTRODUCTION

Insect pod borers of *Theobroma cacao* recorded from Papua New Guinea include the lepidopterous tortricid borers *Laspeyresia* sp. (Froggatt 1938), *Olethreutes* sp. (Szent-Ivany 1961; DASF 1968; Anon. 1969) and *Cryptophlebia encarpa* (Meyrick). Other insects injurious to cacao pods include numerous species of cacao leaf-eating lepidoptera which at times may feed on the epiderm of cacao pods (Szent-Ivany 1961). The larvae of the cacao weevil borer, *Pantorhytes szentivanyi* Marsh. may attack cacao pods, penetrating the mesocarp and feeding on the pulpy layer around the seeds. Adults also may feed on the epiderm of cacao pods (Entwistle 1972). The tipulid *Limonia* sp. has also been recorded feeding within the cacao pod epicarp (DASF 1968).

In the Northern Province of Papua New Guinea cacao pods normally suffer extensive damage from the mirid *Helopeltis clavifer* Walk. and to a lesser extent from the coreid *Amblypelta theobromae* Brown. In recent years these pests have been effectively controlled by the use of insecticide sprays or dusts containing lindane. With the continued and prolonged use of lindane, *C. encarpa* has became increasingly conspicuous as a pest of cacao pods. Damage however continues to be of little economic importance and to date it has not warranted control.

Bradley (1960) lists the distribution of *C. encarpa* as South India, New Hanover Island, Sudest Island and Guadalcanal. The same, or closely related species of *Cryptophlebia*, has also been recorded from New Britain feeding on the epiderm of cacao pods (Szent-Ivany 1963; Entwistle 1972).

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DAMAGE

The larvae of *C. encarpa* damage cacao pods at all stages of development. The severity of the damage varies with the stage at which the pod is attacked, the depth of penetration by the larva (*Table* 1) and the number of larvae attacking individual pods (*Table* 2). The cacao pod invariably dies if the larvae penetrate the mesocarp and feed on either the endocarp or developing seeds.

Feeding on the epicarp does not harm the seeds of large cacao pods, but the damage to these tissues invariably leads to secondary fungal infection (*Plate* IA). This renders pods so attacked unsightly, and causes their neglect at the time of harvest because they resemble pods infected by black pod (*Phytophthora palmivora*).

In the case of young pods, feeding on the epicarp can lead to death of pods as secondary fungal infections can pass through the unhardened mesocarp and infect the seeds.

Penetration of the mesocarp by *C. encarpa* larvae usually only occurs in small pods in which the mesocarp has not hardened. The mesocarp at the distal end of the pod appears far easier for the larvae to penetrate for a longer period than the remainder of the mesocarp.

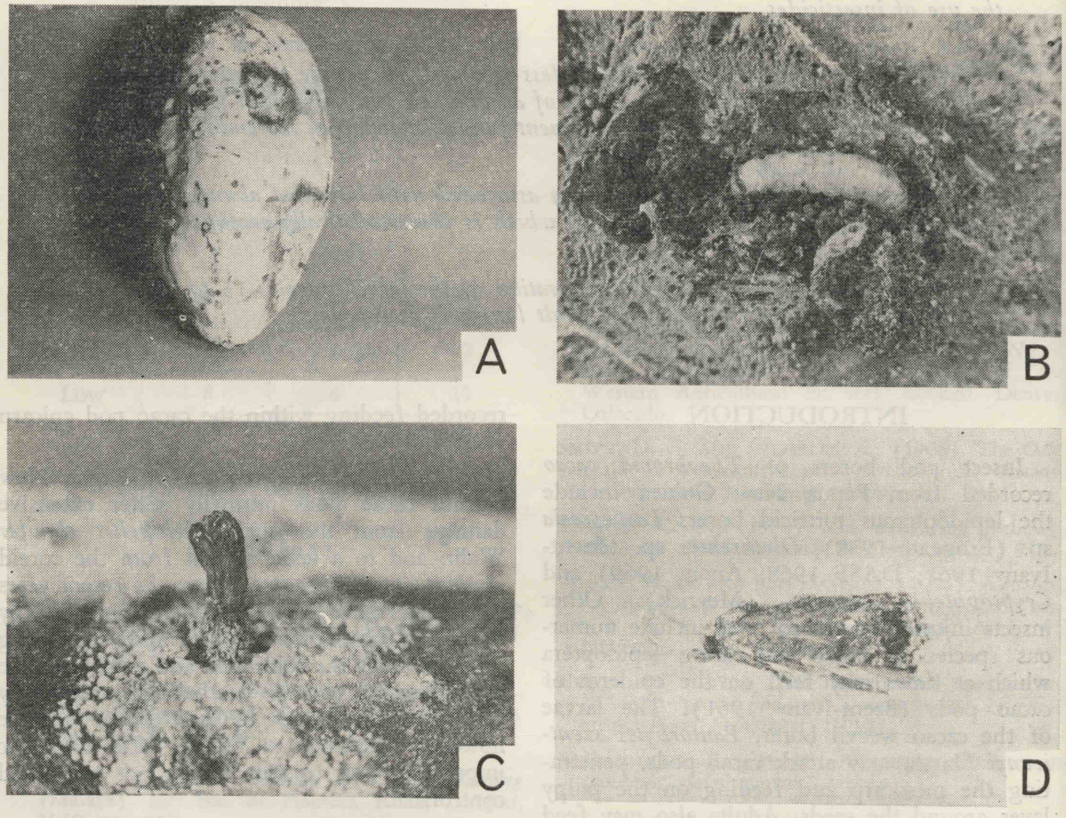

Plate I.—*Cryptophlebia encarpa*. A. Empty pupal case protruding from attacked cacao pod, and surrounded by tissue infected by secondary fungi. B. Final instar larva in channel in cacao pod epicarp. x 2. C. Empty pupal case protruding from cacao pod after emergence of adult. D. Adult female. x 2.5

Table 1.—Number of cacao pods, with maximum penetration by C. *encarpa* larvae to tissue layer indicated

Tissue layer penetrated	Epicarp	Mesocarp	Endocarp	Seeds	TOTAL
Pod size Small (< 10 cm)	29	3	2	9	43
Medium (10-15 cm)	35	0	0	9	44
Large (> 15 cm)	49	0	1	6	56
TOTAL	113	3	3	24	143
As %	79.0	2.1	2.1	16.8	

Table 2.—Number of cacao pods attacked by varying numbers of C. *encarpa* larvae

	Number of pods attacked						
	1	2	3	4	5 or more/no.	Total Pods	Total Larvae
Pod size:							
Small	24	17	6	2	2/11	51	95
Medium	29	23	18	11	10/72	91	245
Large	33	15	14	16	2/14	80	183
Total Larvae	86	110	114	116	97		523
As %	16.5	21.0	22.8	22.2	18.5		
Total Pods	86	55	38	29	14	222	
As %	38.73	24.8	17.1	13.1	6.3		

The maximum extent of tissue penetration by *C. encarpa* larvae in samples of pods of various sizes is shown in *Table* 1. It can be seen that the mesocarp was penetrated in only 21 per cent of cases, most of which were small or medium sized pods.

There is no obvious direct correlation between incidence of attack and crop loss. A conservative estimate would be that between 50 to 70 per cent of pods attacked fail to reach maturity and of the 30 to 50 per cent that do reach maturity, most are not harvested.

BIOLOGY OF *C. ENCARPA*

Eggs

The egg stage is unknown. Oviposition has taken place under laboratory conditions as larvae have been bred in cacao pods placed with females reared from field collected larvae and pupae. However, no eggs which could be confirmed as being those of *C. encarpa* were observed in these instances.

Larvae

Four adults which emerged from pupae on 22nd July, 1971 were placed in a breeding cage with mature cacao pods. All adults died over a period of seven days. Six days after the death of the last adult minute amounts of frass were found exuding from two larval channels in the cacao pods. The channels measured 4.3 and 5.9 mm in length and both were 0.5 mm in width. These larvae are believed to have been first instar larvae as no frass had been observed prior to the twelfth day after the introduction of the adults into the breeding cage.

The two larvae measured 1.46 and 1.61 mm in length and their head capsules both measured 0.25 mm in width. The body of the larvae was a pale yellow-lime whilst the head capsules were black in colour. There was a prominent though paler coloured prothoracic shield on the first thoracic segment.

The adfrontal area of the head capsule was very short with the lateral part of the head capsule posterior to the adfrontal suture flaring back to give the head capsule a distinctly heartshaped appearance.

Two days after being first observed the larvae underwent ecdysis to enter the second instar. The larvae were similar in appearance to first instars and measured 5.1 and 7.3 mm in length. Their head capsules measured 0.90 and 1.06 mm in width respectively.

The dorsal posterior border of the head capsule was much straighter, lacking the medial V-shaped border found in the first instar. The body remained yellow-green in colour.

The larval channels had been extended to 20 and 32 mm in length and had widened to 4 mm.

Ecdysis occurred six days later after which the larvae attained a size similar to that of field-collected final instar larvae.

The two larvae pupated after a further five and seven days respectively, giving a total larval development period of between 13 and 15 days. This excludes the small amount of development which would have occurred prior to the channels being first observed.

There is a marked change in the appearance of larvae between the second and third (final) instar.

In the final instar (*Plate* IB) the head capsule lightens in colour to a pale brown, whilst the prothoracic shield remains black. The body changes from a yellowish green to an orange colouration tinged with mauve. There is a pair of brown spots on the dorsal surface of each of the body segments.

The head capsule width of final instar larvae ranged from 1.2 to 2.0 mm (mean 1.75 mm: 17 larvae). Body length varied from 11.5 to 14.7 mm (mean 13.8 mm : 17 larvae).

Channels occupied by final instar larvae measure from 40 to 65 mm in length and vary between 10 and 28 mm in width. The channels, even when extensively broadened, remain relatively shallow and are usually no deeper than the thickness of the incumbent larva's body.

Pupation

Final instar larvae move towards the surface of the pod and enlarge the channel's entrance before spinning a cocoon within the channel and pupating. The outside of the cocoon is characteristically covered by small frass pellets and other debris from within the channel.

Spinning of the cocoon is usually completed within two hours. The larva remains as a pre-pupa within the cocoon for a further one to two days before pupating.

Adult Emergence

During emergence of the adult the pupa is drawn through the thin fabric of the cocoon by the semi-emerged adult and is dragged along the larval channel to the surface where the anterior third of the pupa remains protruding from the channel entrance after the adult has completed emergence (*Plate* IA and IC).

The pupal period lasts from 8 to 11 days (mean 9.9 days : 10 pupae).

Longevity of Adults

Adults bred from larvae in the laboratory were supplied with water and a sugar solution from the time of emergence. Their longevity, however, was very short and ranged from three to eight days (mean 4.3 days : 21 adults).

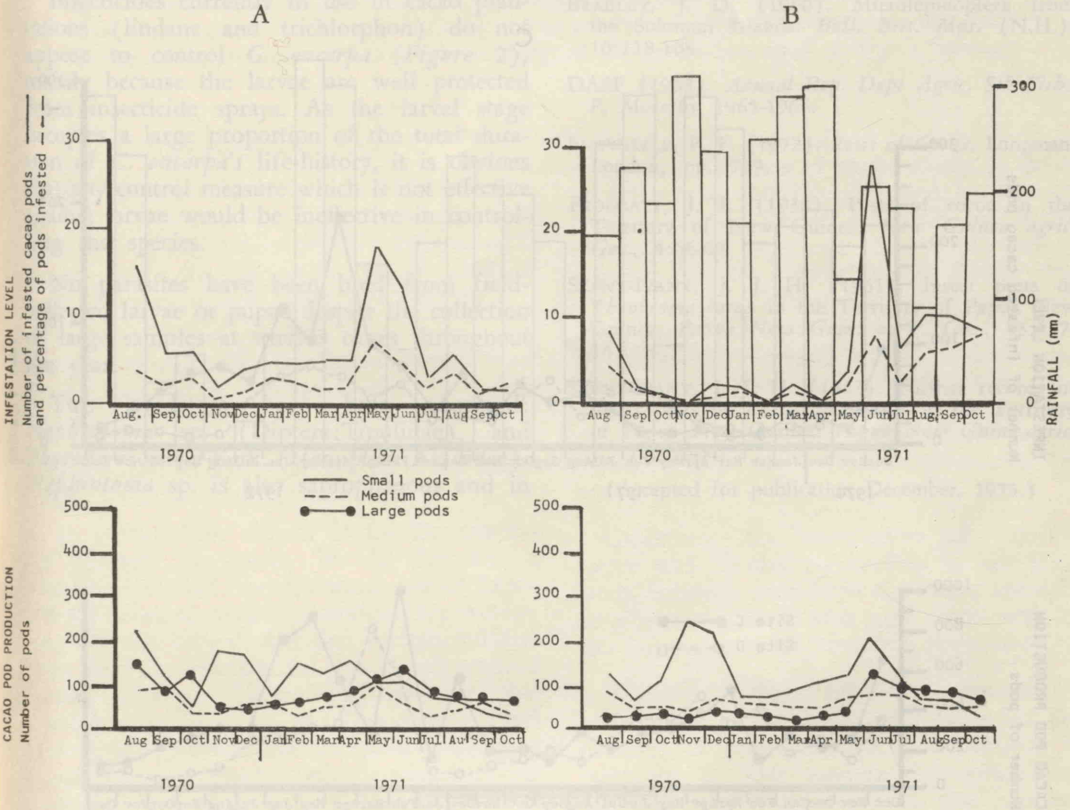

Figure 1.—**Damage to cacao pods by *Cryptophlebia encarpa* in relation to pod production and rainfall at two sites. A. Cacao heavily infested by capsids; occupied by the non-predatory ant *Technomyrmex albipes;* grown under leucaena shade; B. Cacao with low level of capsid damage; occupied by the predatory ant *Anoplolepis longipes;* also grown under leucaena shade**

SEASONAL ABUNDANCE

Recordings of *C. encarpa* damage levels were made at monthly intervals in four areas of cacao in conjunction with trials with unrelated aims.

It can be seen from the results (*Figures* 1 and 2), that there is a consistent tendency for the number of pods damaged and the proportion of total pods attacked to be greater during or immediately following a period of low rainfall.

However, this greater incidence of damage also corresponds with periods when a greater number of large pods are present. There does not appear to be any relationship between damage levels and the number of small or medium sized pods. The data shown in *Figure* 2 do not distinguish between pod sizes, however there are high levels of damage following a large increase in the number of pods which presumably coincides with maturation of pods following a period of flush.

The apparent relationship between high incidence of attack and low rainfall is incidental to changes in the number of large pods. Only two instances of an increase in the damage level corresponding to low rainfall without a concurrent change in the number of

C

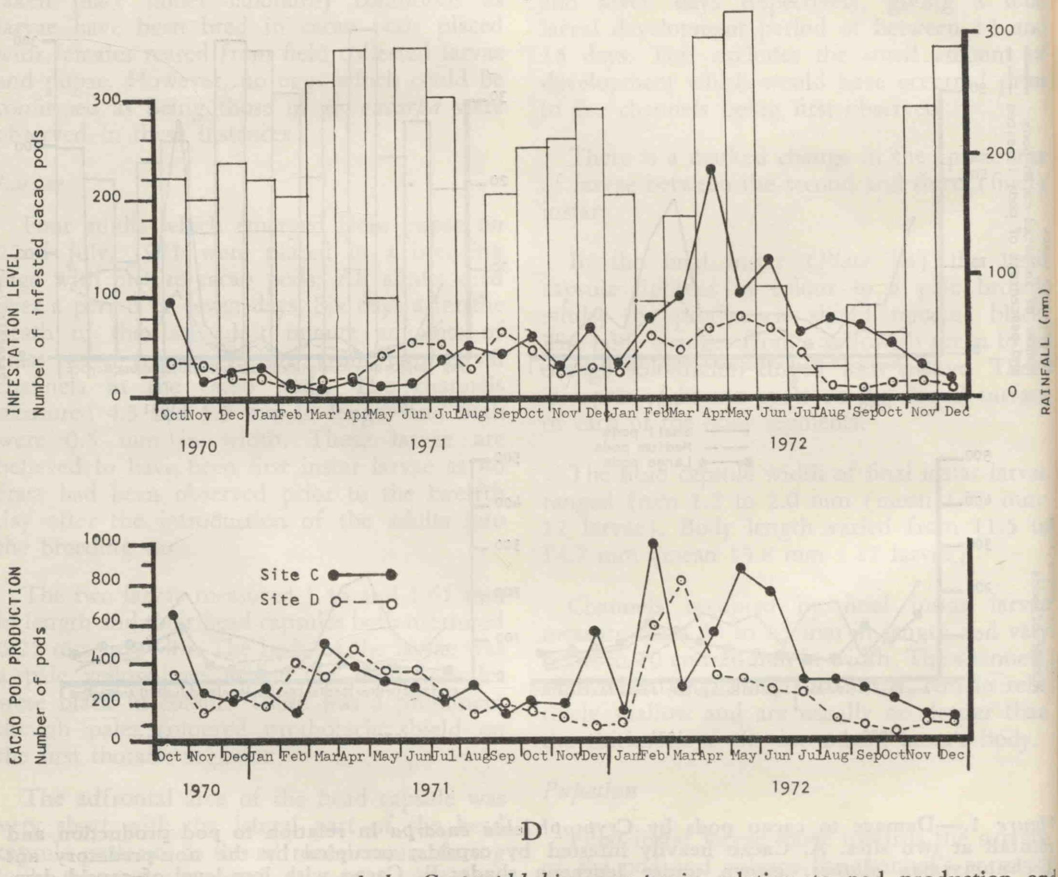

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Figure 2.—Damage to cacao pods by *Cryptophlebia encarpa* in relation to pod production and rainfall at two sites. C. Unshaded cacao sprayed every third month with trichlorfon L.V.C.; D. Unshaded cacao—no insecticide treatment large pods were recorded (August 1971, *Figures* IA and IB).

The seasonality of high damage levels may be due to a preference by the gravid female to oviposit on large pods. An alternative explanation is that it results from a gradual build up in the population of *C. encarpa* beginning soon after a flush, the population increasing to a maximum as the pods develop towards maturity.

CONTROL

As stated in the introduction, attack on pods by *C. encarpa* has not reached levels where it appears to warrant control measures.

Insecticides currently in use in cacao plantations (lindane and trichlorphon) do not appear to control *C. encarpa* (*Figure* 2), mainly because the larvae are well protected from insecticide sprays. As the larval stage occupies a large proportion of the total duration of *C. encarpa's* life-history, it is obvious that any control measure which is not effective against larvae would be ineffective in controlling the species.

No parasites have been bred from field-collected larvae or pupae despite the collection of large samples at various times throughout the year.

Two predators have been observed: *Nephrotoma* sp. (Diptera:Tipulidae), and *Physoderes azreal* Kirk. (Hemiptera:Aradidae). *Nephrotoma* sp. is also saprophagous and in many cases where it is encountered it has possibly only secondarily occupied the *C. encarpa* channel. Neither predator is host-specific, both attacking other cacao borers, e.g. *Pantorhytes szentivanyi*.

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