

OBSERVATIONS ON THE DISEASES AND CONDITIONS OF CACAO PODS IN PAPUA AND NEW GUINEA—POD LOSSES 1962-1965.

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ABSTRACT.

Birds and flying foxes destroyed 8.7 per cent. and rot following borer damage 6.2 per cent. of pods over 12 cm. long in a representative block of cacao at Keravat, New Britain, from 1962 to 1965. Other losses amounted to 6.2 per cent. including only 1.2 per cent. due to the fungus, *Phytophthora palmivora*. It is recommended that beans from rotten pods be kept separate from the main ferment.

INCIDENCE.

Prior to 1962.

Three reports prior to 1962, showed *Phytophthora palmivora* as the major cause of cacao pod losses in the Territory of Papua and New Guinea.

Bryce (1924) reported *Phytophthora palmivora* pod rot and canker as important diseases of cacao at that time in New Guinea. It was not until 1956 (Thrower 1960a), that critical observations were made at Keravat on the incidence of the pod rot disease. An actual figure was not given for losses due to *P. palmivora* but losses of pods over 10 cm. long, except for parrot damaged ones, amounted to 46 per cent. The histograms show that two-thirds of the losses were caused by the fungus. A second rot described was associated with the fungi *Botryodiplodia theobromae* and *Colletotrichum* sp. Some pods wilted from physiological causes (Thrower 1960b). Dr. R. J. van Velsen (unpublished data) recorded average incidence of 7.4 per cent. *Phytophthora* pod rot from November, 1958, to October, 1959, and 23 per cent. from November, 1960, to November, 1961, in a representative block of cacao at Keravat.

Recent observations.

Pods over 12 cm. long, lost from any cause over the period 1962 to 1965, were recorded from 312 trees (1.39 acres) in a trial at Keravat where :—

One-third of the trees were harvested at weekly intervals ;

One-third at three-weekly intervals ; and

One-third at three-weekly intervals, each harvest followed by spraying with Bordeaux mixture.

The sprayed plots had somewhat lower ($P=0.04$) incidence of *Phytophthora* podrot than the unsprayed ones harvested at three-weekly intervals. Otherwise, the treatments had no appreciable effect on pod losses which can be considered representative of untreated areas of cacao. The results are summarized in Table 1.

CAUSES.

Five main causes of losses of cacao pods were recorded at Keravat over the period 1962-1965.

Birds and flying foxes caused considerable losses. Bird damage may appear as a hole of varying size and position on the pod. In some cases (Plate I) the contents of the pod are con-

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Table 1.—The main causes of losses of cacao pods over 12 cm. long at Keravat, 1962-1965 and the number of pods recorded for each cause.

Cause.	Period.*		Combined. %
	August, 1962, to March, 1964.	April, 1964, to September, 1965.	
<i>P. palmivora</i> †	565	41	1.2
Insect borers	2,498	481	6.2
Birds, flying foxes	3,031	1,119	8.7
Harvested green	252	231	1.0
Physiological	283	305	1.2
(wilt)			
Others	463	245	1.5
Unidentified ‡	585		1.2
Total losses	7,677	2,422	21.1
Total pods harvested	32,796	14,994	100.0%

* The area was heavily pruned about November, 1963, and incidence of respective losses may have been affected by this.

† If it were doubted whether *P. palmivora* caused the rot of a moribund pod, then the pod was included in this group.

‡ Early in the trial some reject pods not infected with *P. palmivora* were recorded only as miscellaneous pods. Most of these were lost due to flying foxes or birds.

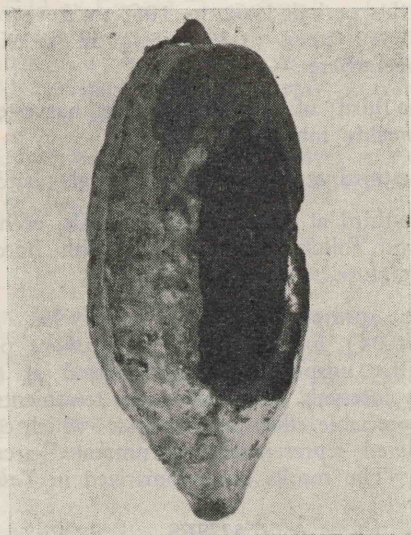


Plate I.—A mature cacao pod, 15 cm. long, destroyed by a parrot.

sumed ; in other cases the husk is only punctured, allowing microbial putrefaction of the pulp. Flying fox damage is similar except that the tip

of the pod is more commonly attacked (Plate II). In the Morobe District, on the mainland, rat damage is relatively more common than the above and is characterized by a hole approximately 2 in. x 3 in. along the middle of the pod (Plate III).

Pod borer also caused considerable losses. *Olethrutes* sp. and other Lepidoptera (Szent-Ivany 1961) may feed in the outer husk of the pods without penetrating the hard layer and in

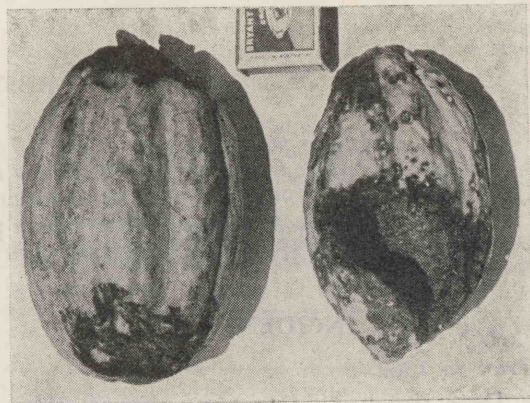


Plate II.—Mature cacao pods attacked by flying foxes. The one on the left has been only lightly attacked near the tip, the shallow rot at the base being unrelated. The one on the right was initially attacked by capsids but this did not affect the destruction of the pod by the flying fox.

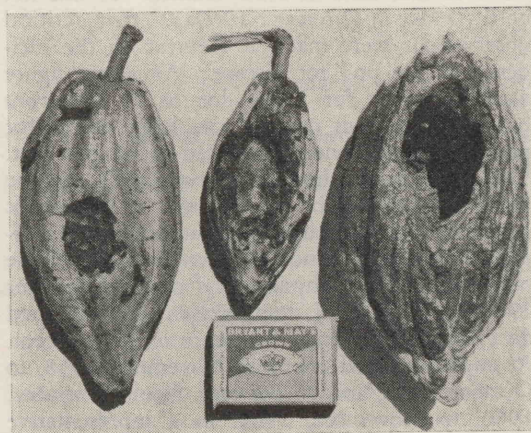


Plate III.—Cacao pods attacked and/or destroyed by rats. Pods as lightly attacked as the one on the left may mature normally.

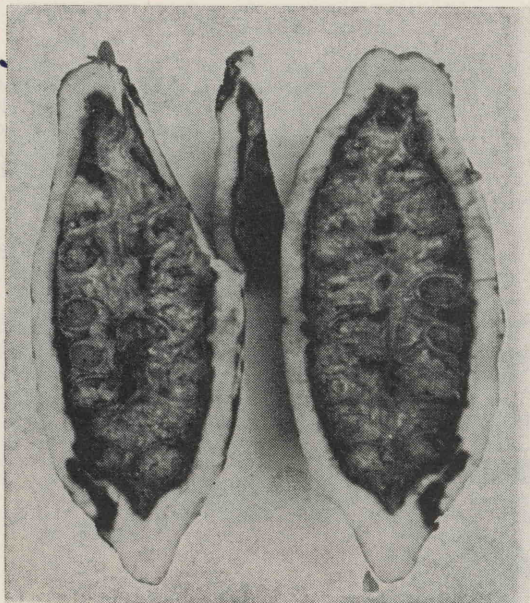


Plate IV.—Dissection of a mature cacao pod, 15 cm. long, showing internal rot following entry of borers. The husk is apparently healthy except for the small dark regions near the base and tip where the borers entered the pod.

these cases the pulp rarely rots. They may, however, puncture the hard layer allowing other organisms into the pulp which rapidly putrefies (Plate IV). In a plantation infested with pod borer, 50 to 80 per cent. of the pods in which pulp has putrefied may show no external signs except for a small borer hole or puncture from a bird or flying fox.

The fungus *P. palmivora* causes a rot first appearing as one or more distinct brown spots on the pod. The lesion then progresses at the same rate through pulp and husk (Plate V), except in ripe pods where the pulp may rot later. *P. palmivora* is rarely associated with rot following bird, flying fox or borer damage.

Physiological disturbances in the tree or pod may result in wilt. The pod becomes yellow before normal ripening time. Often, the whole surface of the pod to a depth of $\frac{1}{8}$ in. becomes brown in the subsequent day or so, before any internal browning sets in (Plate VI).

Conditions of lesser note in cacao pods include 'dry pulp' (where mature beans fail to form the mucilage so important in fermentation),

premature harvesting, and rot following knife damage, failure to harvest when ripe or damage by sucking insects (Miridae).

Important pod diseases in other countries not yet recorded on cacao in Papua and New Guinea are witches' broom and *Monilia* pod rot. The only comprehensive list of pod losses in any overseas country is reported by Owen (1951) for an area at Tafo, Ghana in 1949-1950 where *P. palmivora* and squirrels were the main causes.

FACTORS AFFECTING INCIDENCE AND CONTROL METHODS.

The level of *Phytophthora* pod rot reported in this study is much lower than that previously recorded at Keravat or usually recorded in other cacao areas of the world (Tollenaar 1958). Although rainfall at Keravat is higher, minimum daily temperatures and sunshine duration are

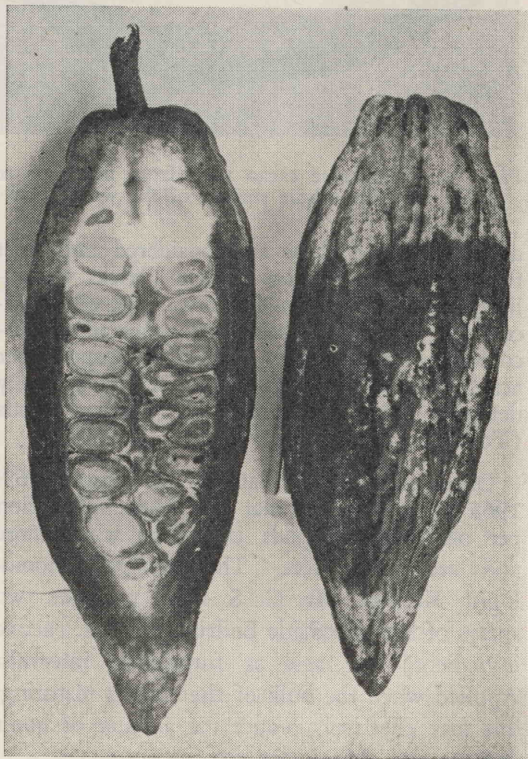


Plate V.—A large (13 cm. long) immature cacao pod partly rotted by *P. palmivora*. The rot has progressed equally in the husk and pulp.



Plate VI.—Immature cacao pods from the same tree showing a healthy pod, left, and a wilted pod, right. The whole surface of the wilted pod has darkened while the contents remain pale.

also higher and these are considered important factors minimizing the disease (Hicks unpublished). *P. palmivora* has been controlled successfully in other countries with sprays of copper-containing fungicides (1 to 2 lb. copper per acre) every three weeks or so and by carefully detecting and harvesting the diseased pods (Tollenaar 1958).

Observations at Keravat over the period 1962-1965 have indicated that pod borer infestation per one hundred pods is greater when more pods are on the trees. The Principal Entomologist, Keravat, Mr. G. S. Dun, proposes two sprays of the insecticide Endrin at 0.5 oz. (active ingredient) per acre at fortnightly intervals. Applied when the bulk of the crop is maturing, this may effectively reduce the amount of borer damage and subsequent rot.

No recommendations can be made for the control of wilt or flying fox or bird damage.

DISCUSSION.

From the foregoing it appears that direct losses of cacao pods from individual causes may not be serious in the Gazelle Peninsula, New Britain, the main cacao growing area in Papua and New Guinea. Losses appeared high in only occasional trees or clones from 1962-1965. In the wetter, cloudier areas of the Territory, losses due to *Phytophthora* pod rot may be higher. Damage by rats, flying foxes and birds may be serious at times. In plantations where trees exceed 20 ft. in height, considerable numbers of pods may not be harvested before their beans have become unfit for fermentation.

The putrefied contents of pods with generally healthy exterior may often escape the attention of the pod breaking supervisor. Although the effect of beans from diseased pods on cocoa quality has not been determined experimentally it is recommended that these beans be fermented separately, if not discarded.

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