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The Swollen Shoot Disease of Cacao in Togo

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The swollen shoot of cacao (*Theobroma cacao* L.) is a virus disease which brings a die-back of the trees and provokes their death sooner or later.

This disease which was already known in Ghana was not noticeable in Togo until 1955. It is only in 1977 and after several campaigns of uprooting the attacked plantations that a plant pathological laboratory was created in order to study the disease.

In 1978, cacao sales represented 16.7% of the exportation of Togo, but at present 21% of the cacao plantations are infected.

The research programme includes the deepening of the understanding of the disease, the setting up of efficient methods of control, the start of prospective investigations. Some foreign laboratories dealing with various specialities are working in collaboration with the plant pathology laboratory of the Institut Français du Café et du Cacao.

Results are encouraging.

Presentation of the disease

The swollen shoot of cacao (*Theobroma cacao* L.) is a disease which provokes die-back of the tree, together with a progressive decrease of the production, and its death, sooner or later. The first symptoms are a reddening of the veins of the very young leaves; then one may observe a mosaic along the veins of the mature leaves (Figs. 1 and 2) and at last the swelling appears on the stems.

This infection was detected for the first time in 1922 at Nankese in Ghana on cacao trees planted fifteen years earlier. But it was not until 1939 that A. F. POSNETTE made evident that the cause was a virus. Afterwards it was found in Nigeria, in Ivory Coast and in Sierra Leone, but in Togo it was found for the first time in 1955. It was found in the region of Agou. The destruction of the infected plantations began in 1963 and by 1977, 3.5 million trees were already destroyed.

The sale cacao is an important source of revenue for Togo, since it represents 16.7% of the total value of all exportations. But in 1978 a detailed inquiry revealed that 21% of the total area was attacked by this disease (PARTIOT *et al.*, 1978). For this reason the Authorities of this country begged in 1977, the Institut Français du Café et du Cacao (IFCC), an institute specialized in the research of Cacao already associated in the Togolese Development programme, to study the subject. The "Ca-

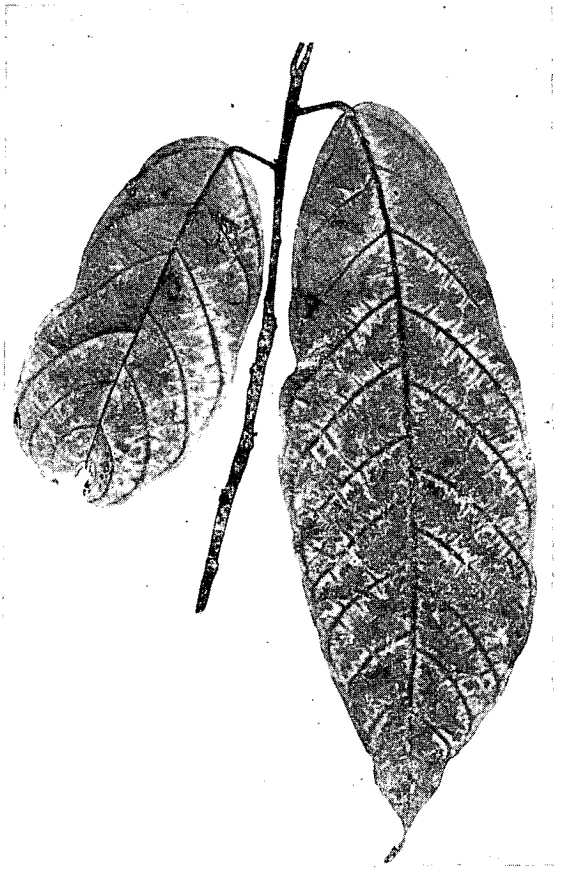

Fig. 1. Cacao swollen shoot disease, vein banding, fern leaf pattern (Agou 1 form)

cao swollen shoot virus" /x/x;x/x;U/U;S/Cc/ was described by POSNETTE (1947). It is a bacilliform particle of 120–130 nm long by 28 nm wide (BRUNT, 1970; DELECOLLE and LOT, 1978, unpublished) (Fig. 3). It is transmitted in a semi-persistent manner by mealybugs (ROVAINEN, 1976).

In Togo the principal vector is *Planococcoides njalensis* (*Homoptera* : *Pseudococcidae*) (DJIEKPOR and PANIS, 1978, unpublished). The virus can infect certain species of the Sterculiaceae family which includes the cacao and also the Bombacaceae, the Tilaceae and the Malvaceae (POSNETTE *et al.*, 1950; TINSLEY and WHARTON, 1958; AMEFIA and BRUNEL, 1978, unpublished). They are mainly trees but C.S.S.V. is also found in weeds like *Commelina* (DELECOLLE, 1977, unpublished; DELECOLLE, 1979). The *Commelina sp.* is a plant difficult to eradicate since it is found in all of the cacao plantations in Togo and now, according to our knowledge, only the up-

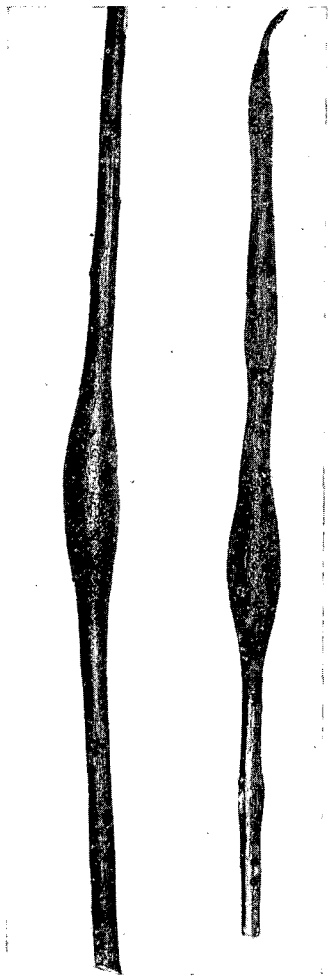

Fig. 2. Cacao swollen shoot disease, swelling of stems (Agou 1 form)

rooting of the diseased trees can be recommended to limit the spread of the disease. The presence of these alternative host plants is an important problem.

Let us see now how the study of this infection is carried out in Togo.

Research programme, methods of work and first results

The programme includes three main sections: the knowledge of the disease at the level of the host, of the virus, its epidemic and ecologic aspects and its economic impact; the control, by breeding, by chemical processes and by changing the

Fig. 3. Cacao swollen shoot virus (× 30,000)

ecological conditions; the prospective investigations about cross protection and thermotherapy.

The work is organized so as to reach a maximum efficiency: the laboratory of Plant Pathology of IFCC, increasing its own methods of investigations, works in collaboration with ten Togolese and foreign laboratories specialized in virology, plant physiology, entomology and soil conditions, each of which has a particular importance in the operation of the programme, the principle being that collaboration is profitable to everyone. All the propositions are studied and more or less narrow links are published.

A certain number of results have already been obtained (PARTIOT *et al.*, 1978; PARTIOT, 1979), in particular the forms and the localization of strains which are in Togo (Table 1). Five principal types of symptoms have been distinguished and put into collections. The apparent level of aggressiveness is different and one can expect to practice trials in cross protection. Some histological observations confirm those made by MANGENOT *et al.* (1946) which explain the swelling of stems by an increasing mitotic activity of the cambium. Some present investigations aim to study the action of virus through the apical meristems by microscopic sections of the stems and by tissue culture (SEGBOR and BRUNEL, 1979, unpublished). As far as the extrac-

Table 1

Form and localization of swollen shoot strains found in Togo

Togolese form	Comparable Ghanean form	Symptoms		Apparent aggressiveness	Localization
		on leaves	in stems		
Agou 1	New Juaben I A	Vein banding Fern leaf pattern	swellings	strong	Mt Agou Mt Touton Nyive (?)
Agou 2	Kpeve – C	interveinal mottle	no swellings	average	Mt Agou Nyive (?)
Kpele	–	Successive circular spots along veins	no swellings	weak	Kponvie
Ananikope	–	–	swellings	average	Ananikope
Nyive	Probable complex of strains Agou 1 and Agou 2				

tion and the purification of virus is concerned, the works of KENTEN and LEGG (1965), have been duplicated and new methods are being studied (LOT and DJIEKPOR, 1979, unpublished). One epidemiological study has shown that the strain "Agoul" is able to kill some 2 or 3 year old trees and that the disease spreads exponentially (PARTIOT *et al.*, 1978).

A breeding programme has begun, with the parents retained by LOCKWOOD and LEGG (1978, unpublished); new genotypes are introduced in order to enlarge as much as possible the available genetic base; the technics of creation of homozygotic cacao issued from haploid types are adapted and the rational utilization of the methods of the early evaluation of the resistance to swollen shoot, to *Phytophthora sp.* and to drought, should permit us to put into action a recurrent breeding strategy (PARTIOT, 1975).

Conclusions

In this brief presentation of the swollen shoot of cacao in Togo, we have shown how a disease can affect the economy of a developing country. Since certain knowledge has been acquired concerning the virus, its vectors, and the alternative host plants, only the uprooting of the disease trees can be recommended now.

A research programme has started the aim of which is the knowledge of the disease, the adoption of a breeding strategy and definition of new methods.

Several laboratories with various specialities are working on the programme. Certain results have already been obtained. The dynamic interest with which it has been realized permits one to be optimistic that useful results will eventuate.

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