COCOA GROWERS' BULLETIN

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Editorial

Dr. F.J. Pound visited parts of Peru, Ecuador, Colombia and Brazil in 1937/38 and again in 1942/43 to collect wild cocoa germplasm. The material collected by him was transported, via quarantine, to the Cocoa Research Unit at the University of West Indies in Trinidad – this unit was at that time called The Imperial College of Tropical Agriculture. His collections were made in the hope that he would find trees with a considerable degree of resistance to Witches' Broom, but these collections have since formed the basis of most of the cocoa breeding programmes for high yield and resistance to fungal and virus diseases in West Africa, South America and the Far East. There have subsequently been a number of collecting expeditions: in 1949 to the headwaters of the Napo River in Ecuador, in 1952 the Anglo-Colombian expedition to the Colombian Amazon Basin, from 1968 to 1973 a series of expeditions to various parts of the Oriente in Ecuador and a series of expeditions to the States of Rio Branco, Rondonia and Acre In Brazil. Nevertheless, a glance at the map of South America will indicate the vast areas of rain forests which remain to be explored for the existence of wild cocoa germ-plasm.

In 1979 a most generous donation by the London Cocoa Trade to celebrate the 50th Anniversary of the London Cocoa Terminal Market and the Cocoa Association of London enabled a two year project to collect wild cocoa in the Oriente Province of Ecuador to be established. An article on this project is contained in this issue of the Cocoa Growers' Bulletin. We hope that the material collected can provide for the future of the world cocoa industry in the same way as the material collected by Pound in the late 1930s. These areas of the Amazon Basin are being developed at a rapid rate for settlement, agriculture and exploitation for mineral resources. These very developments mean that distant parts are more easily visited, but at the same time the wild cocoa trees are being cut down and potentially valuable genetic material is being lost for ever. Programmes of collecting wild cocoa germplasm are needed in many parts of the Amazon Basin. The work of LCTAP has covered Ecuador fairly effectively and CEPLAC are doing considerable work in Brazil, but substantial areas of Bolivia, Colombia, French Guiana, Guyana, Peru, Suriname and Venezuela remain to be explored. This work is becoming urgent.

R.A. Lass, Editor.

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Review of Production and Consumption

October 1982
A.B. Cook, Cadbury Schweppes plc.

PRODUCTION

Gill and Duffus's latest forecast of 1981/82 production is a record 1,695,000 tonnes, 22,000 tonnes more than their final figure for 1980/81 of 1,673,000 tonnes which has itself been revised upwards since their November 1981 report.

The latest forecast shows a reduction of 32,000 tonnes from their November forecast, but this hides a substantial reduction in their forecast for Ghana, which has failed to justify the optimism shown in November and is now expected to produce only 222,000 tonnes compared with 300,000 tonnes previously forecast. Thus it appears that the downward trend in Ghanaian production is continuing, although it should be noted that considerable efforts have been made to solve the evacuation difficulties which were such a major problem at the turn of the year, and the position is now much improved.

On the other hand most of the other countries in West Africa and South America are now expected to produce a little more than originally forecast. Taken together these additional tonnages go some way to offsetting the disappointment from Ghana.

CONSUMPTION

The latest Gill and Duffus forecast of 1982 world consumption is a record 1,589,000 tonnes, 36,000 tonnes less than forecast last November. While consumption in Western Europe and North America is expected to continue to increase at a modest but steady rate, Eastern Bloc consumption is now expected to fall for the second successive year.

STOCKS

Gill and Duffus estimate that world stocks at the end of the 1981/82 season will be 688,000 tonnes, the highest level since 1965. However it must not be forgotten that the Cocoa Agreement Buffer Stock already owns 100,000 tonnes of this stock and has access to sufficient funds to buy a further 40 – 45,000 tonnes if it decides to do so.

PRICES

Month end prices for nearby shipment Ghana cocoa have been:

1981	June	£ 911/tonne	1982	January	£1226/tonne
	July	£1196/tonne		February	£1230/tonne
	August	£1268/tonne		March	£1024/tonne
	September	£1345/tonne		April	£1053/tonne
	October	£1216/tonne		May	£1003/tonne
	November	£1168/tonne		June	£ 988/tonne
	December	£1220/tonne		July	£ 976/tonne
				August	£1008/tonne
				September	£1080/tonne

WORLD COCOA PRODUCTION AND GRINDING DATA
Reproduced from Gill and Duffus Market Report dated May 1982
(Thousand Metric Tons)

PRODUCTION

	1979/80	1980/81 (Estimate)	1981/82 (Forecast)
Africa	1008	1009	1035
America	491	534	526
West Indies	35	42	44
Asia and Oceania	79	88	98
WORLD TOTAL	1613	1673	1695
Principal Countries			
Ghana	275	258	222
Nigeria	169	155	175
Ivory Coast	379	412	455
Cameroun	124	120	120
Equatorial Guinea	6	8	8
Brazil	294	354	312
Ecuador	98	81	85
Dominican Republic	27	32	32
Venezuela	17	14	17
Colombia	30	39	42
Mexico	34	30	40
New Guinea	31	28	30
Malaysia	32	40	45

GRINDINGS

	1980	1981 (Estimate)	1982 (Forecast)
Western Europe	548	599	622
Eastern Europe and USSR	214	208	192
North America	154	207	225
Central and South America	360	344	324
Australia and New Zealand	15	16	16
Asia	68	76	91
Africa	139	126	119
WORLD TOTAL	1498	1576	1589
Principal Countries			
United States	142	190	210
Germany (Federal Republic)	158	167	174
Netherlands	133	141	150
United Kingdom	65	86	90
U.S.S.R.	130	120	112
France	48	52	54

The market has become progressively more disillusioned about the Cocoa Agreement's ability to support the market and its attention has reverted to supply/demand fundamentals. With a surplus of some 90,000 tonnes in the current crop year and, in the market's view, the prospect of a further surplus of the order of 100,000 tonnes in the 1982/83 season, prices fell fairly steadily throughout the first half of 1982. However initial crop reports have suggested that the 1982/83 surplus may be much more modest, say 20 – 30,000 tonnes, and prices have steadied a little over the last two months as a result.

INTERNATIONAL COCOA AGREEMENT

The buffer stock manager continued to buy direct from origin throughout the second half of January and throughout February and by March 8th had fully committed all his existing resources of $ 230 million in buying a total of 100,345 tonnes.

At a series of meetings during the first half of the year the ICCO Council delayed rather than take any firm decisions, but on June 4th they finally agreed to accept the offer of a $ 75 million loan. However they have not yet authorised the buffer stock to spend this money as they wish any buffer stock buying to be only one part of a larger package of measures to support prices. At meetings in July and September they failed to reach agreement on this package. The next meeting is scheduled for November.

There is little doubt that, at present, the market has lost all confidence in the ability of the Cocoa Agreement to support prices. In the present surplus conditions even the fact that the buffer stock owns 100,000 tonnes of cocoa, and may buy more, does not seem to be a significant market factor, although it could still become one should the world supply position tighten.

London Cocoa Trade Amazon Project

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BACKGROUND

Wherever cocoa plantings are being expanded or renewed, there is a demand for improved varieties, based partly on the observation that hybrids developed over the last forty years have greatly increased the yields obtainable under ideal conditions, and also on the hope, so far not clearly realized in practice, that new varieties may be resistant to the diseases which already greatly reduce yields in some countries and are a permanent threat to those countries in which they do not yet occur. Most producing countries have breeding programmes which are intended to lead to the introduction of such improved varieties, and some of these programmes have already lead to large-scale distribution of improved planting material.

It is obvious, however, that all such genetic improvement programmes make use of only a limited part of the genetic potential of the wild cocoa species, *Theobroma cacao L.*. Wild cocoa occurs as a forest tree over large areas of tropical Central and South America, from Mexico south to Bolivia, including the Amazon and Orinoco river basins. Little is known about some of these wild cocoa populations, but it is clear that there is a wide variation in every character of the cocoa tree, including, for example, pod and seed characteristics as well as vigour and tree shape. The greatest variability is found within the Upper Amazon area, on the eastern edge of the Andes (including parts of Colombia, Ecuador and Peru); this area has been described as the 'centre of diversity' for wild cocoa.

Most breeding and selection programmes have been based on existing cultivated populations or on a very small number of collections of wild cocoa. Cultivated populations, particularly in Africa, are descended from a few original introductions and are therefore genetically fairly uniform, and limit the scope for improvement without the introduction of new germplasm. The most widely used germplasm derives from about 120-150 wild trees of the Upper Amazon area from which material was collected by F.J. Pound in 1937-38 and 1942-43, and distributed as the IMC, Nanay, Parinari, Scavina and Pound series of clones. The hybrid varieties which have been distributed in West Africa in recent years are mainly crosses between Pound's Upper Amazon collections and traditional local Amelonado varieties. The success of these hybrids suggests that even greater improvements in vigour and yield would be possible if more wild germplasm were available in cultivation for use by breeders.

In recent years further collecting of wild cocoa has been done in the Amazon basin, notably in a continuing series by CEPLAC (Brazil), by the Anglo-Colombian Expedition in 1952-53, and by W.S. Chalmers and others between 1968 and 1973 in a joint Trinidad-INIAP (Ecuador) programme. However, much of this material has been lost, and very little has been evaluated or distributed to breeders. There have been persistent problems in establishing collected material in cultivation, often caused by delays between collection and propagation. In some areas, even within the crucially important Upper Amazon, no collecting has been done at all. At the same

time, the natural forests of the Amazon basin are rapidly disappearing as a result of settlement programmes, timber-extraction, oilfield development, and the building of roads, so that the wild populations of cocoa everywhere are threatened with extinction.

This erosion of the wild genetic base, which could serve for the future improvement of the cultivated cocoa tree – a problem common to most crops – has been formally recognized by the Cocoa Producers Alliance (CPA) and by the International Board for Plant Genetic Resources (IBPGR) as requiring urgent action to safeguard the long-term interests of the cocoa industry. Specifically, IBPGR (Anon, 1981) has recommended the initiation of new collecting programmes, the development of existing collections to

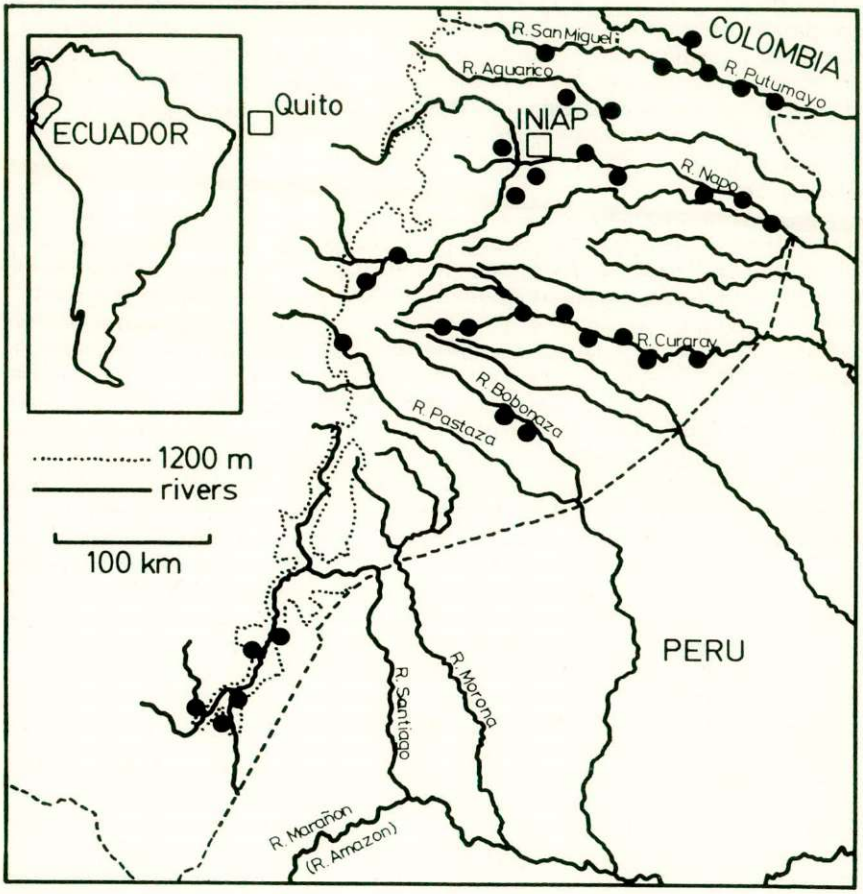

Figure 1
The Amazon region of Ecuador, indicating the location of the Napo Experimental Station and sites where wild cocoa has been collected; each dot represents one or (usually) several collections.

form a co-ordinated network of 'germplasm banks' and more regular exchanges of already-held material between breeders. These developments would achieve for cocoa what has already been achieved for some other crops, for example, potatoes – which originated as wild species in the Andes. A collection of the wild species and primitive cultivated varieties is maintained at the International Potato Centre (CIP) in Lima, and duplicated at other centres in various parts of the world, so preserving a permanent reserve of potentially useful genes for future potato breeders.

For cocoa, it is considered that collecting is required wherever wild cocoa, or old cultivated populations, are found, and includes Central America, Venezuela, the Guyanas, Colombia, Ecuador, Peru, Bolivia and Brazil. Given that the Commissão Executiva do Plano da Lavoura Cacaueira (CEPLAC) collecting programme means that the Brazilian populations are already being effectively covered, attention has centred on the desirability of a renewed collecting effort in the Upper Amazon area, already identified as the 'centre of diversity' for wild cocoa, and hence as the most likely source of extra genetic variability for breeders to work with.

FUNDING

Against this background, at a meeting of the Inter-American Cocoa Disease Committee (CIEC) in Quito in May 1979, it was agreed to begin a new collecting programme in Ecuador, for which Instituto Nacional de Investigaciones Agropecuaris (INIAP) would provide local facilities while outside funding would be sought to pay for a full-time collector and the special expenses of a series of collecting expeditions. In 1979, the London Cocoa Market celebrated its 50th anniversary, and in order to mark this they agreed to fund the new collecting programme. In recognition of this generous and imaginative gesture the project was named the London Cocoa Trade Amazon Project (LCTAP).

The objectives were to systematically collect wild cocoa in the Amazon region of Ecuador, to establish the collected material in cultivation as a permanent 'germplasm bank' at a new research station being developed by INIAP in the Amazon region, and to distribute the material to breeders, via intermediate quarantine. I was appointed as the collector and arrived in Ecuador in January 1980; the project was to run, initially, for two years, but has now been extended to three.

COLLECTING

The project is based at the Napo Experimental Station at San Carlos, about halfway between the towns of Lago Agrio and Coca, in Napo Province, in an area which was first opened up for the development of an oilfield in the early 1970s. From this base, quite large areas of the Amazon region of Ecuador can be reached directly by road and river, while more remote areas are accessible by light aircraft from any of more than a hundred small airstrips serving isolated settlements throughout the region. Detailed exploration of an area is done on foot or by canoe.

In this way, the Amazon region of Ecuador has been systematically covered (Figures 1, 2). Up to June, 1982, seed or budwood has been collected from 325 wild trees, of which 250 collections have been successfully established in cultivation. The relatively high proportion of collections successfully established is mainly due to the deliberate choice of a base

which is strategically located within the region. Material can always therefore be brought back to the nursery within two weeks, and often in only 3-4 days, so that losses in transit are minimal.

Although it is hoped that the final set of collections will include trees with specific genetic characteristics such as resistance to witches' broom disease,

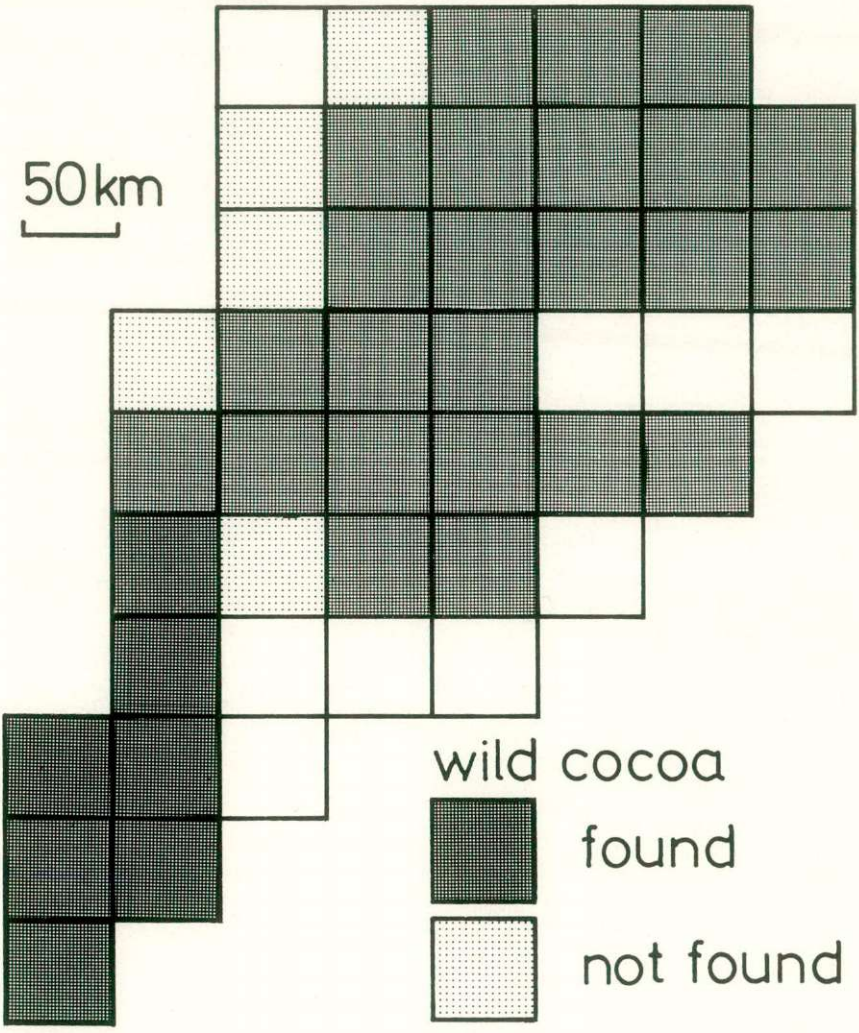

Figure 2
The Amazon region of Ecuador with a grid super imposed (each square 1/2° latitude by 1/2° degree longitude), showing the coverage of the collecting programme up to 29.4.82. All shaded squares have been visited at least once.

the selection of superior trees in the field has generally been avoided. Such characteristics cannot be clearly identified on wild trees as a tree may be free of disease symptoms because of the conditions in which it is growing, and not because it is resistant. A lightly diseased tree may nevertheless have some form of disease tolerance which would be a valuable genetic characteristic. Generally, attempts to select in the field mean that potentialy useful material is not collected because its value is not immediately obvious.

Collections are numbered in a continuous series from LCT-EEN-1; the prefix signifies London Cocoa Trade – Estación Experimental Napo.

CHARACTERISTICS OF THE COLLECTIONS

Data on tree, pod and seed characteristic has been carefully recorded as an aid to evaluating the range of genetic variation among the collections, and to help compare the wild cocoa in this region with material already in cultivation. Here, as elsewhere, wild cocoa trees are typically tall (up to 20m) with 2-5 stout (girth at 1.3m up to 90cm), leaning trunks and 1-10 or more chupons. In this area, the newly-flushed leaves are typically pale green with no red pigmentation at all. About 40% of trees show symptoms of witches' broom disease, although the proportion of diseased trees is much higher among trees growing in full sun than in trees under partial or deep shade. Diseased trees typically carry a few (1-5) small (less than 20cm long) vegetative brooms, but large numbers of cushion brooms and 'chirimoyas'. Wild cocoa trees found in forest rarely carry pods, but in the open, for example along a river-bank, the trees seem to flower and fruit more freely.

Typically, pods are moderately or very wrinkled, with the tip rounded or moderately pointed and the base not or only slightly narrowed ('bottleneck') and green in colour, ripening to yellow. Mean total pod weight was 570g, with a standard deviation (s.d.) of 203g, mean length was 155mm with an s.d. of 25mm, and mean length:diameter ratio was 1.7:1 with an s.d. of 0.2. All pods had clearly paired ridges, separated by well-marked furrows. Pod walls were thick, soft and easily cut.

The mean number of seeds per pod was 25 with an s.d. of 10, and the mean seed weight (fresh, testa removed) was 1.9g with an s.d. of 0.5g. White seeds occurred in 62% of collections. (The means and standard deviations above are based on 58 collections made prior to 30.6.81, but are also representative of more recent collections).

These characteristics suggest that the wild cocoa from this region is genetically different from the Upper Amazon material already in cultivation (as shown by the wrinkled pod surfaces and predominance of white seeds), so that the Ecuadorian material, when distributed, will result in an extension of the range of genetic variation available to breeders. It must be emphasized that a full evaluation of the useful genetic variation present in the collections will take many years.

DISTRIBUTION

Attention has continually been given to the despatch of material into quarantine at both The Royal Botanic Gardens, Kew, Richmond, Surrey, England and U.S.D.A. Plant Introduction Station, 13601 Old Cutler Road, Miami, Florida, 33158, U.S.A. Some collections established at Kew will be available for distribution in late 1982, and inquiries are invited from interested breeders.

ACKNOWLEDGEMENTS

I wish to thank: the London Cocoa Trade, for their generous and imaginative gesture in funding the Project; my assistant Sr Jose Baquero, whose skills have contributed greatly to the success of the Project; R.A. Lass (Cadbury Schweppes plc), who has been largely responsible for the planning and technical supervision of the project; E.T. Beauchamp (CCCA), who has handled the UK administration of the Project; J. Vera (INIAP) and C. Suarez (INIAP), for support in Ecuador; J. Barriga, B.G.D. Bartley, W.S. Chalmers, L. de Verteuil, H.C. Evans, D. Glendinning, P.H. Gregory, A.F. Posnette, N.W. Simmonds, P.K. Soderholm and R. Wastie, who all contributed to discussions on the Project.

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Transport of Cocoa Beans in Containers 2

G.A.R. Wood and G.W. Parsons

About 10 years ago the growth of containerisation of cargo carried south-bound between Europe and West Africa lead to studies of carrying primary products on the return journey. Forecasts made at that time indicated that much of the cocoa trade from West Africa would have to be carried in containers at some future date. About 700,000 tons of the West African cocoa crop is shipped between December and May when there is a considerable fall in temperature during the voyage and earlier experience had shown that zard to quality ited in 1972 to previous article

Erratum:
Page 11, line 11 should read:
'described progress with these trials up to 1974 (Wood 1977).'

THE PROBLEM

At one time shipments of cocoa bags in ships' holds were liable to considerable sweat damage but this was overcome by adequate ventilation of the holds. Cocoa shipped in standard containers is in the same situation. The temperature of the container falls, relative humidity inside the container rises and moisture condenses on the roof and walls. Some of this moisture drips from the roof onto the bags and there have been instances where more than half the number of bags in the container became wet damaged from this precipitation. Apart from this the high level of relative humidity in the container causes cocoa beans in the top layer of bags to absorb moisture and a small proportion will attain moisture contents in excess of the danger level of 8.0% and are liable to become mouldy.

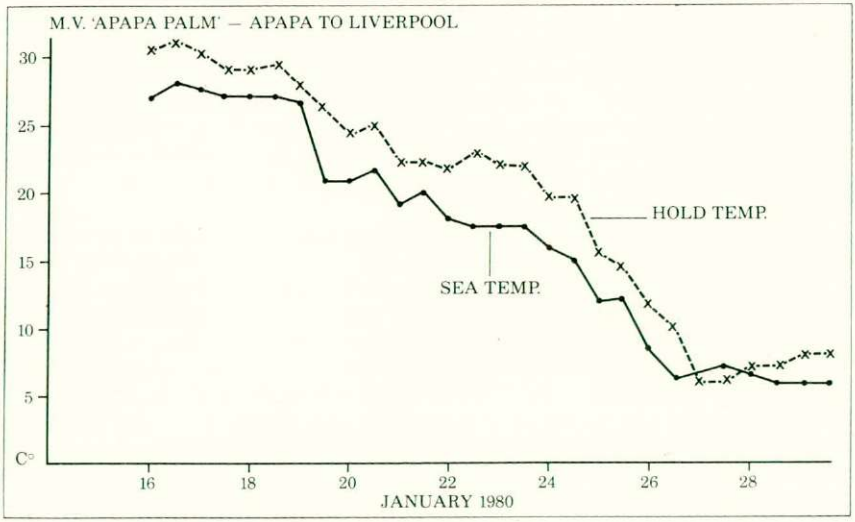


Fig. 1 — Temperature change in sea and ship's hold during a voyage from Nigeria to Liverpool.

The journey from West Africa to Europe during winter presents the most difficult conditions. Apart from the overall temperature differential, there are two points during the voyage where both air and sea water temperatures fall significantly over a short distance, the first between Monrovia and Dakar around 10°N and the second around 45°N latitude (Fig. 1). As the ship crosses these areas the container surfaces cool more rapidly creating conditions for condensation to occur. Shipments at other times of the year are less hazardous to quality.

TRIALS WITH STANDARD STEEL CONTAINERS

The first trials, conducted in the 1972/73 season, used standard steel containers modified by lining them with plywood and painting the metal parts with anti-condensation paint. These modifications did not prevent the moisture content of the top layer of bags from rising by more than 1.0%; in one case over half the bags sampled had moisture contents in excess of 8.0%, with isolated samples exceeding 10.0%.

It was concluded that "containers are unsuitable for transport of bagged cocoa because of the risk of deterioration which would result from delays in delivery of the containers or in processing the beans after delivery" (Wood *et al.*, 1977). This statement referred to the standard containers available at that time on the West African route.

Trials have also been carried out between Papua New Guinea and Australia during their winter months. This journey is rather shorter and the fall in temperature is generally less and it was found that "little or no condensation forms at sea" when standard containers lined with insulating board are used (Sharp *et al.*, 1979). It was concluded that cocoa beans could be shipped on this route in such containers "carried below deck and unstuffed promptly after discharge from the ship".

At about the same time cocoa beans were being carried between Central America and the USA in an otherwise standard container fitted with drain-holes around the bottom edge. Any moisture condensing and dripping from the container roof was diverted by a removable false ceiling and sidewall structure and ran out of the drainholes. Outturns were reported to be satisfactory.

After 1972/73, trials from West Africa were carried out to test other measures to prevent the risk of high moisture content. An extensive series of trials tested the use of polythene liners inside standard hessian bags (Mejule *et al.*, 1979). This measure was successful but could only be considered as a last resort because of the practical difficulties involved in a change to the use of polythene liners. Their use may be justified in some places but it is essential that the cocoa is properly dry with a moisture content of 6-7% before being bagged, and the use of polythene liners is not welcome at the receiving factory where they cause difficulties when the sacks are emptied.

The use of silica gel to absorb moisture has been tested but the quantity required to be effective is considerable as, in a trial, amounts up to 200 kg per container did not prevent condensation entirely. There would be difficulties in arranging the use of silica gel on a large scale and the cost would probably be prohibitive.

Trials were also conducted with bulk containers, the cocoa beans being loaded loose into a special container with top hatches for loading and a hatch in the door for unloading. The container was plywood clad but no other measures to reduce condensation were taken. The results were worse than when containers are loaded with cocoa in bags. The Moisture Content of beans on the top surface rose above 20 per cent and mould developed. No further bulk trials have been undertaken, although the technical problem might be overcome with the latest type of ventilated container.

The use of bulk containers on a regular basis would require special equipment for loading and unloading. In addition, problems concerning commercial aspects – weighing and quality inspection – can be envisaged. For these reasons bulk handling is unlikely to be pursued until the use of containers for transporting cocoa has become more widely used.

VENTILATED CONTAINERS

Following this experience it was concluded that the best solution to the moisture problems on the route from West Africa to Europe was to evacuate the moist air from the container on a continuous basis. This could be achieved by means of a container fitted with ventilation apertures used in conjunction with the ventilating system in the ship's hold. Various trials with ventilated containers have lead to the evolution of a satisfactory design.

The first trial with a container designed by Sea Containers Limited was described earlier (Wood, 1977). This design had two steel mesh panels in the upper half of both sides which could be closed by hinged flaps. The flaps were open during the voyage and provided adequate ventilation, but the use of containers for large shipments must allow for them to remain loaded with cocoa for a period of a week or more after discharge from the ship. With this design the flaps would have to be closed to prevent rain or snow entering, but with closed flaps there remains the danger of condensation as the cocoa will still be at a temperature well above ambient.

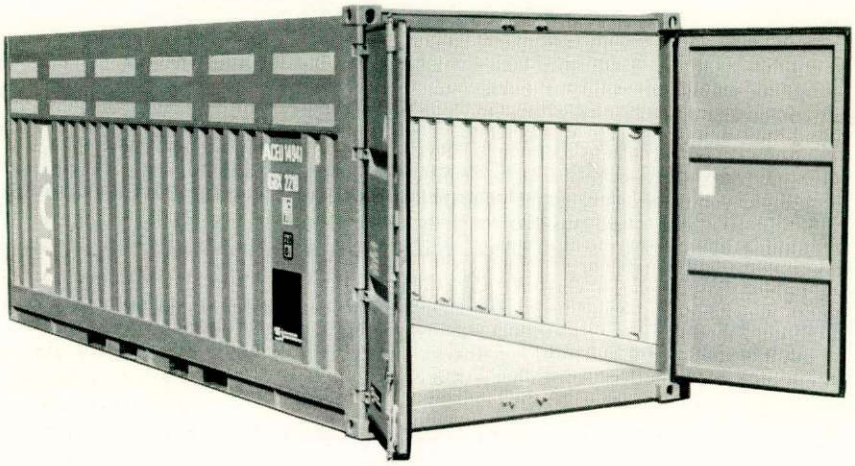
A further design evolved by African Container Express (ACE) had steel mesh grilles about 30cm deep at the top of the sides, the grilles being protected by a hinged flap. When open the flaps were at an angle of 30° to the side of the container, providing protection against the weather while allowing ventilation. This design was effective in preventing condensation during the voyage and after discharge from the ship, but suffered from certain practical difficulties. In the first place all containers lead a very rough life and the flaps were prone to damage. Second the flaps required to be opened before the voyage started, partly closed on discharge, and fully closed for the inland journey from the port. These adjustments had to be supervised and could easily be overlooked with risk of damage to the cocoa.

The most recent design of ventilated container by Adamson has no moving parts and ventilation is provided by grilles the design of which is shown in Fig. 2. A shipment of 800 tons stuffed into 32 containers was received at Liverpool from Nigeria early in February 1981. These containers were unstuffed at a store over a period of a week so that some containers remained on the quayside for several days after discharge. When unstuffed these containers had a slight film of condensation on the ceiling but there were no wet bags.

Apart from the Adamson container there are other similar designs of ventilated containers which have proved to be equally satisfactory on shipments from Nigeria to UK.

On the continent of Europe the East Asiatic Co has pioneered its own design of ventilated container. This container has a double wall with ventilating grilles at the foot and at the top connected to small outlets on the outer wall. In addition there are two roof hatches which can be opened slightly during the voyage and, if conditions allow, after discharge. Trials with this container have proved satisfactory.

Further trials were conducted between Papua New Guinea and Australia in 1980 in which some experimental ventilated containers were tested in comparison with other designs. The conditions were relatively mild but there was no condensation in the ventilated containers whereas condensation occurred in the unventilated containers. In these trials the ships' holds were not fitted with forced ventilation (Sharp and Van S. Greve, 1981).



– Photograph by courtesy of African Container Express Ltd. (ACE).

Fig. 2 – A ventilated container built by Adamson. Ventilating grilles can be seen at the bottom and top of the side walls.

GENERAL REQUIREMENTS

The major potential route for cocoa in containers is between West Africa and Europe where there is a considerable fall in ambient temperature. Under these conditions a container must be designed so as to allow adequate ventilation during the voyage and after discharge from the ship. It is equally important that the ship's hold is ventilated throughout the voyage and in modern vessels this means that the hold has 10-20 air changes every hour.

In addition the container should be strong enough to prevent damage to the ventilators and experience has shown that ventilation which depends on manual adjustments is liable to human error or neglect. Commerically the design should conform to an international specification for containers.

Conditions on cocoa routes in other parts of the world appear to present less severe problems. Voyages are frequently shorter and temperature differentials less and of a more even rate of fall. The risk of condensation must be judged on knowledge of the ambient temperatures likely to be experienced.

COMMERCIAL ASPECTS

The present position is that cocoa sold under a CAL (Cocoa Association of London) contract – and this means most of the world's cocoa – cannot be shipped in a container without buyer's consent. After initial doubts about a change in practice buyers are becoming more willing to accept cocoa in containers but there is still a long way to go before cocoa is carried in containers as a general practice.

All the trials referred to have used 20 foot containers (type 1CC, external dimensions 20' x 8' x 8'6") and the load has been provisionally fixed at 200 bags or 12.5 tonnes because this tonnage is convenient commercially for the sale of 25-50-100 tonne lots. It is, however, possible to increase the load to 15 tonnes and this may become the normal load for economic reasons. Some trials with containers loaded with 15 tonnes have not led to any quality problems.

While the trials have solved the technical problems, there remain some difficulties and disadvantages which hamper the growth of container use. The first concerns unloading which is more laborious from a 20 foot container discharging from doors at one end than from a flat bed truck. There is, therefore, an extra cost in unloading until some mechanical aid is developed.

A second disadvantage also concerns costs. The cost of shipment by container may be rather less than conventional stowage at the port of discharge, but the cost of inland haulage is heavier, so that at some distance from port – in UK the distance has been estimated at about 60 miles – the cost of containerisation equals conventional stowage. Beyond that distance the latter is cheaper. This factor is of greater relevance in Europe than in UK.

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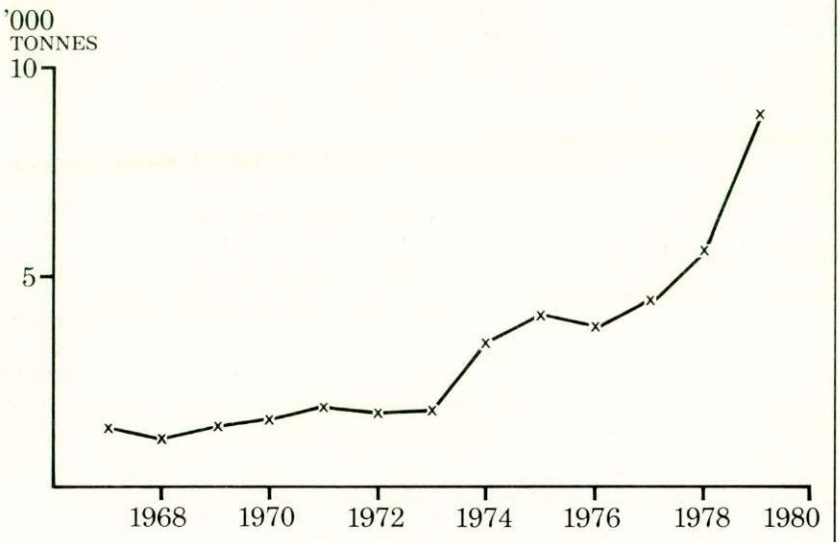
Cocoa in Indonesia

G.A.R. Wood

Cocoa was introduced into what is now Indonesia in the 17th century and at a much later date was one of many crops planted on estates, but production never amounted to more than 2–3000 tonnes until very recently – production in 1981/82 has been forecast to be 8000 tonnes (see Figure 1). Despite this relatively small production Indonesia has made considerable contributions to the science of cocoa growing and promises to become a much larger producer in the near future.

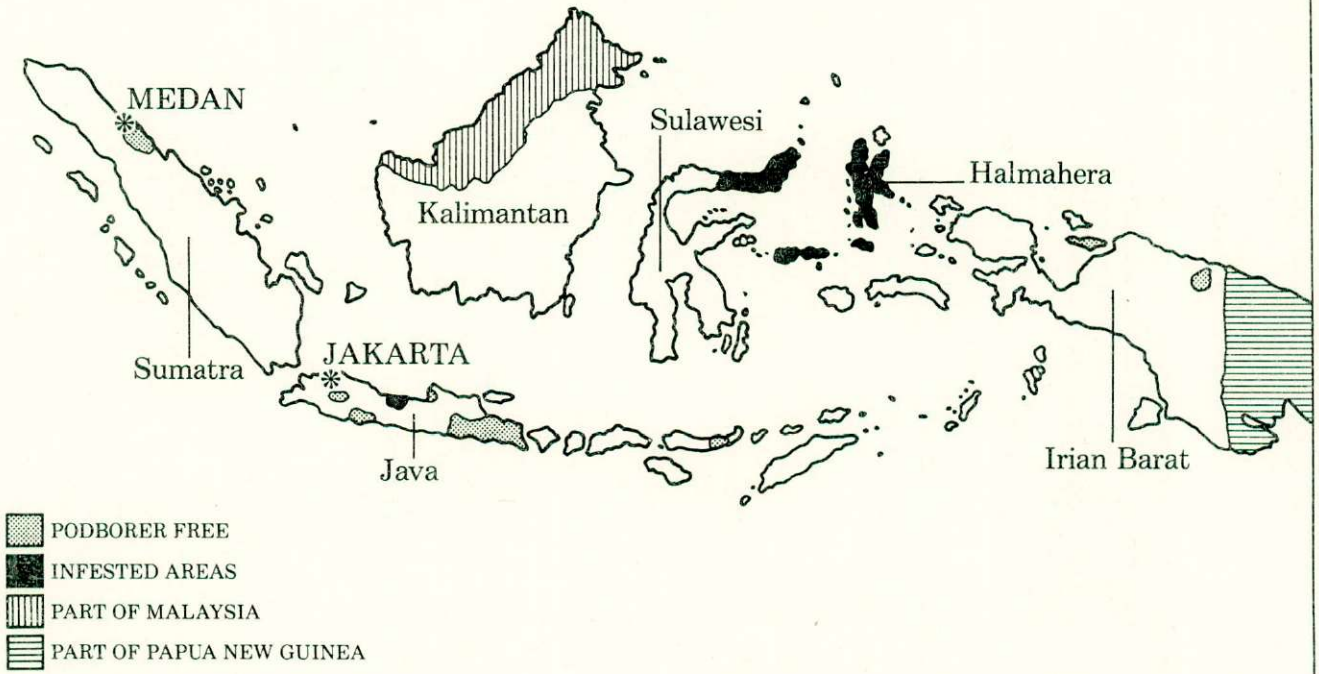
Figure 1: Cocoa Production: Indonesia



Source: Data presented at National Cocoa Conference 1980

Indonesia is a vast country, much larger than maps based on Mercator's projection would lead one to suppose. Astride the equator, it stretches from 5°N to 10°S and the distance between the eastern and western extremities is over 3000 miles. The country is an archipelago of many islands – over 12,000 according to one authority – the major ones being Sumatra, Java, Kalimantan (Borneo), Sulawesi (formerly Celebes) and Irian Barat, the western part of the island of New Guinea. The total land area is 190 million hectares – over 14 times the area of Peninsular Malaysia – and of that total, Sumatra, Kalimantan and Irian Barat cover about 75 per cent (see Figure 2). The population is about 130 million but the bulk of this number lives on Java giving rise to considerable social problems which the government is trying to ease by its transmigration schemes. Indonesia's natural resources include oil, but agriculture is still the source of livelihood for most of the people.

Figure 2: Map of Indonesia showing the cocoa areas, and distribution of podborer.



In such a large country the climate varies according to situation and elevation but on average the climate is typically equatorial with a well distributed rainfall and fairly uniform temperatures. Climatic data for Medan in North Sumatra where much of the cocoa is grown are given in table 1.

THE ERA OF CRIOLLO COCOA

Cocoa is thought to have been introduced to Sulawesi from the Philippines in the 17th century and small quantities were produced from that island at an early stage. Criollo cocoa was planted as this type was carried across the Pacific to the Philippines in 1600 and remained the type grown there until Amazon hybrids were introduced in the late 1970s. There are several volcanoes in Java so the soils are fertile and for many years agricultural development was concentrated there. This was encouraged by releasing land for plantations, one of the first crops being coffee. When coffee leaf rust caused the abandonment of this crop, planters turned to a wide variety of others, including cocoa which was introduced from Sulawesi. This took place about 1880 and cocoa was planted on many estates in Central and Eastern Java.

The first plantings had not been in production for long before pest problems arose. The major pests were *Helopeltis* bugs and the cocoa pod borer, *Acrocercops cramerella* and the losses caused by them, especially by the cocoa pod borer, have been a limiting factor which prevented the expansion of cocoa plantings. Cocoa production increased gradually, reaching a peak of about 2500 tonnes in 1910 but declined thereafter as cocoa was abandoned in favour of more profitable crops. By 1936 almost all the cocoa plantations in East Java had been converted to other crops but cocoa continued to be grown in Central Java.

The *Helopeltis* bugs, *H. antonii* and *H. theivora*, vary considerably in the intensity of their attack but are capable of serious damage to young shoots and to pods, reducing yield. Before the development of modern pesticides planters tried to control *Helopeltis* by means of the Black ant, *Dolichoderus bituberculatus,* nests of which were attached to cocoa trees. The advent of HCH has made effective control possible but this is dependent on careful monitoring of damage and efficient spraying techniques. The cocoa pod borer is a much more difficult pest to control. Soon after its presence was noticed, research on the life-cycle, habits and alternative hosts was started and was carried out principally by two men, Zehntner and Roepke, who successively tackled the problem between 1900 and 1917. This research has recently been reviewed and translated into English (Wessel-Riemens, 1981). The method of control that arose from this research was the removal of all pods from the trees at a time of low crop. This procedure, known as 'rampasan', broke the life cycle of the moth but it was never fully effective as it is extremely difficult to remove all the pods from a large planting.

Apart from research on the cocoa pod borer, selection work was started by van Hall about 1912 on three estates in Central Java: Djati Roenggo, Getas and Assinan, the objective being to find trees of high yield and pale beans. Djati Roenggo was one of the older estates where in 1888 the manager, MacGillvray, tried to introduce Criollo cocoa from Venezuela in order to improve the flavour of the estate's cocoa. However the introduction proved to be a Trinitario variety which was considered to have an inferior flavour. MacGillvray was disappointed but the seed from these trees gave very

TABLE 1. CLIMATIC DATA FOR MEDAN, SUMATRA 3° 35'N 98° 41'E

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Total	Number of Years Data
Rainfall (mm)	114	91	104	132	175	132	135	178	211	259	246	229	2487	58
Temperature														
Mean max. (°C)	29.9	31.3	31.5	31.6	31.7	31.4	31.8	31.2	30.9	30.1	29.7	29.6	–	10
Mean min. (°C)	22.2	22.1	22.5	22.8	23.2	22.7	22.4	22.3	22.4	22.6	22.5	22.3	–	10
Sunshine (hours/day)	5.4	7.1	7.0	7.2	7.7	8.1	8.1	7.5	7.0	6.2	5.9	5.4	2508	21

(Source: Hartley, 1977)

vigorous progeny, probably the first example of hybrid vigour in cocoa and it was from amongst these progeny that van Hall made his selections. With the decline in interest in cocoa, this work was not pursued vigorously and it was not until 1946 that three of the selections DR1, DR2 and DR38 were finally issued for commercial use.

Van Hall worked in the then Dutch East Indies from 1909 to 1926 as Director of the Institute for Plant Diseases and Plantation Crops (Toxopeus, 1969). The first edition of his book "Cocoa" was published in 1914 and following his return to the Netherlands where he became head of the library at what is now the Royal Tropical Institute, he revised the book and the second edition "Cacao" was published in 1932. This text-book was the best and most thorough work on cocoa in its day.

Van Hall also played an important part in initiating the work on the fermentation of cocoa in Java which was carried out by Roelofsen and Giesberger. They wrote a treatise on their investigations (Roelofsen and Giesberger, 1947) which was issued in the year of van Hall's death. This was a valuable work but, being written in Dutch, did not receive the attention it deserved.

POST-WAR DEVELOPMENT

After independence in 1945 all the Dutch plantations were taken over by Government and formed into more than 30 groups, each group covering, on average, 30,000 hectares. Initially each group tended to concentrate on one crop the main ones being rubber, oil palm and tobacco, but most of the groups have now diversified which is more appropriate to their new status as limited companies with the Government as shareholder. They are now referred to as PTPs, *Perseroan Terbatas Perkebunan* – Agricultural Limited Companies.

In 1951 cocoa planting was resumed in East Java, the planting material being the DR clones already mentioned. They were propagated by budding and have proved to be good yielders. The extent of cocoa in East Java has grown to 10,000 hectares and production has risen accordingly. In 1971 all the plantations in East Java were surveyed for the cocoa pod borer but no sign of the pest was found. This suggests that there are no alternative hosts for the pest in East Java and that the moth was introduced with the cocoa from Sulawesi to which it may have been introduced at an earlier date from the Philippines (Wardojo, 1980). The present distribution of the cocoa pod borer in Indonesia is in Central Java where very little cocoa remains, in Northern Sulawesi, in Halmahera and some other islands in the Moluccas. It does not occur in Sumatra.

THE INTRODUCTION OF FORASTERO COCOA

One of the PTPs in North Sumatra – PTP VI – initiated the planting of bulk cocoa in Indonesia by introducing Amazon hybrid seed from Malaysia in 1973. The first plantings developed well, 97 hectares on Adolina estate yielding, 1.7 tonnes per hectare in 1977 and subsequent years. This encouraging start has lead to considerable expansion in the area near Medan, where the soils are developed from volcanic material – Lake Toba is an ancient crater lake – and are very fertile. Coupled with well distributed rainfall, growing conditions can be called ideal and quite remarkable growth and early yields have been achieved. On one private estate several plantings have yielded 600 kg dry beans per hectare within 2½years of planting.

Following these early successes the Government formed ambitious plans for planting cocoa in many parts of Indonesia. These envisaged planting over 60,000 hectares by 1983/84 and 190,000 hectares during the following 5 years (Koestono, 1980). While most of the cocoa already planted is on plantations, at least half the new plantings will be on small-holdings. There will be difficulties in carrying out this programme at the speed envisaged. In the first place the soils in much of the undeveloped parts of the country cannot compare with these around Medan. In general the soils are much less suitable for cocoa and it will take time to locate the potential areas. The second difficulty lies in developing sufficient managerial expertise to handle this programme. The planting and production of bulk cocoa is obviously a new skill and PTP VI, which has been given the task of implementation, will have to expand its staff considerably for this programme. This will be done but it takes time for personnel to gain the necessary experience. PTP VI is being assisted in this work by the Cocoa Advisory Group for Indonesia, a small group of consultants with lengthy cocoa experience. Great interest is being shown in cocoa as indicated by the attendance of some 300 planters, extension workers and others at a National Cocoa Conference held in Medan in September 1980.

Although the first plantings of Forastero cocoa are not yet 10 years old, a selection programme started within a few years has already produced improved material. A seed garden has been planted which will produce enough seed for the national programme.

There is considerable potential for cocoa production which will be realised in time. The cocoa pod borer poses a threat to this development as extension of the cocoa area may allow this pest to extend its area. However, awareness of the danger, vigilance in the field and strict quarantine over internal movement of pods will minimise this threat.

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Archives of Cocoa Research

Background: Research on cocoa production started soon after the discovery of the cocoa bean and the innovation of chocolate by Europeans. Until some time after the last war it was mainly the concern of European scientists working in tropical countries. Most of the research was reported in the Dutch, English, French and German languages. This capital of information and experience, accumulated over some 400 years, lies scattered, in the libraries of the world in a great variety of books and articles in presently issues of obscure journals. Language problems and poor availability often render this massive body of knowledge inaccessible to the present day researchers.

Objective: Through the medium of the *Archives of Cocoa Research* it is proposed to make this information selectively and systematically available to todays research, extension and training workers in annual or biannual volumes and thus put it to work again.

The contents of a volume will either consist of the reproduction of English text, or consist of literal translations of (parts of) publications in other European languages. Each volume would have a, properly introduced, central theme; the work of a certain author; the production of a certain institute in a critical period; one or a few related subjects. The theme will have a distinctively up-to-date relevance.

Form: Volumes will be bound and contain about 160 pages of text and figures on high quality paper printed by offset.

Costs: US$ 25, – for each volume, including postage. The Archives is a non profit operation started off on an initial budget by I.O.C.C. members through the Cocoa Research Policy Committee and the American Cocoa Research Institute (A.C.R.I.). We hope to be able to continue on the basis of this price.

Volume 1 is now available and is a reprint of Pound's reports on his Amazon river expeditions of 1938 and 1942 and other relevant papers.

Volume 2 will consist of translations of the more important parts of cocoa research in Indonesia 1900-1950 with special reference to: cocoa pod borer, *Helopeltis* and black ants, botanical research.

Further volumes will be on: Preuss' travels in S. America 1899-1901; Stahel's work in Suriname especially: Witches' broom disease, wild cocoa, botanical work, vegetative propagation, History of cocoa production in S. America (Erneholm, Rubio Sanchez and others); classical papers from the former I.C.T.A. annual reports on cocoa research. We are keeping a flexible schedule of topics because we want them to be relevant to present day problems.

The Archives of Cocoa Research is a joint publication by the International Office of Cocoa and Chocolate, Brussels and the American Cocoa Research Institute, Washington, D.C. in co-operation with the Royal Tropical Institute, Amsterdam.

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Cumulative Index Cocoa Growers' Bulletin 1—32

Cumulative Indices by subject and by author for Cocoa Growers' Bulletins 1—32 have been prepared by Dianne Stillwell, Information Scientist, Cadbury Schweppes p.l.c. In every case issue number preceeds page number and as many cross references as possible have been included.

Cumulative Subject Index

Cumulative Author Index

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Until his recent retirement was transport manager for Cadbury Ltd. with responsibility for movement of this Company's substantial import of cocoa beans; worked on many other aspects of transport by sea and land; chairman of International Office of Cocoa and Chocolate Working Party 15, established to discuss the use of containers for the transport of cocoa.

Cocoa Abstracts

Cocoa abstracts are reprinted from "Abstracts on Tropical Agriculture" published by the Royal Tropical Institute, Amsterdam.

June 1981

Conquering the capsid in West Africa — *Africa Agriculture (UK)* no. 1, p. 30-31 1981.

This article briefly describes capsids (mirids) infesting cacao, their feeding methods, mode of damage and history of their chemical control with emphasis on Gammalin 20 (lindane).

The optimal producer price of cocoa in Ghana FRANCO, G.R. International Monetary Fund, Washington, D.C., USA — *Journal of Development Economics (Netherlands)* v. 8(1) p. 77-92; Feb 1981.

A model is proposed to compute the producer price of cacao that maximizes either export duty receipts or export earnings. The optimum price is higher than the prevailing producer price, but also higher than the world price at the current exchange rate of the cedi. At this exchange rate, the Ghanaian cacao industry cannot be rehabilitated, unless it is subsidized.

(Contribution to the study of the flower biology of the cocoa tree: results of artificial pollination) Contribution à l'etude de la biologie florale du cacaoyer: bilan de pollinisations artificielles PAULIN, D. Institut Français du Café et du Cacao (IFCC), Abidjan, Ivory Coast — *Café, Cacao, Thé (France)* v. 25(2) p. 105-112; Apr 1981.

The hand pollination of 8 trees belonging to two cacao clones showed that: (1) potentially, the trees are able to produce throughout the year, (2) the number of seeds per pod is linked with the amount of pollen, (3) the first 120 days after fruit set are critical, (4) the usual high loss of fruits is due in particular to insects and *Phytophthora*, while the effect of physiological wilt is often over-estimated.

(Study of cocoa tree pollination conditions in Togo) Etude des conditions de pollinisation du cacaoyer au Togo LUCAS, P. Institut Français du Café et du Cacao (IFCC), Kpalimé, Togo — *Café, Cacao, Thé (France)* v. 25(2) p. 113-120; Apr 1981.

The time spent by diptera, aphids, thrips and ants in the flowers of the cacao tree, as well as their pollinating efficiency have been calculated. To increase the natural pollination of the cacao tree, the use of coloured traps was envisaged, based on the fact that the attractiveness of the flowers must vary with their colour.

Cocoa drying on a platform type dryer with and without drying air recirculation MCDONALD, C.R. and FREIRE, E.S. Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Tropical Agriculture (Trinidad and Tobago)* v. 58(3) p. 253-265; Jul 1981.

Cocoa was dried under controlled field conditions, using a platform type unit with and without recirculation of the drying air. A value known as the 'overall thermal efficiency' was defined to enable the results presented here and elsewhere to be compared. By the application of a reduced air flow to the non-recirculation runs, efficiencies at least as high as those obtained with recirculation could be obtained when drying at or near 60°C. At 70°C the application of recirculation resulted in some increase in efficiency. Overall thermal efficiency values for the no-recycle runs, over the range of conditions tested, was independent of drying air temperature. With recirculation, however, the degree of cocoa loading and to a lesser extent the drying air temperature were important in determining system efficiency. The drying rate curves of the runs carried out showed three distinct periods, corresponding well with previously published results.

(Annual Report 1980) Rapport d'activité 1980 Institut Français du Café et du Cacao (IFCC), Paris, France — 104 p. 1980.

This Annual Report 1980 describes the activities of IFCC in the fields of research, development, training and documentation in 6 countries, i.e. Cameroon, France, Gabon, Ivory Coast, New Caledonia, and Togo. Work on coffee, cacao and tea continued and was resumed on kola.

(How to start a cacao plantation) Aspectos que debe tener presente el agricultor que piensá sembrar cacao MORENO P, L.J. Departamento de Fomento, Compañía Nacional de Chocolates S.A., Medellín, Colombia — *Cacaotero Colombiano (Colombia)* no. 16, p. 9-11; Mar 1981.

The cultivation of cacao is promising in Colombia. The various factors to be considered when starting the cultivation of cacao are very briefly summarized.

(Research on Monilia disease of cacao in Colombia) Avances en la investigación de la moniliasis del cacao en Colombia MERCHAN V, V.M. Instituto Colombiano Agropecuario (ICA), Manizales, Colombia — *Cacaotero Colombiano (Colombia)* no. 16, p. 26-41; Mar 1981.

Cacao is grown on an area of about 75,000 ha in Colombia. Monilia pod rot, caused by *Moniliophthora roreri* (syn. *Monilia roreri*) is bringing about 30 per cent yield loss on the average. Etiology, epidemiology and control measures are discussed.

(The influence of pulp on seed germination and seedling growth in cocoa) Pengaruh pulp terhadap perkecambahan benih dan bibit tanaman cokelat (Theobroma cacao L) ANWAR, S. and HUTOMO, T. — *Bulletin Balai Penelitian Perkebunan Medan (Indonesia)* v. 11(2) p. 67, 99-103; June 1980.

In a nursery experiment, no differences were found in the germination of seed planted with and without its natural covering of pulp or in the subsequent growth of the seedlings.

Results of cocoa nutrition research as a basis for fertilizer use WESSEL, M. Agricultural Univ., Wageningen, Netherlands — 13 p; Sep 1980.

During the last fifty years research on cacao nutrition has been conducted in different parts of the world. In this paper research findings are reviewed and translated in terms of fertilizer treatments. Special reference is made to the fertilizer requirements of cacao in North Sumatra. (Paper presented at the National Cacao Conference, Medan, Indonesia, 16-18 September 1980).

(A new weapon against brown rot of cacao) Une nouvelle arme contre la pourriture brune du cacao — *Cameroun Agricole, Pastoral et Forestier (Cameroon)* no. 177, p. 11-13; Jul 1980.

The Ciba-Geigy technical office in Cameroon, which has developed plant protection programmes for a number of crops grown in Cameroon, has now successfully tested Ridomil (metalaxy) for the control of *Phytophthora palmivora* at both the research and the plantation level.

Agricultural development effort in Nigeria: an economic appraisal of the Western State Settlement Scheme ANDREOU, P. Department of Agricultural Economics, American Univ. of Beirut, Beirut, Lebanon — *Agricultural Systems (UK)* v. 7(1) p. 11-20; Jul 1981.

This paper examines land consolidation and cooperative marketing as tools for achieving higher agricultural productivity, and analyses the probable causes of the failure of such an effort in the Western State of Nigeria. Conclusions can be drawn from past misdirections having regard to the highly charged political atmosphere during the period of establishment of the project.

Annual report and accounts for the 12 months ended 30th June 1980 Cameroon Development Corp., Bota, Victoria, Cameroon — 38 p. 1980.

Administration, finance, agricultural development projects and auxiliary services of the Cameroon Development Corporation are presented for the year ending 30th June, 1980.

Tropical exports and economic development. New perspectives on producer response in three low-income countries INGHAM, B. University of Salford, Salford, UK — MacMillan Press, London (UK) 130 p. 1981.

The author applies economic theory to the historical experience of cacao production by smallholders in Ghana, Nigeria and New Guinea in order to arrive at a better understanding of empirical findings on smallholder decision-making.

The intercropping of smallholder coconuts in Western Samoa: an analysis using multi-stage linear programming BURGESS, R.J. Development Studies Centre, Australian National Univ., Canberra, Australia — *MADE Research Series — Development Studies Centre, Australian National University (Australia)* no. 4, 285 p. 1981.

A modern systematic intercropping system is examined as to its technical and economic feasibility as a means of providing rural family cash income requirements in competition with alternative sources. The technical basis of intercropping is established prior to detailing individual crop yield, price and input parameters. Cash flow data obtained were compared with returns to labour. To obtain an optimal combination of coconut and intercrops from an economic standpoint, alternative programming techniques were considered and multi-stage linear programming adopted. This permitted adequate modelling of the intercropping system's inter-relationships and optimization of the system over the life-cycle of the coconut stand.

The present status of cocoa bee bug, Platyngomiriodes apiformis Ghauri, in Sabah and its life cycle study PANG, T.C. Agricultural Research Center, Department of Agriculture, Kota Kinabalu, Sabah, Malaysia — *Trop. Agric. Res. Series. Proc. of a Symp. on Trop. Agric. Res., Kyoto, Japan, Aug 6-7, 1980* no. 14, p. 83-90; Mar 1981.

Cocoa is a comparatively new crop to Sabah, currently covering an area of about 3845 ha. The bee bug, *Platyngomiriodes apiformis* has become a cocoa pest of considerable importance, but it has not yet been reported as a cocoa pest elsewhere in Malaysia. Life history, habits, seasonal incidence, distribution and damage are reviewed. Control measures consist of spraying with lindane (0.1% a.i.) at a rate of about 135 l of spray liquid per ha.

(The socio-economic aspects of cacao growing. A bibliography) Aspectos sócio-econômicas da cacauicultura. Levantamento bibliográfico SANTOS, J.C. and LEITE, I.A. Divisão de Bibliografia e Documentação, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *CEPEC, Itabuna, Bahia (Brazil)* 179 p. 1980.

This bibliography dealing with socio-economic aspects of cacao cultivation contains 1169 references covering the period between 1914 and 1979.

Cacao genetic resources in Latin America WILLIAMS, J.T. International Board for Plant Genetic Resources (IBPGR), FAO, Rome, Italy — *FAO Plant Genetic Resources Newsletter (FAO)* no. 45, p. 20-22; Apr 1981.

Since cacao is an important cash crop for developing countries and its genetic resources are being threatened, IBPGR convened a working group in 1980 to propose counter-measures. Its report recommends that Brazil and Ecuador maintain primary collections, Trinidad and Costa Rica universal collection depositories and USA and UK quarantine transfer collections. Priority areas for collecting in Central and South America were identified.

(New developments in cacao cultivation in Malaysia and Indonesia) Nieuwe ontwikkelingen in de cacaocultuur van Maleisië en Indonesië WESSEL, M. Department of Tropical Crops, Agricultural Univ., Wageningen, Netherlands — *Landbouwkundig Tijdschrift (Netherlands)* v. 93(9) p. 229-233; Sep 1981.

The article reviews the history and the development during the last 15 years of cacao cultivation in Malaysia and Indonesia in terms of area, planting material, yield and bean quality. The combined production of both countries totals at present some 40 000 tons. In view of planted and planned planting areas, the achievements and favourable environmental conditions the author expects a threefold increase in production within the next 10 years.

(A review of theses on cacao presented at the Graduate School at Turrialbà, over 1948-1979) Resúmenes de tesis de cacao presentadas a la Escuela para Graduados de Turrialba 1948-1979 ARIAS DE G, A.M. Biblioteca Conmemorativa Orton, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica — *Serie Bibliotecología y Documentación — CATIE (Costa Rica)* no. 2, 74 p. 1980.

This is a compilation of (mostly) unpublished theses on agronomic matters dealing with cacao. They can be requested from Biblioteca Commemorativa Orton, CATIE at Turrialba, Costa Rica.

(The herbarium of the Cacao Research Centre of Itabuna, Brazil) O herbário do Centro de Pesquisas do Cacao em Itabuna, Brasil MORI, S.A. and SILVA, L.A.M. Divisão de Botânica, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil – *Boletim Técnico – Centro de Pesquisas do Cacau (Brazil)* no. 78, 31 p. 1980.

The herbarium comprises about 19 500 specimens, for the greater part collected in South Bahia. The aim of this publication is to furnish geographic data on the cacao producing region and on types of vegetation.

(Economics of spraying copper fungicides by helicopter against black pod rot disease of cacao) Estudo da economicidade do controle da podridão parda do cacaueiro com fungicida cúprico aplicado por helicóptero MONTOYA, L.J., RAM, A. and MEDEIROS, A.G. Divisão de Socioeconomia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil – *Boletim Técnico – Centro de Pesquisas do Cacau (Brazil)* no. 79, 37 p. 1980.

This paper analyses the economics of helicopter aerial spraying for controlling black pod rot disease, caused by *Phytophthora palmivora*, in cacao plantations. The standard spraying of 12 l/ha using ground equipment was also included. Two dosages of Copper Sandoz (cuprous oxide), 6.4 kg in 20 l/ha and 12.8 kg in 40 l/ha, sprayed by helicopter, were compared with 6.4 Copper Sandoz in 12 l/ha sprayed with ground equipment, in private plantations in 7 localities. It was shown that aerial spraying was not sufficiently advantageous in terms of costs.

(Through the leaves of the cacao-tree: changes in the Eton society of southern Cameroon) A travers le feuillage du cacaoyer: changements dans la société éton du Cameroun méridional DELPECH, B. ORSTOM, Abidjan, Ivory Coast – *Cahiers ORSTOM. Série Sciences Humaines (France)* v. 17(3-4) p. 273-277 1980.

The country of Eton covers about 3000 km^2 and produces 23% of the national cacao output. After having made a study of the history of the Eton people, the author describes the impact of the cultivation of cacao on the social and economic development of this people.

August 1981

Pod rot of cacao caused by Moniliophthora (Monilia) roreri EVANS, H.C. Overseas Development Administration, London, UK – *Phytopathological Papers – Commonwealth Mycological Institute (UK)* no. 24, 44 p.; Mar 1981.

Pod rot disease of cacao caused by the fungus *Moniliophthora roreri* is one of the principal yield-limiting factors in Colombia and Ecuador. This article deals with origin and distribution of this disease, host range, taxonomy and morphology, disease losses, types of infection by this fungus, and the disease cycle.

Mammalian pests of cocoa in South India BHAT, S.K., NAIR, C.P.R. and MATHEW, D.N. Regional Station, Central Plantation Crops Research Inst., Vittal, Karnataka, India – *Tropical Pest Management (UK)* v. 27(3) p. 297-302; Sep 1981.

By 1977, some 6500 ha were planted to cacao in South India, most in mixed plantations. The Western Ghats squirrel, *Funambulus tristriatus*; the South Indian palm squirrel, *F. palmarum* and the black rat, *Rattus rattus* were observed to be causing much damage to cacao in South India; the palm civet, *Paradoxurus hermaphroditus* and the bonnet monkey, *Macaca radiata* were causing minor damage. Monthly surveys made for one year in Karnataka showed that the percentage of damage caused by rodents was 29.0; that by civets and monkeys 0.4 and 0.3 respectively. In Kerala and one district of Tamil Nadu rodents were estimated to be causing 15% damage and civets 3% ; no monkey damage was found.

An integrated control scheme for cocoa pests and diseases in Papua New Guinea SMITH, E.S.C. Lowlands Agricultural Experiment Station, Keravat, Papua New Guinea – *Tropical Pest Management (UK)* v. 27(3) p. 351-359; Sep 1981.

Pest control recommendations in Papua New Guinea cocoa plantings are based on an integrated approach to insect pest and disease management. The most damaging problems are *Pantorhytes* weevils, black pod and bark canker disease (both caused by *Phytophthora palmivora*) but vascular streak dieback (VSD) disease is important in some areas of the country. Recent investigations have shown that certain cocoa environments are unfavourable to Pantorhytes and some other major pests. In particular, the selection of shade types and levels, the spot treatment of borer channels with penetrant insecticides and the introduction of antagonistic ant colonies can reduce populations of the main insect pests to low and stable levels. In addition, planting material resistant to VSD, black pod and bark canker is currently being propagated and released to growers.

The cocoa pod borer moth in Malaysia WOOD, B.J. Ebor Research, Batu Tiga, Selangor, Malaysia – *Perak Planters' Association Journal (Malaysia)* p. 28-36 1980.

The cacao pod borer moth *Acrocercops cramerella* is now firmly established in cacao in Sabah. This paper reviews some aspects of its biology and control under the following headings: biology, early detection of attack, history and origin of the pest; losses caused; control approaches, (a) cultural control and regulation, (b) biological, (c) chemical, and (d) other control approaches; future outlook.

Control of Apogonia spp. in cocoa through ground application of insecticides OOI, L.H. and HAN, K.J. Highlands Research Unit, Syarikat Penyelidikan Pertanian Barlow Boustead Sd. Bhd., Kelang, Selangor, Malaysia – *Perak Planters' Association Journal (Malaysia)* p. 76-84 1980.

This paper reports the results of two experiments evaluating the efficacy of granular insecticide Dursban 2.5G (chlorpyrifos), heptachlor 10G, Furadan 39 (carbofurna) and Volaton 5G (phoxim) on soil inhabiting *Apogonia* spp. (mainly *A. expeditionis* and *A. cribricollis*) in a cacao plantation.

(Chemical composition of virus infected cocoa leaves) Komposisi kimia daun cokelat terserang virus MUSTAFA, M., DELILAH, M.A. and SYAFRUL, L. Balai Penelitian Perkebunan Medan, Indonesia – *Bulletin Balai Penelitian Perkebunan Medan (Indonesia)* v. 11(3) p. 113, 127-134; Sep 1980.

Cocoa leaves infected with Cocoa Swollen Shoot Virus were analysed to study the changes in chemical composition that might have taken place. It was revealed that in the chlorotic parts of the leaf, the chlorophyll and the lipid contents were very significantly lower than those in the non-chlorotic parts. The water, glucose, sucrose, free amino acids and protein contents did not show any significant difference. This finding would mean that in the chlorotic parts of the leaf, the vascular system is still in order, and the transport of water and sugar to all parts of the plant is unaffected by the viral infection.

(Cacao cultivation as an aid to soil conservation) Defendamos el cultivo del cacao como un recuperador conservador de suelos LONDOÑO, H.C. Federación Nacional de Cacaoteros, Caldas, Colombia – *Cacaotero Colombiano (Colombia)* no. 17, p. 10-13; Jun 1981.

About 1 139 000 ha of land are cultivated in Colombia, of which only 24.8% (282 000 ha) are free of erosion. The destructive effects of erosion are discussed and the beneficial influence of cacao cultivation, considered as being a form of afforestation, on soil conservation is recorded.

(Cacao fermentation bibliography) Fermentação de cacau. Levantamento bibliográfico SANTOS, J.C. (COMP.) Divisão de Bibliografia e Documentação, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Brazil – 42 p. 1980.

This bibliography on the fermentation of cacao contains 418 references, covering the period 1901 to 1980.

(Summary of the meeting on cacao held at Cartagena, 19 to 21 May 1981) Resumen del seminario sobre Agronomìa del Cultivo de Cacao, Cartagena, Mayo 19-21 de 1981 MUÑOZ, A.A. Federación Nacional de Cafeteros, Bogota, Colombia – *Cacaotero Colombiano (Colombia)* no. 18, p. 10-25; Sep 1981.

During this meeting, held at Cartagena from 19 to 21 May 1981, papers were presented in 6 sessions dealing with economic perspectives of cacao production, breeding, cultural practices, disease control, and quality and field processing of cacao. This report gives an overview of the matters which were discussed.

(The effect of diseased fallen pods on the incidence of Monilia pod rot of cacao caused by Moniliophthora roreri) Exploraciones acerca de la importancia que tienen los frutos enfermos dejados sobre el suelo como fuentes primarias de infección de Moniliophthora roreri (Cif. & Par.) Evans et al. CUBILLOS Z., G. Departamento de Fomento, Compañia Nacional de Chocolates, Medellín, Colombia – *Cacaotero Colombiano (Colombia)* no. 18, p. 38-43; Sep 1981.

Good results have been obtained in controlling Monilia pod rot of cacao caused by *Moniliophthora roreri*, through collecting and destroying affected pods twice weekly.

However, this method is very labour-intensive. A field trial was conducted in which 400 infected, sporulating pods were spread over 16 plots. Disease incidence countings started 2 weeks later and were continued over a period of 3 months. The results showed that high concentrations of diseased material did not affect disease incidence. The best control measure seems to be weekly collection of all diseased pods.

(Importance of endomycorrhiza in the mineral nutrition of cacao) Importância da endomicorriza na nutrição mineral do cacaueiro EZETA, F.N. and SANTOS, O.M. Centro Nacional de Pesquisa de Mandioca e Fruticultura, Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Cruz das Almas, Bahia, Brazil — *Revista Brasileira de Ciência do Solo (Brazil)* v. 5(1) p. 22-27; Jan 1981.

Mycorrhiza for cacao were studied in pot experiments under unsterile and partially sterile soil conditions. Plants grown in sterile soil were stunted showing symptoms of zinc deficiency. Plants inoculated with *Gigaspora margarita* recovered after 15 weeks while control plants remained stunted. Zn concentration as well as total Zn uptake increased by inoculating with *G. margarita.* In sterile soil, inoculation with *G. margarita* increased total nutrient uptake two-fold relative to other species.

(A new industrial solar drying technique for cacao) Nova técnica de secagem solar industrial de cacau BORGES, J.M., ROA, G. and VILLA, L.G. Departamento de Engenharia Civil, Universidade Federal de Viçosa, Vicosa, Minas Gerais, Brazil — *Revista Ceres (Brazil)* v. 28(155) p. 19-35; Jan 1981.

The good results obtained in small-scale tests of cocoa drying using forced aeration with air heated in solar collectors and by artificial heaters led the authors to develop a prototype of a solar dryer to operate under farm conditions with the same capacity as the traditional dryers of the cocoa region of Bahia, Brazil. The new process is technically and economically feasible for drying cocoa. Comparing the new process with the traditional one of the 'barcaças', it presented the following advantages, without imparting any defect to the quality of the product: (a) reduction of the dryer area 1:4; (b) reduction of the cost of the installation 1:2; (c) reduction of the drying time 1:16; (d) reduction of the hand labour 1:14; and (e) no development of mould on the beans.

(The control of black pod of cocoa with copper fungicides sprayed in high and low volumes) Controle da podridão parda do cacaueiro com novas formulações de fungicidas à base de cobre empregados a alto e baixo volumes FIGUEIREDO, J.M. DE and LELLIS, W.T. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 11(1) p. 33-38; Jan 1981.

The quantity of fungicides employed in the cacao region of Bahia has increased from 100 t in 1970 to 1800 t in 1978. Field experiments were undertaken against black pod disease (Phytophthora palmivora) with 6 fungicides for 2 years in order to test their efficacy. Two oil formulations of copper oxychloride were tested at low volume (20 l/ha), viz. Duriac and Kauritol, depositing 2.81 and 2.80 g Cu/tree. Coprantol (copper oxychloride), and Copper Sandoz (cuprous oxide) were applied in 160 l of spray liquid/ha, with deposits of 2.47 g and 4.00 g Cu/tree respectively. Oxychloride Sandoz was applied in 20 l spray liquid/ha, with a deposit of 2.77 g Cu/tree. It was shown that Duriac, Kauritol, Oxychloride Sandoz and Coprantol were effective, in spite of their depositing less Cu per tree than is usually applied.

The effect of succinic acid 2,2-dimethylhydrazide, chlorflurenol methyl ester, and N,N-dimethyl piperidine chloride on the growth and development of seedlings of Theobroma cacao L. ORCHARD, J.E. and RESNIK, M.E. Divisão de Botânica, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 11(1) p. 39-46; Jan 1981.

An experiment was carried out on the effect of three growth retardants on the growth and development of seedlings of cacao. Three month old plants were sprayed with various concentrations of succinic acid 2,2-dimethylhydrazide (daminozide, SADH), chlorflurenol methyl ester (a morphactin), and N,N-dimethyl piperidine chloride (mepiquat chloride, PIX). Terminal shoot growth was completely inhibited by the application of 100 and 1000 ppm morphactin. These two treatments caused lateral shoot development, but subsequent lateral shoot growth only continued with plants sprayed with 100 ppm morphactin. Of the other growth retardants, 5000 ppm SADH and 10 000 ppm PIX reduced internode elongation but no reduction in the rate of growth was observed.

Defoliation and dieback of cacao in India MOHANAN, R.C. Regional Station, Central Plantation Crops Research Inst., Vittal, Karnataka, India – *Revista Theobroma (Brazil)* v. 11(1) p. 87-89; Jan 1981.

Severe defoliation and dieback of cacao were observed in many cacao plantations in India. The symptoms of this disease are described. *Calonectria rigidiuscula* was consistently isolated from the leaves and stem. Pathogenicity experiments proved that this fungus is the causal organisms. This is the first report of the occurrence of defoliation and dieback of cacao caused by *C. rigidiuscula* in India.

16th Annual report 1980 Research Dept., United Plantations Berhad, Teluk Anson, Perak, Malaysia – 91 p; 20 Feb 1981.

This report gives an account of the activities of the United Plantations Research Department (Malaysia) for the year 1980. The research activities are grouped in the following fields: (1) oil palm – breeding and selection, agronomy, nutrition, physiology; (2) coconuts – breeding and selection, agronomy, nutrition; (3) cacao – breeding and selection, agronomy, nutrition; and (4) crop protection – pests, diseases, weeds. The report also includes a chapter on extension and advisory activities. Rainfall and sunshine records are presented.

September 1981

(Study on the method of foliar diagnosis of fertilization and mineral nutrition of cacao (Theobroma cacao) in Ivory Coast) Etude par la méthode du diagnostic foliaire de la fertilisation et de la nutrition minérale du cacaoyer (Theobroma cacao L.) en Côte d'Ivoire VERLIERE, G. Institut Français du Café et du Cacao (IFCC), Abidjan, Ivory Coast – *Travaux et Documents de l'ORSTOM (France)* no. 131, 275 p. 1981.

This book deals with foliar diagnosis and mineral nutrition of cacao under the following headings: (1) growth and ecological conditions of cacao and the history of fertilizing; (2) yield increase by fertilizing on granitic soils and relationships of higher yields and foliar diagnosis; (3) ditto for sandy soils; (4) ditto for shale soils; (5) the effect of K, Ca, and Mg ratios in hydroponic culture; (6) fertilizing and chemical composition of fruit and seed; (7) yield improvement by fertilizing and mineral nutrition; and (8) conclusions.

Cytokinin-like substances and cherelle wilt in cacao (Theobroma cacao L.) UTHAIAH, B.C. and SULLADMATH, U.V. Division of Horticulture, University of Agricultural Sciences, Bangalore, Karnataka, India – *Journal of Plantation Crops (India)* v. 8(2) p. 78-81; Dec 1980.

Studies with cacao, conducted in India, showed wilting pods contained less cytokinin-like substances than health pods except in the tenth week from fruit set. During the wilt susceptible stage of pod growth healthy as well as wilting pods showed lower levels of cytokinin-like substance.

Boron nutrition of Amazon cocoa in Nigeria. 1. Early results of fertilizer trials OJENIYI, S.O., EGBE, N.E. and OMOTOSHO, T.I. Cocoa Research Inst. of Nigeria, Ibadan, Nigeria – *Experimental Agriculture (UK)* v 17(4) p. 399-402; Oct 1981.

Boron application increased bean yield of 12-year old cacao trees on boron deficient soil between 13 and 70% . Application of N and K reduced the impact of B application.

The cocoa of discord: the Indian dilemma – *Planters' Chronicle (India)* v. 76(8) p. 360-369, 384; Aug 1981.

Cocoa ranks second to coffee in world trade. Most of the annual world production of some 1.5 million tons is export. India started growing it in the early 1970s, mostly by small farmers interplanted in arecanut or coconut. At present production is around 3000 tons, but this is expected to rise to 10 000 tons by 1982/83 from plants not yet bearing fruit. However this implies oversupply for export, and the prices are low. In this connection the cocoa situation was reviewed at a seminar to initiate the organization of the cocoa growers in the country. Subjects discussed included cultivation techniques, varieties, quality improvement, research, marketing and the International Cocoa Agreement.

Effect of growth regulators on cherelle wilt in cacao Theobroma cacao L. UTHAIAH, B.C. and SULLADMATH, U.V. Division of Horticulture, University of Agricultural Sciences, Bangalore, Karnataka, India — *Journal of Plantation Crops (India)* v. 9(1) p. 46-50; Jun 1981.

Studies with benzyladenine (BA), gibberellic acid (GA_3) and indole acetic acid (IAA) conducted in India showed that the incidence of cherelle wilt was significantly reduced by the growth regulators. Treatment with BA at 1 ppm + IAA at 200 ppm + GA_3 at 400 ppm reduced cherelle wilt to 47% as compared to 96% in the control. A second application 15 days after the first, further reduced cherelle wilt significantly as compared to the single application. The fresh weight and number of beans per pod were also significantly increased by IAA at 200 ppm and GA_3 at 400 ppm respectively.

The financing of palm oil and cocoa industries with special reference to the Agricultural Bank of Malaysia Agricultural Bank of Malaysia, Kuala Lumpur, Malaysia — *Planter (Malaysia)* v. 57(664) p. 401-418; Jul 1981.

The financing of the oil palm and cacao industries are discussed, with special reference to the Agricultural Bank of Malaysia, its loan terms and conditions, some aspects of its loan appraisal and supervision, and the prospects, problems and constraints of the industries. The background of both industries in the country is also described. In 1979 the production of palm was 2 188 000 tons (54.2% of the world's production) and of kernels 423 000 tons. Its share in the world's export of palm oil was 70%. For cocoa bean the production in 1978 was 21 900 tons (1.52% of the world's production). For both products production figures are expected to increase.

Agricultural pricing in Togo BOVET, D. and UNNEVEHR, L. West Africa Regional Office, World Bank, Washington, D.C., USA — *World Bank Staff Working Paper (IBRD)* no. 467, 82 p.; Jul 1981.

This paper analyses the pricing policies pursued by the Government of Togo for its export crops — cocoa, coffee and cotton — and proposes an analytical framework which could be used in price-setting. Because these crops are handled through a marketing board system, the conflicting pricing policy objectives of government revenue maximization and of foreign exchange maximization determine the type of analysis used. Supply elasticities and measures of private and social profitability are computed, and the effects of competing food crop prices and cross-border trade are analysed. The results suggest that in the case of cocoa, the policy of pursuing revenue maximization in the short-run means that special measures must be introduced to provide an incentive for cocoa replanting. For cotton, the effect of input subsidies is shown to be more than offset by the relatively low producer prices.

October 1981

Cacao production on well-drained soils along the banks of the Mamoré river in north-eastern Bolivia LUGO LOPEZ, M.A. and BAUZA SALAS, J. Agricultural Experiment Station, University of Puerto Rico, Rio Piedras, Puerto Rico — *Journal of Agriculture of the University of Puerto Rico (USA)* v. 65(3) p. 309-310; Jul 1981.

Cacao is becoming an attractive crop in N.E. Bolivia. Probably some 1 million ha along the river banks of Beni are suitable for cacao production. Present yields are very low due to no fertilizer application, no pruning, excessive shade and infestation with witches' broom disease. It is necessary to make new plantings with high-yielding hybrid or clonal cacao types, resistant to witches' broom under full sunlight and intensive fertilizer application. The use of cover crops such as *Desmodium* is essential.

(Microclimatic factors associated with incidence of black pod disease on cacao pods) Fatores microclimáticos associados à incidência de podridão parda em frutos de cacaueiro BUTLER, D.R. and MENDES, L.F. Setor de Climatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 11(3) p. 167-176; Jul 1981.

Humidity, wind speed, air and pod temperatures were measured in a cacao plantation for 24 hour periods in April and October 1976. When the air temperature changed, the pod temperature lagged behind, giving a possible temperature difference of several degrees. On 9 April the dew-point of the air increased rapidly between 5.00 am and 11.00 am being above the pod temperature from 6.00 to 9.00 am. Condensed water on the pod surface was present for 5 hours, giving conditions suitable for germination of zoospores of *Phytophthora palmivora.* On 6 October the dew-point of the air did not increase after 7.30 am and remained below pod temperature so that the pod surface remained dry, not allowing infection by zoospores. In 1976 the observed duration of condensation between April and July, when the incidence of black pod disease was 17%, was significantly higher than that between September and December when 5% of the pods were infected.

Growth of Theobroma cacao L. under conditions of accelerated shade removal WILLS, G.A. and YEGAPPAN, T.M. Jasin Lallang Estate, Dunlop Estates Berhad, Jasin, Melaka, Malaysia – *Planter (Malaysia)* v. 57(667) p. 562-575; Oct 1981.

Analysis of cacao plants of 5 different ages grown under a regime of accelerated reduction of *Gliricidia maculata* shade, shows that the vegetative growth of the cacao and especially the leaf area development and root/shoot ratios are favourably influenced. The increases in leaf area index are associated with decreases in net assimilation rate. Although crop growth rate increases initially, it declines in stages after 50 months from planting. The yield of dry beans increases throughout this period despite the associated responses of net assimilation rate and crop growth rate: thus questions arise about optimum leaf area indices for cacao yield and vegetative productivity. One unfavourable characteristic of the rapid vegetative growth is the production of dominant fan branches. The height increment of these dominant branches and their potential to compensate for the yield lost from lower sloughed-off branches is discussed.

Vascular streak dieback of cocoa in Malaysia. 2. Isolation and culture techniques of causal pathogen VARGHESE, G., ZAINAL ABIDIN, M.A. and MAINSTONE, B.J. Faculty of Agriculture, Universiti Pertanian Malaysia, Serdang, Selangor, Malaysia – *Planter (Malaysia)* v. 57(667) p. 576-580; Oct 1981.

The previous method of isolation of vascular streak dieback (VSD) pathogen of cacao from cut pieces of stem of infected plants proved destructive when attempted on seedlings in the nursery. Therefore, a non-destructive technique was developed by planting sections of lamina containing midrib of leaves exhibiting symptoms. The new technique gave a higher percentage frequency of successful isolation of VSD fungus when compared to stem isolations. The fungus hitherto recorded to have poor regrowth on artificial media, when tested on a variety of media, showed satisfactory growth in Corticium culture medium. The VSD fungus was also successfully established in dual cultures with cacao stem callus tissue on solid medium.

Clorophyll stability index as an aid in screening for heat tolerance in cocoa (Theobroma cacao L.) RAVINDRAN, P.N. and MENON, M.A. Regional Station, Central Plantation Crops Research Inst., Vittal, Karnataka, India – *Planter (Malaysia)* v. 57(667) p. 581-583; Oct 1981.

Chlorophyll stability index (CSI) of 20 cacao genotypes were estimated. Results showed that CSI varied from 25.0 to zero. The highest CSI was recorded for the Criollo variety and the lowest in the NC 34, a genotype obtained from Nigeria. The CSI is inversely related to the heat resistance of chlorophyll and thus may be related to drought tolerance. The P combinations (hybrids derived from the collections of Pound) are considered as more tolerant to heat and moisture stress, and such combinations are found to have low CSI values. This finding is further supported by higher proline accumulation and better germination and seedling growth of these genotypes under induced moisture stress. Thus in cacao, CSI seems to be a parameter that can be used for screening for heat tolerance.

Some notes on maturation of cocoa beans as a means to reduction of acidity SCHWARTZ, P.B., WONG, D.Y.C. and BRIDGER, R. State Cocoa Project, Tawau, Sabah, Malaysia – *Planter (Malaysia)* v. 57(667) p. 584-587; Oct 1981.

Chocolate manufacturers regard high bean acidity as the most serious quality defect. The pH of Sabah cacao beans leaves room for improvement, being generally around 4.8 compared with pH levels of 5.3 to 5.5 for West African beans. These notes describe work carried out by the authors on a cacao estate in Sabah on maturation of beans, after completion of fermentation and prior to drying. The principles of maturation, first introduced by Liau (1976), formed the basis for the tests conducted. Observations on results obtained are presented.

Technical development in cocoa production SANTIAGO, J.T. Agronomy Dept., Filipro, Manila, Philippines — *Planter (Malaysia)* v. 57(667) p. 588-593; Oct 1981.

Two types of cacao farms may be considered, big or estate farms and smallholdings. Recommendations for planting materials for both farms, cultural practices including propagation of planting materials, plantation lay-out, the use of cover crops, pruning and plant protection measures against the pod borer (*Acrocercops cramerella*) and *Phytophthora palmivora* are discussed, and overviews of big estate holders and of smallholders are made.

Some thoughts on the life span of cocoa MONTGOMERY, P.J. — *Planter (Malaysia)* v. 57(667) p. 604-609; Oct 1981.

The life span, or longevity of a commercial tree crop such as cacao can be regarded from several aspects, but essentially, refers to the physiological age of an individual or its species, depending on the particular context. It is stated that little is known about the longevity of any trees, whether in their natural state or grown by man. In theory, the cacao tree should have an almost indefinite ideal physiological life span, being possessed of certain built-in factors favouring longevity. The various causes of senescence of the cacao plant, including hormonal and other chemical reactions, are discussed. A consensus of opinion holds that in economic terms, the highest yields are achieved 15 to 25 years after planting, and that a profitable life yield span is 50 years.

Review of control measures for Pantorhytes (Coleoptera: Curculionidae) in cocoa SMITH, E.S.C. Lowlands Agricultural Experiment Station, Keravat, New Britain, Papua New Guinea — *Protection Ecology (Netherlands)* v. 3(4) p. 279-297; Dec 1981.

Weevils of the genus *Pantorhytes* are the most damaging insect pests of cacao in Papua New Guinea, and are extremely difficult to control. The life histories and damage caused by these pests are outlined and the various control measures that have been used against them are reviewed, and a list is given of their recorded host plants. Certain cacao environments are unfavourable to this genus and these findings have been incorporated into a system of integrated pest management. Hand collection of adults combined with spot treatments of borer channels using penetrant insecticides, the selection of shade types and the introduction of antagonistic ant colonies are now recommended to achieve low and stable *Pantorhytes* populations in cacao plantations. The possibility of using pathogens and resistant planting material for future control schemes is briefly discussed.

(The effect of different substrates on the development of young cacao plants (Theobroma cacao)) Influência de diferentes substratos na formação de mudas de cacau (Theobroma cacao, L.) FASIABEN, M.C.R. and COSTA, J.D. Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, São Paulo, Brazil — *Solo (Brazil)* v. 73(1) p. 60-63; Jan 1981.

This work had the objective of testing the effect of different substrates, in which the organic matter source was the variable factor, on the development of young cacao plants. The following organic matter sources were tested: chicken manure (100 l/m^3 of soil), cow manure (400 l/m^3 of soil), castor bean meal (20 l/m^3 of soil) and 2 dosages of the commercial product Hiper Humus (10 l and 20 l/m^3 of soil). The treatments were evaluated periodically by determining plant height and diameter. Dry matter in the aerial parts and root system was also determined. The results showed that chicken and cow manure were superior to the other treatments studied.

(Bibliography of Phytophthora palmivora on cacao) Bibliografía de Phytophthora palmivora del cacao ARIAS DE GUERRERO, A.M. and CALDERON DE CERDAS, A.I. Programa de Plantas Perennes, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica — *Serie Bibliotecologia y Documentación — CATIE (Costa Rica)* no. 4, 50 p. 1980.

The objective of this bibliography is to disseminate the information available at the Orton Memorial Library on *Phytophthora palmivora* attacking cacao. It includes 526 references dealing with geographic distribution, symptomatology, etiology, epidemiology, control, etc.

Annual report 1978 Central Plantation Crops Research Inst., Kasaragod, Kerala, India — 252 p.; Jul 1981.

This annual report presents the major research results on coconut, arecanut, cashew, spices (pepper, ginger, nutmeg), oil palm and cacao obtained by the Central Plantation Crops Research Institute. Aspects covered include crop improvement, plant protection, agronomy, extension and technology.

(Determination of the fatty acid composition and physical characteristics of fats of the seeds of Theobroma grandiflora and Theobroma bicolor and comparison with the fat of Theobroma cacao) Determinação do teor, ácidor graxos e características físicas das gorduras das sementes do Theobroma grandiflora L. e do Theobroma bicolor L. e comparação com a gordura do Theobroma cacao L. BERBERT, P.R.F. Divisão de Bioengenharia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 11(2) p. 91-98; Apr 1981.

The fatty acid composition and physical characteristics of butter from *T. grandiflora* and *T. bicolor* were studied and compared with those of T. cacao (var. Comum) using gas chromatography and scanning calorimetry). It was found that the butters of the first two species are softer than cocoa butter but have a melting point (slip point) equal to or higher than that of the latter. This fact makes the butter from *T. grandiflora* and *T. bicolor* apparently inadequate for preparing chocolate bars, but shows the possibility of using them in the margarine industry. The softness, besides being related to the triglycerides composition is possibly due to the presence of other substances such as long chain alcohols and esters. These are responsible for the agreeable aroma which is found in the *T. bicolor* butter.

(Potassium fixation and release in soils of the cacao region of Bahia) Liberação e fixação de potássio em alguns solos da região cacaueira da Bahia CHEPOTE S, R.E. and PEREIRA, G.C. Divisão de Geociências, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 11(3) p. 193-202; Jul 1981.

Potassium fixation and release in 7 soils of southern Bahia, was measured. Samples were extracted successively 8 times with boiling 1N HNO_3. Following incubation for 1, 2, 4, 6 or 8 months a further extraction was carried out. K fixation was evaluated in moist samples ($<$ field capacity) and in samples submitted to alternate moist and dry conditions. The Alfisol (Cepec) released more K in all extractions. In the Oxisols (Coloina, Una and Valença) K was almost completely removed in the first extraction. Both the Ultisols (Vargito Eutrófico) and the Inceptisol (Rio Branco) showed higher releasing capacity than the Oxisols. Extractions after the different incubation periods showed the same order of K release as that in the 8 initial extractions. K fixation increased not only with the level of K added but also with the incubation time. There were no clear distinctions between soils nor amongst incubation treatments. Other soil properties are described and Oxisol K fixation discussed.

November 1981

(Chemical control of Cerconota dimorpha, pest of cacao in Amazonia) Control químico de Cerconota dimorpha Duckworth em cacaueiros na Amazônia GARCIA, J. DE J. DA S. and MENDES, A.C. DE B. Departamento Especial da Amazônia, Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Belém, Pará, Brazil — *Revista Theobroma (Brazil)* v. 10(3) p. 113-116; Jul 1980.

The experiments show the efficacy of certain insecticides for the control of *Cerconota dimorpha (Lepidoptera, Oecophoridae)* on cacao in the Amazon region. The insecticides employed, their dosages and percent effectiveness were as follows: permethrin 70 g a.i./ha (94.4%), carbaryl 1200 g a.i./ha (89.07%), BHC 240 g a.i./ha (86.12%), trichlorfon 105 g a.i./ha (76.00%) and malathion 105 g a.i./ha (23.70%).

(Control of cacao black pod disease with copper fungicides) Controle da podridão parda do cacaueiro com fungicidas cúpricos FIGUEIREDO, J.M. DE and LELLIS, W.T. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(3) p. 117-121; Jul 1980.

All copper fungicides used an in experiment for the control of cacao black pod disease had a positive effect, Kocide 6F (copper hydroxide) and Gafex (copper oxychloride) having a greater effect than the others.

(History of cacao introductions in the Recôncavo region, Bahia, Brazil) Histórico das introduções de cacaueiro (Theobroma cacao L.) no Recôncavo da Bahia, Brazil SILVA, P. and CARDOSO, A. DE O. Centro de Introdução de Plantas, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(3) p.135-140; Jul 1980.

A history of cacao introductions into the Recôncavo region, Bahia, Brazil, is presented. From 1888 up to the present five introductions were made, in a broad sense, involving cultivars of the Amazonian Forastero, Criollo hybrid and Forastero hybrid groups.

(Mechanical pollination of cacao using motorized knapsack sprayers in Brazil: agro-economical assessment) Avaliação agroeconômica do uso da técnica da polinização mecânica por ventilação forçada no cacau, Brasil SORIA, S. DE J., GARCIA, J.R. and TREVIZAN, S. Divisão de Zoologia Agrícola, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(3) p. 149-155; Jul 1980.

The technique of blowing air over the flowers of the self-compatible variety Comum of *Theobroma cacao* to induce mechanical pollination nearly doubled the yield in relation to untreated plots. The net benefit computed was equivalent to 100 per cent, approximately, of the treatment costs. It is concluded that the technique is viable in field conditions.

(A new method for testing resistance of cacao to witches' broom disease (Crinipellis perniciosa)) Um novo método para testar resistência do cacau à vassoura-de-bruxa (Crinipellis perniciosa) EVANS, H.C. and BASTOS, C.N. Departamento Especial da Amazônia, Commissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Belém, Pará, Brazil — *Revista Theobroma (Brazil)* v. 10(4) p. 175-186; Oct 1980.

This new method for the evaluation of the resistance of cacao cultivars against witches' broom disease is based on the analysis of the germination of the basidiospores of the causal agent Crinipellis perniciosa in flush stem extracts of cacao.

Symptomatology of Phytophthora canker of cacao following river flooding PEREIRA, J.L. and PIZZIGATTI, R. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(4) p. 203-211; Oct 1980.

Heavy losses of cacao trees after flooding were originally attributed to the physiological effects of inundation but subsequently found to be related to severe outbreaks of canker, *Phytophthora palmivora.*

Cacao pollination with spray equipment in Costa Rica KNOKE, J.K., SORIA, S. DE J. and CHAPMAN, R.K. Department of Entomology, Ohio Agricultural Research and Development Center, Wooster, Ohio, USA — *Revista Theobroma (Brazil)* v. 10(4) p. 213-224; Oct 1980.

Mechanical pollination of cacao using mistblowers or by brushing cacao flowers greatly increased pod set and may have great practical application where insect pollination is inadequate and self-compatible cultivars are being used.

The use of Ethrel-induced senescence of cacao fruits to study the control of cherelle wilt RESNIK, M.E., ORCHARD, J.E. and MENDES, L.F. Divisão de Botânica, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(4) p. 253-256; Oct 1980.

One of the problems in the study of cherelle wilt is to predict which fruits are going to wilt. It was found that application of Ethrel (ethephon) to the pedicel of young fruit produced morphological changes similar to natural wilt. A preliminary experiment showed that induced wilt could be prevented by the application of indole butyric acid and gibberellic acid.

Record world cocoa bean crop forecast for 1981/82 Foreign Agricultural Service, USDA, Washington, D.C., USA — *Foreign Agriculture Circular, Cocoa (USA)* USDA-FCB 3-81, 15 p.; Oct 1981.

Cocoa production, consumption and trade are reviewed against the background of the expected bumper crop of 1.73 m tons for the 1981/82 crop year.

(Cacao: an uncertain outlook) Cacao: un horizon incertain TUOR, R. – *Afrique (UK)* no. 51, p. 66-67; Sep 1981.

Notwithstanding the signing of the new international cocoa agreement the author considers the future of the cocoa market uncertain because both the USA and Ivory Coast have refused to join the agreement.

(Cacao black pod disease due to Phytophthora sp. in Togo: assessment and control strategies) La pourriture brune des cabosses du cacaoyer due à Phytophthora sp. au Togo: évaluation et stratégies de lutte DJIEKPOR, E.K., GOKA, K. and LUCAS, P. Centre de Recherches, Institut Français du Café et du Cacao (IFCC), Kpalimé, Togo – *Café, Cacao, Thé (France)* v. 25(4) p. 263-268; Oct 1981.

The very high losses of cacao in Togo caused by black pod disease might be reduced by an integrated control strategy, combining agronomic, chemical and genetic approaches.

The future of cocoa in Indonesia Bank Negara Indonesia, Jakarta, Indonesia – *Economic Review – Bank Negara Indonesia (Indonesia)* no. 94, p. 35-38 1981.

The growing of cacao has received the Government's special attention for export promotion. Its cultivation will be extended to cover 190 000 ha with an expected production of 170 423 t in 1988. The development of cacao growing, and the cacao development programme are reviewed. It is concluded that cacao is at this time in an unstable condition, especially with regard to world market prices and that Indonesia herself seems to have had no firm strategy for her cacao so as not to be entirely dependent on the international market.

(Performance of cacao in oxisols of Southern Bahia) Comportamento do cacaueiro em oxisols do Sul da Bahia SANTANA, C.J.L. DE and ZEVALLOS, A.C. Divisão de Geociências, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil – *Boletim Técnico – Centro de Pesquisas do Cacau (Brazil)* no. 82, 23 p. 1981.

The oxisols of southern Bahia cover approximately 2 000 000 ha. They are used mainly for pasture and cassava plantations. These soils are characterized by low nutrient content and low water retention capacity. Cacao planted on these soils is less productive in comparison with cacao planted on good soils (alfisol). However, well cared-for oxisol cacao plantations produced as much as those on alfisols. It is concluded that areas with proper shade, suitable management practices, adequate fertilization, consisting of soils with correct physical properties and with rainfall evenly distributed throughout the year, are the most productive for cacao.

The processing before export of cocoa: areas for international cooperation UNCTAD, Geneva, Switzerland – TD/B/C.1/PSC/18, 103 p.; Sep 1981.

This report by the UNCTAD secretariat analyses the market for raw and processed cacao products and the long-term projections of demand for cacao, barriers to the increased processing of cacao in producing countries which are related to corporate and market structures or to trade and, in an appendix, the effects of the Tokyo Round tariff cuts on cacao products.

(Cumulative index of existing cacao documentation) Indice cumulativo 1966-1977 GOES, R, L. Commissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Itabuna, Bahia, Brazil – *Cacau Atualidades (Brazil)* 49 p. 1981.

The first number of Cacau Atualidades, dealing with research on cacao, was published in January 1964. The last item was issued in 1977. This cumulative index lists the 201 articles that have been published during this period of about 13 years.

(Pollination in tree fruits and cacao: a bibliographic study) Etude bibliographique. Pollinisation: arbres fruitiers et cacaoyers BOUSSARD, B. Institut Français du Café et du Cacao (IFCC), Paris, France – *Café Cacao Thé (France)* v. 25(4) p. 297-304; Oct 1981.

After discussing the various factors which may affect pollination in (mainly) temperate tree fruits (cultural, climatic and insects), the author then considers the much more important role of insects in cacao pollination. The biology and behaviour of the *Ceratopogonids (Forcipomyia* spp. in particular) and cultural practices which lead to greater pollination are discussed. The relationship between pollination and crop production in cacao is also explored.

(Morphological forms of Phytophthora palmivora in Brazil) Tipos morfológicos de Phytophthora palmivora no Brasil CAMPELO, A.M.F.L. and MEDEIROS, A.G. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 10(3) p. 141-147; Jul 1980.

Both the morphological forms MF1 and MF4 of *Phytophthora palmivora* (with, respectively, short and long pedicels) were found in isolates from Amazonia and Bahia but only MF4 in isolates from Espírito Santo. MF1 isolates were of the A2, and MF4 isolates of the A1 compatibility type.

December 1981 — no abstracts on cocoa.

January 1982

Cacao pod husk as source of potash fertilizer AHENKORAH, Y., HALM, B.J. and AMONOO, R.S. Cocoa Research Inst., Tafo, Ghana — *Turrialba (IICA)* v. 31(4) p. 287-291; Oct 1981.

Field trials were carried out for 3 successive years with maize var. Composit IV. The crop received cacao pod husk ash or muriate of potash each at 0, 23.2, 46.6, 69.7 and 93.0 kg K/ha. Results showed that there was no significant difference between both K sources. The 2 K sources were significantly better than the unfertilized treatment. Using 38 per cent as an average K content of ash, it was estimated that the bulk of the total needs of K fertilizers of Ghana and some 4 other cacao producing countries, including perhaps Brazil, can be obtained from this source.

(The 4th session of the FAO Panel on Agricultural Mechanization: materials and methods for the application of pesticides for soil preparation and crop protection) La quatrième session du Panel FAO sur la Mécanisation Agricole: matériels at méthodes pour l'application de pesticides pour la préparation des sols et la protection des cultures WEBER, R. — *Machinisme Agricole Tropical — CEEMAT (France)* no. 77, 54-63; Jan 1982.

This article contains the conclusions and recommendation of a FAO panel meeting on materials and methods for the application of pesticides during soil preparation and crop protection. This meeting was held in Montpellier in November 1981. Among other things, attention was paid to: sprayers; protective clothing during spraying; spraying by hand, and with animal and engine traction; and recently developed spray equipment such as the electrodynamic equipment called Eltrodyn. Furthermore, the panel dealt with crop protection in certain regions and countries, such as arid and humid regions in India, Ivory Coast, Sudan and Suriname.

Guidelines on pesticide residue trials to provide data for the registration of pesticides and the establishment of maximum residue limits Codex Committee on Pesticide Residues, FAO, Rome, Italy — *FAO Plant Protection Bulletin (FAO)* v. 29(1/2) p. 12-27 1981.

This paper discusses the design of residue trials and deals with broad details of trial lay-out, including, selection and number of sites, replications, plots and crops. The subject matter deals also with application of pesticides, including, methods and dosage rates, with degradation studies, residue disappearance studies and soil sampling. A detailed guide is given for sampling and sampling procedures for vegetables, fruits, grasses, nuts and seeds, herbs, spices and tea leaves, and sugar-cane. Sampling procedures for stored products, sample-size reduction, packing and storage and reporting on residue trials are briefly described.

Influence of specific gravity of seeds on early seedling growth and development in cacao RAVINDRAN, P.N. Regional Station, Central Plantation Crops Research Inst., Vittal, Karnataka, India — *Turrialba (IICA)* v. 31(4) p. 351-356; Oct 1981.

Seeds from 4 cacao forastero types were grouped into the following specific gravity (SG) values: < 1.00, 1.00–1.03, 1.03–1.06, 1.06–1.09, 1.09–1.12, or > 1.12. Seeds of each group were studied in relation to various seedling characters. Results showed variations among types in respect of seed distribution in various SG groups and in their influence on seedling characters. An increase in SG was highly correlated with an increase in growth and dry matter production. Specific gravity of seeds can be used in mass selection criterion for selecting seeds which give seedlings of greater vigour and may be beneficial in enhancing establishment ability and drought tolerance in the initial critical growth period.

Control of bark canker in cocoa with metalaxyl PRIOR, C. and SMITH, E.S.C. Lowlands Agricultural Experiment Station, Keravat, New Britain, Papua New Guinea — *Tropical Pest Management (UK)* v. 28(1) p. 45-48; Mar 1982.

Bark canker caused by the fungus *Phytophthora palmivora* causes serious damage to cocoa of all ages in Papua New Guinea and its severity has recently increased. Bark cankers very often start around bark damage made by the larvae of wood-boring insects. 0.25 per cent a.i. metalaxyl added to an aqueous dichlorvos/white oil mixture used to control these insects was also effective in eliminating the fungus. It was considered that scraping (removal of outer bark) followed by natural desiccation, which effectively controls canker in W. Malaysia, would not be reliable under the wetter conditions in Papua New Guinea. Painting with 0.5 per cent metalaxyl very effectively controlled the fungus, with or without scraping.

(Effect of flowering and pollination on cacao yields. Mathematical relationships between experimental data: yield equation) Influence de la floraison et de la pollinisation sur les rendements du cacaoyer. Liaisons mathématiques entre les données expérimentales: equation du rendement MOSSU, G., PAULIN, D. and REFFYE, P. DE Institut Français du Café et du Cacao (IFCC), Abidjan, Ivory Coast — *Café Cacao Thé (France)* v. 25(3) p. 155-168; Jul 1981.

Flowering cycles were found to be affected to a large extent by edapho-climatic conditions, while pollination conditions are subject to great variations. Mathematical expressions were established which make it possible to predict with great accuracy pod and seed yields.

A study of growth periodicity in cocoa seedlings, with particular emphasis on the root system SLEIGH, P.A., HARDWICK, K. and COLLIN, H.A. Department of Botany, University of Liverpool, Liverpool, UK — *Café Cacao Thé (France)* v. 25(3) p. 169-172; Jul 1981.

Cocoa seedlings grown in an acceptably constant greenhouse environment show clear alternation of root and shoot growth. Pattern of transport of photosynthetically labelled carbon throughout the plant varies markedly with stage of the growth cycle, periods of growth of root and shoot each being positively correlated with the period of maximum assimilated carbon input.

(Comparative study of the resistance of three species of the genus Theobroma against Phytophthora palmivora: demonstration of the presence of phytoalexin-type substances responsible for induced resistance) Etude comparative de la résistance à Phytophthora palmivora (Butl.) Butl. emend. Bras. et Grif. de trois espèces du genre Theobroma: mise en évidence de substances de type phytoalexines responsables de la résistance induite DAGUENET, G. and PARVAIS, J.P. Laboratoire de Phytopathologie, Institut Français du Café et du Cacao (IFCC), Abidjan, Ivory Coast — *Café Cacao Thé (France)* v. 25(3) p. 181-190; Jul 1981.

Theobroma cacao, T. bicolor and *T. grandiflora* were found to differ in their degree of resistance against a slightly aggressive and a very aggressive strain of *Phytophthora palmivora.* Prior inoculation with the slightly aggressive strain increased the resistance to the very aggressive strain. It is likely that fungicidal compounds (phytoalexins) are formed.

Annual report for the year 1979/80 International Cocoa Organization, London, UK — 29 p. 1981.

This annual report for 1979-80 deals with the organization and administration of the International Cocoa Organization, with economic provisions including the operation of the Buffer Stock Fund and of the annual export quotas, reviews the world cocoa situation, and reports on the third part of the UN Cocoa Conference 1979.

Cocoa, coffee and tea: producer co-operation for structural change SILVA, L. DE — *Marga (Sri Lanka)* v. 6(3) p. 9-41 1982.

The author analyses the position of coffee, tea and cocoa which have in common that they have no substitutes and are virtually exclusively produced in tropical developing countries. He argues that the production and in particular the processing, trade and distribution of these commodities is largely controlled outside the producing countries, and that these countries should strengthen their common position by closer consultation and co-operation.

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