

COCOA GROWERS' BULLETIN
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COCOA GROWERS' BULLETIN

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Cadbury Limited
Bournville



Editorial

The importance of quality

It is some years since the subject of grading was mentioned in the "Cocoa Growers Bulletin". At that time, 1970, International Cocoa Standards had just been formulated and were being put into practice. These standards were more stringent than the commercial grades and the grading standards in use in many cocoa growing countries, and were formulated with the right and proper aim of raising the quality of cocoa beans generally. Since then, the International Cocoa Standards have been adopted by several of the older producing countries and by some countries which have only recently started to produce cocoa. These standards have not, however, been adopted everywhere, nor are they in use for commercial contracts. It is a pity that this has not occurred. The International Standard for grade 1 — a maximum of 3% each for the three categories of mould, slate and other defects — is relatively easy to meet. Nevertheless there are countries whose quality remains unsatisfactory, and others where the quality seems to be declining. We live in a world in which standards of food hygiene and preparation are improving and where the final consumer expects even greater protection from possible hazards, so that chocolate manufacturers look for improving quality of their raw materials. With this in mind, it seems appropriate to publish a paper, first written in 1972, which describes manufacturers' requirements for quality of cocoa beans. These requirements have not changed since 1972 but the need to meet them increases year by year.

G.A.R. WOOD

Review of Production and Consumption

May 1979

A.B. Cook, Cadbury Schweppes Limited

Production

Gill & Duffus's latest forecast of 1978/79 world production is 1,467,000 tonnes which will put it very close to the average of the last ten seasons.

Both Ghana and Nigeria have poor crops this season and they are both forecast to have their lowest outturn since 1958/59. Compared with the average of the last ten seasons Ghana will be 30% down and Nigeria 40% down.

On the other hand production in the Ivory Coast and Brazil continues to expand and they are both forecast to set new record outturns this season.

On a smaller scale but equally impressive is Malaysia where 26,000 tonnes is expected to be produced compared with just 2,000 tonnes ten years ago.

Consumption

1979 estimated world consumption at 1,404,000 tonnes is expected to show a small increase over 1978 which, in turn, was marginally up on 1977. However it needs to be emphasized that this is still 115,000 tonnes below 1976 and there are no signs yet of any major recovery in world consumption.

Stocks

Gill & Duffus are forecasting that world stocks at the end of the 1978/79 season will be 503,000 tonnes compared with 440,000 tonnes at the end of 1977/78 and 327,000 tonnes at the end of 1976/77. This would be the highest season end stock figure since 1971/72.

Prices

Month end prices for nearby Ghana shipment cocoa have been:—

1978 February	£1665/tonne	October	£2045/tonne
March	£2090/tonne	November	£2196/tonne
April	£2115/tonne	December	£2049/tonne
May	£1820/tonne	1979 January	£1814/tonne
June	£1930/tonne	February	£1848/tonne
July	£1910/tonne	March	£1692/tonne
August	£2030/tonne	April	£1724/tonne
September	£2032/tonne		

Shipping delays from Ghana and Nigeria, coupled with the fact that the Brazilian Temporao crop accounted for a large proportion of the season's surplus, meant that the full weight of the 1977/78 surplus did not bear on the market as stocks held in consuming countries until the beginning of 1979. With another large Temporao crop forecast in 1978/79, this effect may well be repeated this year.

WORLD COCOA PRODUCTION AND GRINDING DATA

Reproduced from Gill & Duffus Market Report

Dated 19th April 1979

(Thousand Metric Tons)

Production

	1975/76	1976/77 (Estimate)	1977/78 (Forecast)
Africa	848	930	881
America	392	458	475
West Indies	42	42	44
Asia and Oceania	60	63	67
World Total	1342	1493	1467
Principal Countries			
Ghana	320	268	263
Nigeria	165	205	138
Ivory Coast	230	297	315
Cameroun	82	105	110
Equatorial Guinea	7	7	6
Brazil	234	283	294
Ecuador	72	75	77
Dominican Republic	30	30	30
Venezuela	15	18	17
Colombia	29	29	30
Mexico	24	33	38
New Guinea	28	30	29
Malaysia	21	22	26

Grindings

	1977	1978 (Estimate)	1979 (Forecast)
Western Europe	502	506	511
Eastern Europe and U.S.S.R.	198	191	196
North America	195	174	176
Central and South America	256	279	292
Australia and New Zealand	20	17	18
Asia	55	53	55
Africa	137	155	156
World Total	1363	1375	1404
Principal Countries			
United States	184	163	165
Germany (Federal Republic)	142	144	147
Netherlands	126	126	126
United Kingdom	75	72	73
U.S.S.R.	85	90	96
France	36	40	40

Manufacturers Needs with Respect to Quality

G.A.R. Wood
Cadbury Limited

The prime interest of chocolate manufacturers with respect to the quality of cocoa beans lies in the flavour they produce after roasting and processing. Manufacturers are also interested in bean size, shell percentage and butter fat content but these factors are largely outside the control of growers and are not covered by grading regulations.

It might be as well to enlarge a little on these factors because of their importance to manufacturers and because the cocoa market takes them into account to a certain extent. These three factors are important because they influence the roasting process and determine the yield of cocoa butter.

Bean size influences roasting because small beans are more easily heated to roasting temperatures than large beans, so that roasting times have to be altered for batches of different size beans. It is, therefore, important that shipments of beans should be fairly uniform in size. The International Cocoa Standards state that cocoa of merchantable quality "must be reasonably uniform in size". The size has not been specified but "as a guide not more than 12 percent of the beans should be outside the range of plus or minus one third of the average weight". This is a desirable limit but it is not a standard.

Shell percentage and butter fat content together determine the yield of cocoa butter from a consignment of beans. The usual figures for Ghana cocoa are:

Shell percentage	11.5—12%
Butter fat	57—58%

The butter fat is expressed as a percentage of fat in the dry nib.

Taking the higher of these percentages there would be 51 tons of butter in 100 tons of beans. Such figures are taken as a standard by many manufacturers and other cocoas are usually measured against them. Many countries produce cocoa beans with a higher shell percentage and this lowers their value as compared to Ghana cocoa. If, for instance, a sample has a shell percentage of 14 and a butter fat percentage of 57 it would have 49 tons of butter in 100 tons of beans.

It is unusual for any cocoa to exceed the normal figure for Ghana cocoa, so, on this basis as on others, Ghana is the premium cocoa.

To revert to flavour, this is judged by a taster or a tasting panel. While an individual taster will give a subjective judgement, the use of panels comprising several experienced tasters will establish an objective answer as to differences of flavour. It is not, however, possible to measure flavour chemically or by any other objective means.

There are, however, certain common defects which affect flavour and which can be measured objectively. The major defects of this type are mould and slate.

Mouldy Beans

Mould has been described as the worst defect of cocoa beans. Mould in cocoa beans has various effects. The most important is the effect on flavour. The unpleasant flavours produced by mould cannot be removed by normal manufacturing processes. They can be removed from cocoa butter by a deodorising process but this produces an odourless fat suitable only for special purposes. Moulds vary in their effect on flavour but it is possible to detect mould off-flavours in samples with as little as 4 percent mouldy beans.

The other effects of mould are:

- i) To increase free fatty acid content of the cocoa butter.
- ii) The growth of some moulds may produce mycotoxins and mycotoxins have been known to occur in mouldy beans.

Moulds can enter beans during fermentation or drying, or during storage. A common cause of internal mould is prolonged drying which often occurs at the beginning of the cocoa season. The remedy may lie in a simple form of artificial dryer. Another common cause is incomplete drying at the time the farmer sells his cocoa. This is often followed by an interval of time before final drying. This does not occur where cocoa is graded at up-country buying centres.

We are concerned here with the possible development of moulds after drying and after grading. Moulds can develop on beans with a moisture content of more than 8 percent, therefore beans must be dried to a moisture content below that level. It is recommended that moisture content should be between 6 and 7 percent. At moisture contents below 5 percent, the beans become brittle, and in any case there is a loss of income from the producers' point of view if he dries his beans to an unnecessarily low level.

Beans which are properly dried but which are stored for too long a period in highly humid conditions can become mouldy as the beans absorb moisture. This is a rare occurrence in the major cocoa countries for two reasons: first, conditions in stores are generally just on the right side of the limits and second, it has been found that large stacks of beans tend to maintain a slightly higher temperature than ambient, i.e., stacks are slightly warmer than their surroundings.

Slaty Cocoa

Slaty or unfermented beans are a major defect because they cannot be made into chocolate. The production of chocolate flavour depends on the two processes of fermentation and roasting; one process without the other will not give chocolate flavour.

A further objection to slaty beans is that the shell adheres closely to the cotyledons or nib and the two cannot be easily separated. Slaty beans contain less fat than fermented beans and are more difficult to grind. There are, therefore, several reasons for manufacturers' objection to slaty beans but the most important one is the absence of any chocolate flavour.

Foreign Flavours and Odours

Cocoa beans can absorb unpleasant foreign odours during the drying, storage and transport stages. Such odours can produce flavours in chocolate which cannot be removed.

The commonest defect of this type is due to smoke which produces a

hammy flavour. This defect arises from drying in a crude manner over a fire or from the use of defective drying apparatus or during storage in a smoky atmosphere. This defect is less common than it used to be; certain countries had the reputation of producing some parcels of smoky cocoa and as a result all the cocoa from these countries was sold at a discount. West Cameroon is a case in point. At one time it had a bad reputation for smoky cocoa and suffered a discount of 5–10 percent; after the introduction of better dryers and stricter inspection, this defect disappeared and West Cameroon cocoa is no longer sold at a discount.

Other unpleasant odours can arise from storage with commodities, such as copra, which have a definite smell; some agricultural chemicals come into the same category.

Another possible source of off-flavours lies in the pesticides applied to cocoa trees to control pests and diseases. There have only been one or two cases where pesticides have been shown to cause off-flavours, but these cases have caused manufacturers and cocoa growing countries to be rightly cautious in the use of pesticides, particularly systemic ones, and to test their effect on flavour before approving their general use.

So much for the defects which affect flavour. There are other defects which affect the keeping quality of beans and lower their value to manufacturers.

Infested Beans

The major objection to infested cocoa is the threat it poses to factories and stores. There are a few pests which can affect cocoa beans — not many, fortunately, because the moisture content of cocoa is too low for many potential pests — and only one pest can readily survive in temperate climes. This is the tropical warehouse moth, *Cadra cautella*, which is commonly found in cocoa stores and can continue to breed in cocoa stores in importing countries. In chocolate factories this moth presents a threat to the quality of finished chocolate.

Infestation of cocoa beans will also lead to some loss of nib but this is unimportant in relation to the other objection.

Moisture content

In dealing with mouldy beans it was stated that mould could develop on beans with a moisture content in excess of 8 percent. This is the critical level of moisture and for safety it is recommended that moisture content be between 6 and 7 percent.

The Working Party on Cocoa Grading has accepted a maximum moisture content of 7.5 percent as determined at first port of destination. The precise relevance of this limit to the moisture content as determined in country of origin is uncertain. It can be expected that cocoa beans will tend to an equilibrium in accordance with the relative humidity of the atmosphere so that the changes in moisture content during shipment will depend on the initial moisture content and ambient conditions. Therefore cocoa should be dried thoroughly in the first place and then stored so that this condition is maintained.

** This article is taken from a report on a Training Seminar on Cocoa Grading which was held in Lagos in 1972. This seminar was organised by FAO with funds from United Nations Development Programme. The report was published by FAO as TA 3195.*

Some corrections have been made to the original in the light of new knowledge.

Technical Consultation on Agricultural Extension Methods and Techniques for Cocoa

R.A. Lass

Cadbury Schweppes Limited

Introduction

The Technical Consultation on Agricultural Extension Methods and Techniques for Cocoa was held in Itabuna/Ileheus, Bahia, Brazil, from 2-7 May 1977, under the joint sponsorship of the Cocoa Producers' Alliance, the Cocoa, Chocolate and Confectionery Alliance of Great Britain, the Federative Republic of Brazil and F.A.O. It was the first of its type at a world-wide level.

The Consultation was attended by 72 delegates from 13 FAO Member countries which are cocoa producers, with the objective of identifying methods of establishing an efficient and quick delivery of technical information at the production level.

Participants examined thoroughly the different aspects of extension methods and techniques for cocoa farmers on the basis of six case studies presented by Brazil, Cameroun, Ghana, Ivory Coast, Nigeria and Venezuela, together with consideration of channels of mass communication and the integration of basic services as support to extension.

Discussion

Participants then split into three groups and discussed various specific problems and proposed a programme of action for their solution.

1. How does the extension service communicate effectively with farmers by radio, press and television?

The group considered the role of the different communication methods to carry out the extension work, taking into account the cultural environment. The group recommended the following programme of work:

- A detailed study of the area of work involved should be completed.
- The methods of mass communication available should be defined.
- The resources of farming families should be assessed.
- A programme based on the detailed study of the area of work shall be established.
- A programme for training the extension workers should be fully developed.
- The farmer's skills should be evaluated.
- The messages transmitted to the farmers should be continuously evaluated by a feedback mechanism.

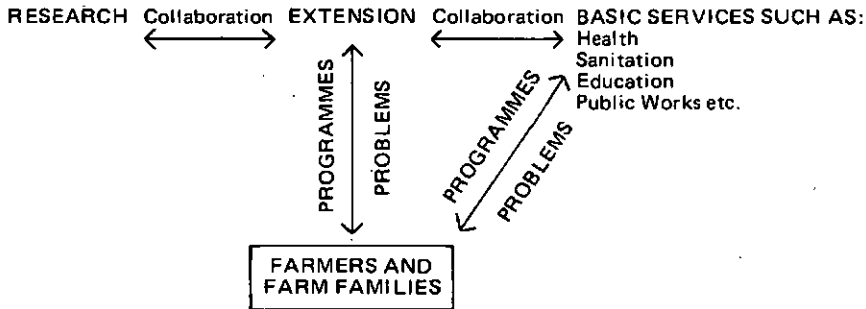
2. Should the extension service be directed only to cocoa or should it include other aspects of rural development and other crops?

The following conclusions were reached:

- The extension service must be involved in the development and approval

of the policies and plans established by the Government in matters relating to cocoa extension.

- The extension agents must be stimulated and encouraged to promote improved cocoa cultivation and motivated to contact other institutions in relation to the solutions of social and economic problems affecting peasants and farmers. The following relationship was proposed:



3. What are the short term training needs for the improvement of yields on old cocoa plantations?

After considering the organisation of training systems and the participation of farmers and farmers' associations it was recommended that:

- An agro-economic diagnostic study to determine the priorities of the practices (fertilizer usage, pruning etc.) under consideration should be completed.
- A training programme for extension workers be established using the following methodology:
 - Training through leaders (individuals) of groups should be developed.
 - Training through groups of farmers should be developed.
 - Individual farmers training facilities should be developed.

This training should be by talks, meetings, result and method demonstrations and through mass media radio, press and publications using a fully integrated programme.
- A number of elements must be considered when planning and organising training. These are:
 - Duration of training activities.
 - Location of trainers.
 - Size of group to be trained.
 - Timing of training activities.
- A number of organisations and institutions might collaborate in training activities. These are:
 - Agricultural schools and colleges.
 - Experimental stations.
 - Model and private farms.
 - Producers' associations and co-operatives.
 - Peasant unions.
 - Civic clubs and societies.
 - Training centres

4. What is the logical system to adopt in improving farmers' managerial capacities?

Management in this context is defined as the ability to make effective decisions on the best combination and level of production factors to maximise output at minimum cost. It is assumed that the extension staff are properly trained and able to motivate and assist farmers in making effective decisions. The following sequence was proposed:

- Determination of the present level of farmers' managerial ability.
- Identification of weaknesses in existing situations.
- Creation of awareness in farmers of the need for change.
- Education of farmers to improve their management by exposing them to all possible lines of action with due consideration to economic aspects.
- Ensure that all inputs including credit and extension advice are readily available once the farmer has agreed to try new management procedure.
- Establishment of a system of continuous evaluation of farmers' progress.
- Analysis of farmers' decision making process will help in the improvement of their management capacities.

5. What should be the successive steps for delivering better services to farmers? These steps were suggested to be:

- Creation of awareness by farmers of existing services available to them and encouragement to use them properly.
- Identification of weaknesses in current services providing inputs to farmers.
- Creation of awareness in decision-makers of the need to improve existing services.
- Strengthening co-operation between farmers, farmers' associations, extension and related services.
- Continuous evaluation of improvements.

6. What are the key steps in providing credit to farmers?

To ensure credit facilities are available for cocoa farmers, credit institutions must be set up for small farmers. Credit should be channelled through co-operative associations or farmers' associations. From the onset, it is necessary for credit institutions, extension services and farmers to participate in the policy, planning and implementation processes. A governing body should be formed including credit institutions, extension services and farmers. The level of credit required, method of repayment, duration and terms of the loans should be carefully worked out after due consultation. Flexibility must be sufficient to enable the farmers to make the best use of these facilities. Credit may be either as cash or in kind.

7. What should the responsibility of extension staff be in credit programmes?

The level of competence of the farmers will determine the level of intervention necessary by the extension staff. In some cases, the extension staff need only certify that the operations have been satisfactorily completed by the farmers, but in other cases, extension staff may need to arrange for timely raising of seedlings, land preparation and the purchase

and delivery of inputs. If input purchase is through a co-operative organisation, it will debit the farmer accordingly and ensure loan recovery on agreed terms, by debit from the sales proceeds of the farmers' produce. The role of the extension service in the collection of debts must be very carefully examined when developing the policy and modifications made in the light of changing conditions.

8. What action can be taken to ensure adoption of new practices and information flow from farm to researchers?

This group discussed the methods the extension service should employ to convince farmers to adopt new practices recommended by the research station and the way in which farmers' problems may be brought to the attention of the research station so that a two way flow of information is maintained. The following recommendations were proposed:

- A close liaison should exist between research and extension and it was felt desirable that they be under one general administration in order that their efforts were co-ordinated.
- The objectives, inputs, activities and areas of action for research and extension should be clearly defined.
- For best results, the level of training between researchers and extension agents should be the same and extension agents must be well trained in order to carry out their work efficiently.
- Priority should be given to the establishment of demonstration plots on the farms which have adopted the recommended practices.
- Field trips and visits of small groups of farmers to 'result demonstration' plots as well as experimental stations should be promoted.
- Frequent meetings should take place between the extension agent and research specialists to exchange knowledge, for analysis and evaluation, and for planning changes necessary in the work programmes.

9. What action should be taken in combating a newly identified disease? The following scheme was suggested:

- Quick joint action by extension service and research scientists to identify the limits of the area of attack and identify possible consequences.
- Establishment of a control plan perhaps with laws or decrees with the objective of controlling the attack immediately to avoid spread.
- Specialists must provide special training to update the extension agents on matters relating to identification and control of the disease.
- A system must be created to provide the necessary equipment for carrying out control; the material and inputs must be available at the proper time to both technicians and farmers.
- Farm visits should be promoted in the attacked areas with the objective of making farmers more aware of the problem provided this does not increase the risk of spreading the disease.
- Responsibility for the control should be transferred to the farmer at the correct time.
- If control measures require expensive equipment, then farmers should be encouraged to organise themselves in groups to minimize the operational costs.
- Extension agents must activate all farmers — even farmers who seem uninterested to prevent spread of the disease from untreated areas.

Recommendations

At the final session of the Consultation a number of recommendations for future action were drawn up and endorsed by the participants. In summary these were as follows:

1. Adoption of a strategy for accelerating the adoption of improved practices
The Consultation identified the following as the factors necessary to accelerate the adoption of improved practices in cocoa production:

- i) Improved level of training for extension staff;
- ii) Encouragement of greater dedication of extension staff to their work;
- iii) Availability of adequate inputs essential to successful extension work;
- iv) Fair prices in relation to the cost of production of cocoa and reduction of price disparity between cocoa and other crops;
- v) Adequate provision of credit, taking account of favourable rates of interest and its timely availability;
- vi) Promotion of institutions, such as co-operatives, to facilitate the access to credit, mainly for small farmers;
- vii) Establishment of a good supporting infrastructure;
- viii) Promotion of healthy environmental conditions;
- ix) Encouragement of farmer participation in the planning and implementation of extension programmes;
- x) Fuller integration of extension, research and other support institutions.

2. A need for the development of knowledge, skills and attitudes of farmers and extension officers

In addition to the above factors, extension service personnel should be given salaries and incentives comparable with those of other institutions.

3. Future consultations

Those participating in the Technical Consultation recommended that similar consultations should take place every two years in the future and invited the Cocoa Producers' Alliance and the Cocoa, Chocolate and Confectionery Alliance, in co-operation with FAO, to combine their efforts to that end. Suitable occasions might be presented by the current series of International Cocoa Research Conferences.

POSTSCRIPT

With this in mind the Organising Committee of the 7th International Cocoa Research Conference to be held in Douala, Cameroun, from 4–12 November 1979, have decided to devote a special session to cocoa extension. A number of papers for this session are in preparation and further details of the Conference can be obtained from Mr. Mbondji, Station de Recherches Agronomiques de Nkolbisson, B.P. 2067, Yaounde, Cameroun.

The report of the Technical Consultation on Agricultural Extension Methods and Techniques for Cocoa meeting has been published in English, French and Spanish and copies of the full report are available on request, free of charge, from R.A. Lass, Cocoa Dept., Cadbury Schweppes Limited, Bournville, Birmingham B30 2LU.

Cocoa Conferences

The interest in cocoa growing in Malaysia has developed strongly during the past few years and it has been possible to go ahead with planting, based on the experience gained during the previous 10—15 years. A large proportion of the cocoa has been interplanted under coconuts, a crop in which renewed interest has arisen from the introduction of hybrids with much higher yields. The interest in the two crops has led to the holding of two conferences, the first in Sabah in 1976, the second in West Malaysia in 1978. The following notes summarise the findings described in some of the papers presented at the first of these conferences.

Seminar on Cocoa — Coconuts 1976

This seminar was arranged by the East Malaysia Planters Association and attended by a large number of people from Sabah and other parts of Malaysia together with some from Indonesia. Of the 21 papers presented, 17 were devoted to cocoa.

Two of the papers on cocoa are of interest to many. The first of these is by R. Shepherd and his colleagues with Harrisons and Crosfield, and describes the cultivation of cocoa under coconuts on two of their company's estates in Peninsular Malaysia. The conditions of climate and soil on these estates will be typical of the considerable area in Lower Perak where coconuts have been interplanted with cocoa. These conditions are described, together with the methods of planting and cultivation used on more than 10,000 acres of cocoa that now exist on these estates.

Rainfall is 70" and is evenly distributed throughout the year and this results in the crop being fairly uniformly spread; on average, the maximum crop in one month is only 12—13% of the annual total.

The soils are coastal clays but there is considerable variation between the two estates. On one estate the soils are less acid and better drained than on the other and this is said to account for the difference in yield, one estate averaging 1093 lb dry beans per acre, while the other averaged 738 lb per acre over the same four years. Interplanting has not affected the yield of cocoa.

The second paper of general interest describes the potential for cocoa in Sabah. This paper by E. Wyrley-Birch, who spent many years with the Department of Agriculture in Sabah, assembles the information available on soils in Sabah and their suitability for cocoa. The total area of soils which are likely to be suitable for cocoa reaches the staggering figure of 830,000 hectares. Only 3% of this area is under cultivation and the total area of cocoa in 1975 was 9700 hectares. Land is obviously not a limiting factor.

Seed supplies are sufficient for up to 16,000 hectares a year but it is skilled management, together with finance that will limit the rate of expansion.

Planting Material

Three papers describe the results of progeny trials on Borneo Abaca Limited estates and the Department of Agriculture station. The earlier trials compared Amelonado with several inter-Amazon crosses and with some Amelonado-Amazon crosses. Although Amelonado yielded well at 2000 lb/acre, the crosses gave 30–40% higher yields, Pa 35 x Na 32 and Amelonado x Pa 7 giving the highest yields. Later trials tested a further series of crosses, including some triple crosses, i.e. F1 x F0 hybrids. Amelonado x Pa 7 was common to these later trials and was amongst the highest yielders in all of them.

Much data on growth and yield are presented, but the relationship between rate of growth and yield is not discussed. The figures suggest that the progeny with poorest growth at 18 months prove to be the poorest yielders and that the highest yielders are amongst those which grow most quickly. This conclusion has been reached in other trials but further confirmation from this data would be useful.

The third paper describing the trials at the Cocoa Research Station at Quoin Hall, Tawau, gives data on similar progeny, but strangely the results are different as Amelonado x Pa 7, which did so well at BAL, gives the poorest yield in these trials.

A paper by K.B. Armstrong describes another BAL trial which compares various spacings coupled with thinning and various numbers of stems. It has sometimes been argued that close spacing followed by thinning will lead to higher yields and a better return. There has been little evidence to support this theory and none to evaluate the economics of the method. Now we have an answer. Some plots were planted closely at 13 x 6 feet (558 trees/acre). Half these plots were thinned selectively to half the number of trees when the trees were 5 years old. Two years later, the thinned plots yielded slightly more than the unthinned plots and considerably more than plots planted at the same final density. There is evidence that the extra costs of close planting and thinning are recouped.

On other plots single stem trees are compared with two or more stems, but there is no evidence of any advantage from multiple stems.

Processing on Estates

There are three papers on fermentation and drying and the attempts to overcome the problem of acidity. The acidity problem is a complicated one which cannot be dealt with in any depth at this time, but will be dealt with in future issues of the "Cocoa Growers Bulletin".

The first paper by F.T.P. Hubbard describes the methods of harvesting and fermentation normally employed in Malaysia, together with a review of some of the chemical and microbiological changes which take place.

In Malaysia wet beans have more pulp and more sugar than wet beans in West Africa and this is thought to be a major cause of acidity. Various ways of reducing the sugar and the alcohol derived from it have been tried in an attempt to improve the final flavour. At the time this paper was written, these trials were at an early stage.

The drying process is also reviewed and various types of dryer described. The beans must be stirred regularly during drying and it is desirable to do this mechanically. This can be done much more effectively on a circular

drying bed than on a rectangular one. With a well designed agitator on a circular bed, the losses of broken beans are reduced to less than 2%.

J.A. Anselmi describes his own design of fermentary in a paper on the Barico dryer and fermentary. Part of his paper is reprinted in this issue.

Finally a paper by Dr. Liao describes his studies into the acidity problem. He found that greater aeration at the end of fermentation reduced acidity. He promotes aeration by a process called maturation for which it is necessary that the beans have a high moisture content, a temperature of 40–50°C as well as aeration and time. With the right conditions the chemical change by which acetic acid is broken down to carbon dioxide and water will be promoted and a less acidic bean produced. Having found the right conditions, Dr. Liao found several ways of achieving them in a normal fermentary and dryer. One of these methods is to turn the beans three times a day during the last three days of fermentation.

The proceedings of this seminar have been published and copies can be obtained from the Executive Secretary, The Incorporated Society of Planters, P.O.Box 262, Kuala Lumpur, Malaysia.

The second conference referred to was arranged by the Malaysian Agricultural Research and Development Institute (MARDI) and the Incorporated Society of Planters, and was held in Kuala Lumpur in June 1978. The proceedings of this conference have not yet been published.

7th International Cocoa Research Conference

This conference will be held in Douala, Cameroon 4 - 12 November 1979 and sponsored by the Cocoa Producers' Alliance and the Government of Cameroon. The theme of the conference will be:

"The influence of environment on the growth and production of the cacao tree".

Three sessions will be devoted to the theme:

1. Agronomy, including Rehabilitation, Soils and Nutrition.
2. Genetics and Breeding.
3. Diseases and Pests.

These will be followed by two other sessions, one of which will be devoted solely to "Extension methods and techniques".

For further information, enquiries should be addressed to:

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Station de Recherches Agronomiques de Nkolbisson
BP 2067
Yaounde
CAMEROON

New Barico Dryer

J.A. Anselmi

Balung River Cocoa Estate, Tawau, Sabah

Two years of experience in operating the Barico Dryer (ANSELM *et al.*, 1974) have confirmed its efficiency and viability. The simplicity of this large capacity dryer, which achieves high thermal efficiency and produces low acidity cocoa without mechanical stirring of the beans, has much to recommend it.

Although the drying time for a four-ton batch of cocoa can be less than 48 hours, the efficiency of the process continues to be better than most systems when drying is extended to a three day cycle during which 12 tons of beans (dry weight) are processed. The production is then regulated to four tons a day, or 112–120 tons a month.

Another advantage of this dryer is in the almost complete absence of accountable broken bean waste, which for most dryers amounts to a nominal 1.5%, representing a revenue loss of two-thirds of the current market value for an equivalent weight of whole beans. Thus, when cocoa sells at M\$3,000 per ton (and M\$1,000 only can be obtained for broken bean waste), each Barico Dryer could generate an additional revenue of M\$17,000 on its practical annual production of 575 tons of beans.

There are few other dryers which can, allowing for peak production periods, cope with 575 tons of dry beans a year. Nor is there another dryer which is convertible in minutes from a heat source derived from an oil burner to wood or any other combustible solid fuel like coconut shells or husks. The advantages of such conversion is in the opportunity for using any solid fuel available on the estate at low cost and the use of oil burners only when necessary.

The Barico Dryer at full capacity, requires about half a ton of firewood to dry one ton of cocoa, whereas the average oil fired heater uses 27–30 gallons of diesel fuel per ton of cocoa produced.

Thermal Efficiency

Much thought has been given to the economic need for thermal efficiency in the context of drying seed crops. The particular problem with cocoa is that the very wet, sticky beans out of the fermentary are inclined to lump together unless kept separate by some form of agitation. Depths of more than one foot are difficult to turn by hand. Therefore most large capacity systems provide mechanical agitation, with which it is possible to pass air through bean depths of 30 inches or more. However, any form of agitation inevitably causes some bean breakage. No matter how cleverly contrived, mechanical agitators cause progressively more damage as they wear and/or become maladjusted.

The thermal efficiency of the Barico Dryer is derived from passing the hot air through three separate four-ton lots of cocoa beans on different perforated

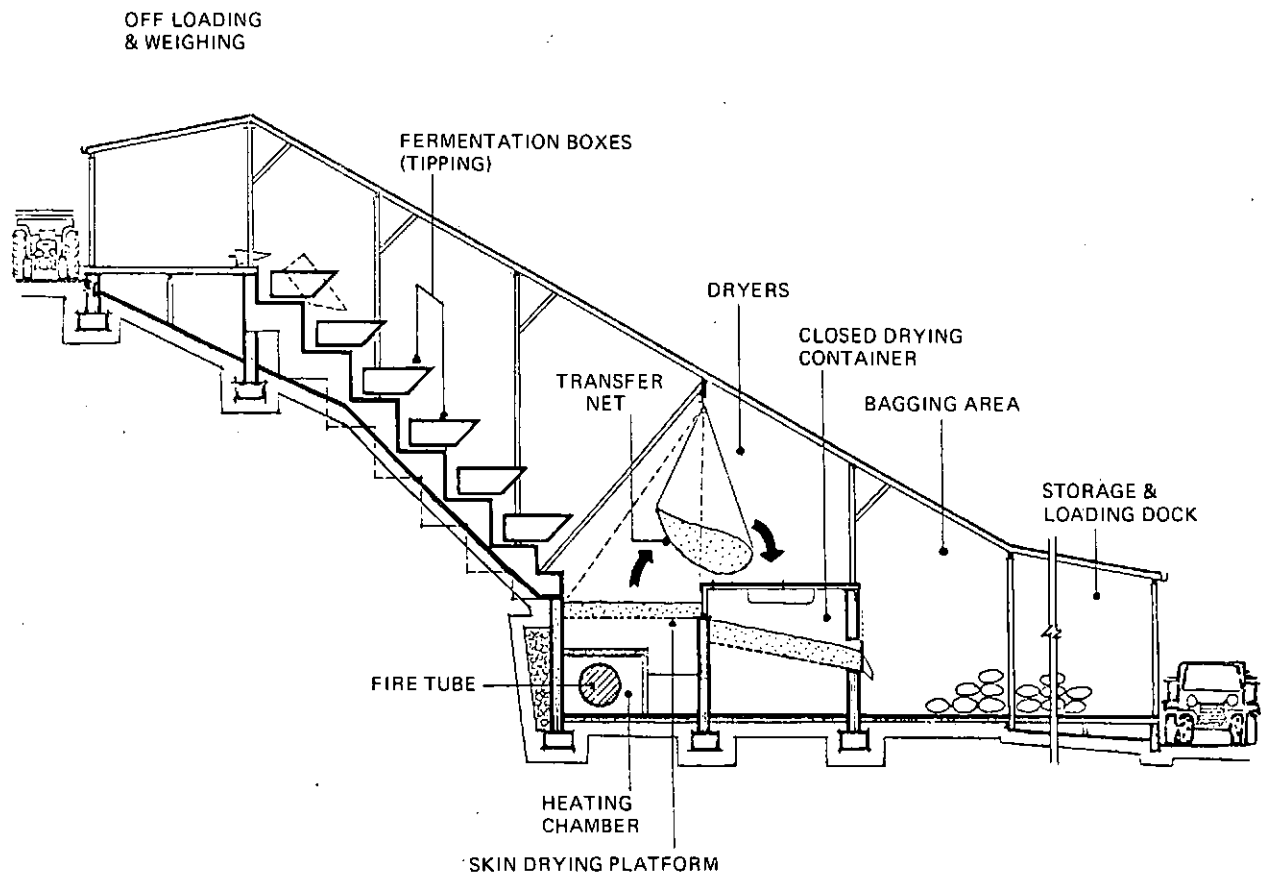


FIGURE 1 The new Barico dryer and fermentary

floor levels, to a total depth of fifty inches of beans. During the first day, the wet beans are stored on nets on the skin-drying platform, at a depth of no more than 10 inches. After twenty-four hours, when the beans are no longer sticky, they are lifted in the nets and tipped into an adjoining container where, on a smaller area of perforated floor, they lie 20 inches deep (*Figure 1*). There are two containers to accommodate alternate daily production. At these depths, cocoa beans will not lump together, even with no agitation whatsoever throughout the entire drying period. However, the nets can be used to turn the beans on the skin-drying platform to aid easy removal of unwanted debris during the first day of drying.

Each day, the air flow is reversed in order to pass through the driest cocoa first and down through the second container. It subsequently exhausts through the wettest cocoa on the skin-drying platform. This results in the hot air being used most efficiently in absorbing a proportion of moisture from each progressively wetter batch of beans; the whole process is achieved with minimum movement of the beans and therefore without breakage. The beans dry very evenly and at a rate compatible with the process of movement of moisture from the centre of each bean. Faster drying merely results in more brittle and broken beans.

The latest version of the Barico Dryer has sloping perforated floors in the containers, which help the dry beans to flow freely out through the hatches directly into the bags.

Another improvement is in the repositioning of the fire flues to avoid obstruction of the bagging chutes of which there are now three to each container.

Reversal of the air flow is controlled by two easily accessible doors.

Fermentary

The new 'downhill' type fermentary incorporates six lines of tipper boxes for daily mixing by minimum labour. These boxes are shallow to enable better aeration and more frequent turning of the beans, towards reduction of bean acidity. Each line of eight boxes (24" in depth) has a capacity of four tons of beans (dry bean equivalent) at half a ton per box. Each box tips directly into the box below and finally onto the skin-drying platform. In the absence of a convenient hill slope, a ramp or conveyor can be erected to lift the beans to the top level boxes. This arrangement involves lifting the beans once only; thereafter the movement is progressively downwards, onto the dryer, into the containers, and out into the bags.

REFERENCE

ANSELM, J. A., LIU, S. N. AND MU, C. H. (1974) The Barico Cocoa Drier. *Planter, Kuala Lumpur*, 50, 144.

This paper was published in the proceedings of this seminar on cocoa and coconuts referred to on previous pages. The editor is grateful for the author's permission to publish this shortened version of the original.

"Cocoa" — Third Edition

It may interest readers to know that the third edition of "Cocoa" has been reprinted and should be available from bookshops. However, in case of difficulty, inquiries may be directed to one of the publishers overseas offices. Their addresses are:

Ghana

Sedco Publishing Ltd., P.O. Box 2051, Accra, Ghana.

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Orient Longman Ltd., 36a Anna Salai, Madras 600002, India.

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Cocoa Abstracts

COCOA ABSTRACTS: These abstracts are reprinted from "Abstracts on Tropical Agriculture" published by the Royal Tropical Institute, Amsterdam.

September 1977

Aspects of cocoa cultivation under coconut on two estates in Peninsular Malaysia SHEPHERD, R.; GILBERT, J.R.; COWLING, R.G. *Harrisons and Crosfield Ltd., Banting, Malaysia — Planter (Malaysia)* v. 53 (612) p. 99-117; Mar 1977.

Interplanting of cocoa in avenues between old coconut palms has proved an unqualified success. Coconut crops have not declined and it is expected that yields in excess of 1,000 lb dry beans/acre can be obtained from the cocoa stand. Even although the cocoa has not reached full maturity in all plantings, the revenue from cocoa in recent years has exceeded that from the coconut stand and the current combined revenue per acre is greater than obtained from oil palms. Interplanting has not been without problems. Most of the difficulties have been overcome, but close vigilance must be maintained to ensure that vascular-streak dieback and diseases caused by *Phytophthora palmivora* are contained. Strict checks and timely remedial measures are also necessary to minimise damage by insect and mammalian pests. Limited replanting of old coconut stands underplanted with cocoa has been attempted. A means of disposal of the palms which causes very little damage to cocoa has been developed.

[Improving cocoa quality: different levels of association of some variables] **Melhoria de qualidade do cacau: níveis diferenciais de associacao de algumas variaveis** ASMAR, S.R.; BARROCO, H.E. *Divisao de Socio-Economia, Centro de Pesquisas do Cacau (CEPEC), Ilheus, Bahia, Brazil — Boletim Tecnico — Centro de Pesquisas do Cacau (Brazil)* no. 46, 27 p.; Aug 1976.

Suggestions are made to improve cocoa quality in Bahia, Brazil, which are derived from the analysis of 24 factors affecting quality.

[Response of cacao to fertilizers in southern Bahian soils] **Respuesta del cacaotero al abonamiento en el sur de Bahia, Brazil** ROSAND, P.C.; SANTANA, C.J.L. DE; MIRANDA, E.R. DE *Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — Boletim Tecnico — Centro de Pesquisas do Cacau (Brazil)* no. 43, 24 p; Jun 1976.

Trials conducted during 10 years showed a yield of 1,680 kg dry cocoa beans/ha from unshaded trees with fertilizers, 1,258 kg/ha from unshaded without fertilizers, 1,064 kg/ha from shaded with fertilizers, and 980 kg/ha from shaded without fertilizers. Application of P showed a highly significant increase in production. N was beneficial only in 2 years, while K never showed any effect.

United Nations Cocoa Conference, 1975 — United Nations, New York, USA — UN/TD/COCOA.4/10, 35 p. 1976.

Contains the text of the International Cocoa Agreement, 1975, proposed for ratification to participant governments.

Cocoa establishment and maintenance on alluvial soils MENON, K.G. Tanah Merah Estate, Port Dickson, Negri Sembilan, Malaysia — *Planter (Malaysia)* v. 53 (612) p. 88-98; Mar 1977.

This paper is meant for the practical planter. It provides information on the current techniques and practices for the cultivation of cacao in Malaysia, e.g. planting material, nursery techniques, field preparations, lining, holing, transplanting, care after planting and early maintenance, including manuring and weed and pest control.

(Report of activity 1976) Rapport d'activité 1976 — Institut Français du Café et du Cacao (IFCC), Paris, France — *Rapport d'Activité — Institut Français du Café et du Cacao (France)* IFCC Paris (France) 94 p. 1976.

This report on activities in 1976 deals with coffee, cacao, tea, and other stimulant crop research conducted in France, Ivory Coast, Togo, Cameroon, Central African Republic, Madagascar, and New Caledonia.

(Some notes on a virus disease on cocoa in North Sumatra) Beberapa catatan mengenai penyakit virus tanaman coklat di Sumatera Utara PARNATA, Y. — *Bulletin, Balai Penelitian Perkebunan Medan (Indonesia)* v. 7 (1) p. 5-13; Mar 1976.

Cocoa swollen shoot disease has been damaging to the cultivation of cocoa since 1936. The research on this disease and the study on CSSV (Cocoa Swollen Shoot Virus) has intensively been carried out in West Africa (especially Ghana) and in England. Besides in West Africa, CSSV has been found in Central and South America, Sri Lanka, Sabah and Indonesia. However, the disease found on the Indonesian varieties of the so called "quality cacao" appeared to be mild and caused neither death nor swellings. But since 1975 this disease has been found on varieties of the so-called "bulk" cacao (UAH=Upper Amazon Hybrids). It is too early, however, to arrive at a definite conclusion of the severity of the disease on this cocoa variety.

(Relation between plant vigour and resistance to the fungus *Ceratocystis fimbriata* in cacao) Relación entre vigor de las plantas y resistencia al hongo *Ceratocystis fimbriata* en cacao DOMINGUEZ R, P.F. Facultad de Agronomía, Universidad Central de Venezuela (UCV), Maracay, Venezuela — *Revista de la Facultad de Agronomía, Universidad Central (Venezuela)* v. 9 (1) p. 5-21; Jun 1976.

This study of the potential use of native cacao clones for obtaining resistance to *Ceratocystis* (*Ceratommella* wilt) and a higher productivity resulted in a proposal for a breeding programme.

October 1977

Verticillium wilt of cacao in Uganda: incidence and progress of infection in relation to time EMECHEBE, A.M.; LEAKEY, C.L.A.; BANAGE, W.B. Makerere Univ., Kampala, Uganda — *East African Agricultural and Forestry Journal (EAAFRJ)* v. 41 (2) p. 184-186; Oct 1975.

Verticillium dahliae Kleb. from wilted cacao (*Theobroma cacao* L.) was re-isolated from the stem above soil level 3 days after inoculating the roots of container grown plants and reached the top of some 45 cm tall seedlings within 6 days. No visible vascular discoloration was observed before the 9th day after inoculation. It is inferred that conidia or mycelium of the fungus

must move passively within the transpiration stream. Mechanical damage to roots may facilitate early passage to the xylem and systemic distribution within the host. A Progress of Infection index reached 100 percent by the 13th day from inoculation. There were significant linear correlations both between internal progress of infection and between percent incidence, within replicates, and time. Author's summary.

November 1977

A possible new approach to cocoa FREEMAN, W.E. Ministry of Agriculture, Lands and Fisheries, Centeno, Trinidad and Tobago – Ministry of Agriculture Lands and Fisheries Centeno (Trinidad and Tobago) 13 p.; Feb 1975.

Based on cocoa trials conducted in Trinidad, it is recommended to plant for trial on a small scale at a spacing of 0.90 x 1.80 m instead of the normal spacing of 3.60 x 3.60 m. Fertilizer should be applied twice a year, and windbreaks should be planted wherever possible.

Hemeroblemma rengus on cocoa FELIZ, M. Division Cuarentena Vegetal, Centro Nacional de Investigaciones Agropecuarias, San Cristobal, Dominican Republic – *FAO Plant Protection Bulletin (FAO)* v. 25 (1) p. 41 1977.

During September and October 1975 an infestation of *Hemeroblemma rengus* (Poey) Lepidoptera, Noctuidae, which damaged cocoa pods (*Theobroma cacao* L.) was first discovered in the major cocoa-growing area of Fantino, Cotui, Dominican Republic.

The Cocoa Research Institute of Ghana (CRIG) – Cocoa Research Inst. of Ghana (CRIG) Tafo, Ghana – *CMB Newsletter (Ghana)* no. 64, p. 29-30 Dec 1976.

The history and various research activities of the Cocoa Research Institute of Ghana are briefly outlined. Among the research findings are the control of swollen shoot disease by the "cutting method", the development of a high and quick yielding cocoa variety, now being planted all over the country, and the fermentation of beans by the sweat-box and tray methods. Preliminary results showed that mechanical drying of beans can be achieved in about 24 to 30 hrs. If mechanical drying experiments prove successful, the method could replace sundrying which takes at least 10 to 14 days with the risk of mould in humid weather.

(Results of mother trees selection in cocoa (*Theobroma cacao* L.) on the Kalikempit Estate) Hasil pemilihan pohon induk pada cokelat di perkebunan kalikempit MUHADJIR Balai Penelitian Perkebunan Bogor, Jember, Indonesia – *Menara Perkebunan (Indonesia)* v. 44 (4) p. 179-183; Aug 1976.

During the period 1968 to 1974 observations and yield recording were carried out on 95 cocoa mother trees in Kalikempit estate, near Banyuwangi, East Java (Indonesia). Only 14 of the 95 trees have been selected with an average yield of 4 times that of the standard yield, i.e. the mean yield of the whole original population. It was estimated that the best numbers could produce 6.786 kg, 5.971 kg, 3.393 kg and 2.714 kg dry bean/year/ha, when planted at 2 x 4 m, 3 x 3 m and 4 x 5 m spacing, respectively. In order to know the actual yield potential of the 14 selected numbers, it is recommended to conduct a clonal testing trial on various estates.

December 1977

Fertilizer for cacao in Western Nigeria — Cocoa Research Inst. of Nigeria (CRIN), Ibadan, Nigeria — *C.R.I.N. Advisory Leaflet (Nigeria) Cocoa* Research Inst. of Nigeria Ibadan (Nigeria) no. 11, 8 p.; Feb 1972.

An advisory leaflet on fertilizer for cacao in Western Nigeria. It contains recommendations on type of fertilizer and rate of application to be used at different ages, including during the initial bearing and mature stage. General responses of cacao to fertilizer in Western Nigeria are also briefly presented.

(Influence of the leaf and lignification of the stem on the rooting of the cuttings from cocoa trees (*Theobroma cacao* L., Sterculiaceae) Influence de la feuille et de l'aouëtment de la tige sur l'enracinement des boutures de cacaoyer (*Theobroma cacao* L., Sterculiacées) VOGEL, M. — *Café Cacao Thé (France)* v. 21 (2) p. 91-98; Apl 1977.

An experiment was carried out with the clone Amelonado SNK 37. Ninety semi-lignified plagiotropic cuttings with a single node were split longitudinally at their base, so as to separate the 2 types of "wood", i.e. green and lignified. The limb of each leaf was reduced to a quarter of its length. It was shown that rooting tended to take place towards the base of the cutting, and preferentially on the lignified side. Rooting is the result of internal morphogenous correlations between an emitter site, the leaf (associated perhaps with its bud) and a receptor site on the more basal and lignified part of the cutting. The messages pass through the stem longitudinally or very slightly obliquely, according to a strict polarity.

(Storage of cocoa under vacuum in polyethylene containers) Stockage du cacao sous vide dans des conteneurs en polyéthylène CHALLOT, E.; VINCENT, J.C. — *Café Cacao Thé (France)* v.21 (2) p. 129-136; Apr 1977.

The beans were introduced into parallelopiped-shaped 240 l capacity polyethylene containers, which were then sealed, a vacuum of 600 mm having been obtained by means of a laboratory pump. The containers were stored for twenty months under shelter, but after eight months, two containers were exposed to bad weather. The samples taken before the test and after various storage periods, were analyzed for moisture content, submitted to cut tests, and the swelling index, weight of hundred beans, number of beans in 100 g, amount of matter oxidisable with KMnO_4 , and the inner Zeller acidity figure determined. The chocolate was examined for organoleptic properties. On the basis of the results obtained, the conservation of cocoa beans under vacuum does not affect their physical, chemical and organoleptic properties adversely. The proliferation of insects and the development of microflora are checked.

Malaysia thinks big on cocoa GILL, R. — *Far Eastern Economic Review (Hong Kong)* v. 97 (36) p. 43-44, 49; 9 Sep 1977.

In Malaysia extensive cultivation of cocoa on estates and on smallholdings is being actively encouraged. Extensive research is being carried out at the Cocoa Research Centres set up by the government. The national aim is to increase the acreage under cocoa to 300,000 acres (/ 120,000 ha) within the next 7 years. Apart from the FELDA scheme, the main thrust will come from the private sector. Malaysia's edge, and the motivation for getting into cocoa in a big way, lies wholly with the high yields its estates have reported (3,360

kg of cocoa beans per ha against 840 kg/ha in Africa) and the fact that it can be just as successfully cultivated as an intercrop. Another factor is that cocoa grown in West Africa is regularly subject to pest infection while the Malaysian crop has so far been free from such attacks. A further and more crucial factor is the minimum acreage yield required to make cocoa cultivation profitable. At present, a yield of 350 kg/ha ensures profitability.

Annual report on cacao research 1974-1975 — University of the West Indies, St. Augustine, Trinidad and Tobago — *Annual Report on Cacao Research (Trinidad and Tobago)* University of the West Indies St. Augustine (Trinidad and Tobago) v. 1974, 31 p.; v. 1975, 29 p. 1977.

A report of the activities of the Unit Cacao Research of the University of the West Indies, Trinidad, in 1974 and 1975. It includes detailed results of varietal test trials and brief progress reports of the various sections, including plant breeding, plant pathology, biochemistry and processing.

Cocoa production. Economic and botanical perspectives SIMMONS, J. (ED.) Development Economics Dept., World Bank, Washington, D.C., USA — Praeger Publishers New York (USA) 431 p.

This book attempts to provide both the basic information about cocoa production and a synthesis of the research results. It gives an overview of the technical aspects of policy issues and also of the development in cocoa research. The economic perspectives of cocoa are well covered in this book.

Recommended international standard for cocoa butters — Codex Alimentarius Commission, FAO/WHO Food Standard Programme, Roma, Italy — FAO/WHO/CAC/RS-86, 14 p. 1976.

This booklet contains information on the international standard for cocoa butter used as an ingredient in the manufacture of chocolate and chocolate products.

(The mirids of cacao) Les mirides du cacaoyer LAVABRE, F.M. (ED.) Institut Français du Café et du Cacao (IFCC), Paris, France — IFCC Paris (France) 366 p. 1977.

The mirids are major pests of cocoa, especially in W. Africa, the world's principal cocoa producing region. This book is a compilation of 22 papers by experts on mirids from all over the world. A general description of the family Miridae (formerly also called Capsidae), is followed by papers dealing with the world-wide distribution of mirids, the principal species occurring in W. Africa, such as *Sahlbergella singularis* and *Distantiella theobroma*, their economic importance, seasonal variation of population densities, biological control and their relations with other insects, chemical control, insecticide resistance, spray equipment, and varietal resistance.

The sceptical cocoa grower NG SIEW KEE Research Dept., United Plantations Berhad, Teluk Anson, Malaysia — *Planter (Malaysia)* v. 53 (614) p. 202-205 1977.

In order to place the fast expanding cocoa industry on a stronger footing, the author urges the progressive and dynamic Malaysian industry to strengthen and intensify research. As first priority breeding for resistance against VSD (Vascular Streak Dieback) must be accelerated. In this fashion the scepticism of the cocoa grower can mellow into guarded optimism as threats of explosive pestilences recede into the background.

January 1978

Malaysia expands cocoa production and exports FREEMAN, T.R. — *Foreign Agriculture (USA)* v. 15 (29) p. 12; 25 Jul 1977.

Cocoa area increased from 16,400 ha in 1971 to 38,900 ha in 1976 with cocoa bean production in the latter year at 22,000 tons (77 percent exported). Production in 1980 is expected to be 30,000 tons.

Coleopterous insects associated with stored cocoa SILVA, P.L. Commissao Executiva do Plano da Lavoura Cacaueira (CEPLAC), Salvador, Bahia, Brazil — *FAO Plant Protection Bulletin (FAO)* v. 25 (2) p. 90 1977.

During a survey of insect pests in stored cacao bean in Salvador and Itheus, Brazil, 16 insect species were found including *Oryzaephilus surinamensis*, *O. mercator*, *Gibbium psyllodes*, and *Attagenus megatoma*.

(Effect of the soil compaction on the growth of cacao seedlings and penetration of their roots) Efeito da compactação do solo no desenvolvimento de plântulas de cacau (Theobroma cacao L.) e na penetração das suas raízes SILVA, L.F. DA; PEREIRA, C.P.; MELO, A.A.O. DE Divisao de Geociencias, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (1) p. 13-18; Jan 1977.

In a greenhouse test, development of cacao seedlings var. Catongo was compared when grown in soils with densities 1.0, 1.1, 1.2 and 1.3. The following factors were taken into account, viz. (1) dry weight of roots and aerial parts of the plants, (2) depth of the main root when seedlings were 6 months old, and (3) hydraulic conductivity of the soils. Growth in soils with densities 1.0 and 1.1 was normal, while growth in soils with higher densities was poor, probably due to a deficiency in oxygen. It is concluded that hydraulic conductivity in soil densities higher than 2.5 cm water/hr permits normal growth.

(Population dynamics of Forcipomyia spp. (Diptera, Ceratopogonidae) in Bahia, Brazil. 2. Biotic variables related to natural cacao pollination) Dinâmica populacional de Forcipomyia spp. (Diptera, Ceratopogonidae) na Bahia, Brasil. 2. Variáveis bióticas relacionadas com a polinização do cacaueiro SORIA, S. DE J. Divisao de Zoologia Agricola, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (1) p. 19-33; Jan 1977.

The relationships between *Forcipomyia* spp. populations and other factors related to productivity in cacao were studied over a period of approx. 3 years in a number of cacao plantations. The degree of natural pollination was positively related to the intensity of flowering and insect population levels. Fruit setting and yield were also positively correlated with pollination level. These relationships allow the speculation that total productivity may be forecast from observations on flowering intensity and on insect populations, instead of only on the basis of fruit setting. It is concluded that attainment of production targets will depend on protection of *Forcipomyia* spp. populations and on proper and timely synchronization of the insect populations with flowering periods.

(Contribution to the knowledge of the hereditary transmission of the resistance of the cocoa tree to the black pod disease (*Phytophthora palmivora*) in Cameroon.) Contribution à la connaissance des modalités de la transmission héréditaire de la résistance du cacaoyer à la pourriture brune des cabosses (*Phytophthora palmivora*) au Cameroun BLAHA, G.; LOTODE, R. Institut Français du Café et du Cacao (IFCC), Montpellier, France — *Café, Cacao, Thé (France)* v. 21 (3) p. 179-196; Jul 1977 (Fr).

Inoculations with local strains of *Phytophthora palmivora* of pods growing on cocoa hybrid trees showed that resistance and susceptibility are transmitted genetically but that the offspring of resistant parents is more susceptible than the parent trees, while the variability within hybrid families is very pronounced. Reciprocal crosses produce different results and demonstrate the predominant role played by the male parent. This might be attributed to a maternal effect which is not located in the chromosomes.

Variation and correlations of some pod and bean values in cacao (*Theobroma cacao* L.) with reference to the parental effects on fruit setting and bean number ESKES, A.B.; BEEK, M.A.; TOXOPEUS, H. Seção de Genética, Instituto Agronômico, Campinas, São Paulo, Brazil — *Turrialba (IICA)* v. 27 (2) p. 193-198; Apr 1977.

Fruits obtained from 2 pollination experiments were analyzed for various characters. Differences in fruit setting and bean number per pod were significant between male parents, indicating genetical differences in pollen fertility. When a heavy cherelle wilt occurred 7 weeks after pollination, the only clone showing considerable tolerance was 'SCA 12'. Correlations between 7 pod and bean characters have been determined within 5 clones. Generally dry bean production per pod was closer related to bean number, than to the average bean weight. However, in fruits with a relatively high number of beans the average bean weight is of a major importance. In this group of fruits the average bean weight becomes a less independent character, showing high correlations with pod weight and dry weight of the pod wall. Authors' summary.

(Preliminary study on the utilisation of resins for prolonging the persistence of fungicides used against the black pod disease of the cocoa tree (*Phytophthora palmivora* Butl.)) Etude préliminaire sur l'emploi des résines pour améliorer la rémanence des fongicides utilisés contre la pourriture brune du cacaoyer (*Phytophthora palmivora* Butl.) COUPRIE, F. ONAREST, Yaounde, Cameroon — *Café, Cacao, Thé (France)* v. 21 (3) p. 203-209; Jul 1977.

Climatic conditions in Cameroon necessitate a high frequency of fungicide application if cocoa pods are to be protected against *Phytophthora palmivora*. Experiments with various fungicides in combination with resin-type additives showed that in the presence of the latter, both run-off during spraying and leaching during subsequent rains are reduced.

Annual report 1972-73 — Cocoa Research Inst. of Nigeria (CRIN), Ibadan, Nigeria — *Annual Report — Cocoa Research Institute of Nigeria (Nigeria)* CRIN Ibadan (Nigeria) v. 1972-73, 302 p. 1974.

Annual report 1972-73 of the Cacao Research Institute, dealing with research on plant breeding, agronomy, soils and chemistry, plant pathology, entomology, economics and statistics, and with cacao, kola, coffee and cashew.

Recent advances in the processing of cocoa beans GHOSH, B.N. Gulf Western Advanced Development & Engineering Section, Swarthmore, Pennsylvania, USA — *Agricultural Mechanization in Asia (Japan)* v. 8 (3) p. 61-66 1977.

The need for a continuous drying operation during the farm processing of cacao in Brazil was solved by the newly developed glass-roof dryer which uses solar energy and/or artificial heat in the same installation. The dryer can be easily modified for drying practically any other crop on the farm.

February 1978

(Technical information CEPEC 1975) Informe Técnico 1975 — Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Informe Técnico — CEPEC (Brazil)* CEPEC Itabuna, Bahia, (Brazil) 141 p. 1975.

A report of the activities in 1975 conducted by the cacao research centre CEPEC.

(Supply, demand and prices of cacao, 1979/80 and 1984/85) Oferta, demanda e preços de cacau, 1979/80 e 1984/85 LAFLEUR, J.R. Secretária Geral, Plano de Recuperação Econômico-Rural da Lavoura Cacaueira (CEPLAC), Brasília, D.F., Brazil — *Cacau Atualidades (Brazil)* v. 14 (1) p. 8-14; Jan 1977.

The influence of the future price on supply and demand of cacao is discussed.

(Technical information CEPEC 1974) Informe Técnico 1974 — Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Informe Técnico — CEPEC (Brazil)* CEPEC Itabuna, Bahia, (Brazil) 198 p. 1974.

A report of the activities conducted in 1974 by the cacao research centre CEPEC.

(Possibilities of cacao plantation in the lower Amazon, Pará) Possibilidades de implantação de um polo cacaueiro no baixo Amazonas, Pará SILVA, L.F. DA; LEO, A.C. Divisão de Geociências, Centro de Pesquisas do Cacau (CEPEC) Itabuna, Bahia, Brazil — *Cacau Atualidades (Brazil)* v. 14 (1) p. 15-21; Jan 1977.

In the lower Amazon are areas with excellent soil, climatic and topographic conditions for cacao growing.

(Soils suitable for growing cacao in Rondonia) Solos adequados para o cultivo do cacaueiro em Rondônia CARVALHO FILHO, R.; SILVA, L.F. DA Divisão de Geociências, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Cacau Atualidades (Brazil)* v. 13 (4) p. 2-7; Oct 1976.

In the 4 areas studied 13 pedological units were identified of which only 4 were suitable for cacao growing. These 4 are described.

(Some considerations on transport costs of cacao husks on one type of farm) Algumas considerações sobre os custos de transporte de casca de cacau numa fazenda tipo BRANDAO, A.L. DE A.; TAFANI, R.R. Divisão de Socio-Economia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Cacau Atualidades (Brazil)* v. 13 (4) p. 8-14; Oct 1976.

Analysis and discussion of transport costs of entire cacao pods or husks and beans separate.

(Trends and projections of world cacao demand) **Tendências e projeções da demanda mundial do cacau** LAFLEUR, J.R. Secretaria Geral, Plano de Recuperação Econômico-Rural da Lavoura Cacaueira (CEPLAC), Brasília, D.F., Brazil — *Cacau Atualidades (Brazil)* v. 14 (1) p. 22-28; Jan 1977.

Producer prices over the last years in the main cacao producing countries are given, and the influence of prices on the world cacao demand in 1979/80 and 1984/85 is discussed.

March 1978

Field differentiation of black pod from other cacao pod diseases SREENIVASAN, T.N.; QUESNEL, V.C. — *Tropical Agriculture (Trinidad and Tobago)* v. 54 (4) p. 371-372; Oct 1977.

Phytophthora infected cacao pods (black pod disease) in both Nigeria and Jamaica have a characteristic seaweed-like colour, which may be used in laboratory test to distinguish black pod from other pod diseases caused by *Monilia roleri*, *Trachysphaera fructigena*, *Botryodiplodia theobromae*, and *Macrophoma* sp.

Reflections on yields from hybrid cocoa varieties in Ghana LOCKWOOD, G. Cocoa Research Inst., Tafo, Ghana — *Cocoa Growers' Bulletin (UK)* no. 26, p. 4-10; Sep 1977.

An analysis of cacao variety trials in Ghana suggests that Amazon x Amelonado hybrids are likely to outyield Amelonado varieties by only 25 to 50 percent and not by 90 percent as sometimes suggested. The hybrids may be expected to yield in the range from 550 to 650 kg/ha. They are easier to establish than Amelonado, which is important when replanting old cacao land, but more susceptible to blackpod disease.

Recent research on insect pollination of cocoa WINDER, J.A. Division of Entomology, CSIRO, Curitiba, Parana, Brazil — *Cocoa Growers' Bulletin, (UK)* no. 26 p. 11-19; Sep 1977.

The author reviews the recent investigations on the pollination of cocoa which is largely effected by the females of the genus *Forcipomyia*. Taxonomy breeding sites, behaviour including pollinating activity, ecology and the effect of insecticides are discussed in relation to the possible increase in fruit set. It is, however, felt that the present information is insufficient for that latter purpose.

The transport of cocoa beans in containers WOOD, G.A.R. Cadbury Schweppes Ltd., Bournville, UK — *Cocoa Growers' Bulletin (UK)* no. 26, p. 20-22; Sep 1977.

Cocoa shipped in containers and travelling from warm to cool regions suffers from moisture condensation and mould development, especially when transported in bulk. Polythene lining of jute bags is effective but not always feasible. Silica gel only partly prevents condensation of moisture. Most likely, ventilated containers will prove suitable.

Green budding and grafting in cacao nurseries GIESBERGER, G.; COESTER, W.A. Department of Agricultural Research, Royal Tropical Inst., Amsterdam, Netherlands — *Acta Horticulturae (Netherlands)* no. 53, p. 263-271; Apr 1977.

Greenhouse experiments conducted on green budding and grafting of two- to six-week old seedling root-stocks are described. For budding, the modified Forkert method, and for grafting, the sidegrafting method were found to be most suitable. For practical purpose budding in the nurseries is to be preferred to grafting. A tubular budding knife has been developed, allowing mechanization of the budding operation to a certain extent. Green budding of very young root-stocks in the nurseries should enable the establishment of cacao plantings from well-grown buddings with 5-6 months.

April 1978

(Eco-physiological studies on cocoa) *Recherches éco-physiologiques sur le cacaoyer* LEMEE, G. — *Revue Générale de Botanique (France)* Librairie Générale de l'Enseignement Paris (France) v. 63, 54 p. 1956.

Pot experiments on cocoa in the Ivory Coast showed that growth and stomatal aperture were more rapidly affected by decreasing soil moisture than leaf water deficit, diffusion pressure deficit, apparent photosynthesis, and transpiration per unit of leaf area. Field observations demonstrated the pronounced interactions between age of leaf, stomatal aperture, soil moisture content, light intensity, leaf water deficit, apparent photosynthesis, water conductivity of tissues, and transpiration. Cocoa was found to be highly susceptible to both excess and shortage of soil water and to prefer light shade over full sunlight.

(Observations on free pollination in Theobroma cacao: mathematical analysis of data and modelling) *Observations sur la pollinisation libre chez Theobroma cacao: analyse mathématique des données et modélisation* PARVAIS, J.P.; REFFYE, P. DE; LUCAS, P. Centre de Recherches, Institut Français du Café et du Cacao (IFCC), Bingerville, Ivory Coast — *Café, Cacao, Thé (France)* v. 21 (4) p. 253-262; Oct 1977.

Lack of pollination is a limiting factor in fruiting of cocoa trees. In this study it appeared that only a minority of styles carried any pollen and that of these only a few carried sufficient pollen to fertilize the ovules and set fruits. Pollen tends to aggregate, thus pollination depends on the frequency of the deposition of aggregates on the style and on the size of these aggregates. The frequency of the deposition of the aggregates depends on the mode of action of the pollination vectors, mainly insects. Simulation methods enable the various means of the pollination of the cocoa tree to be evaluated and the possible influence of external factors to be described.

(The mineral nutrition of cocoa at the Nkoemvone Station: present situation and prospects) *La nutrition minérale du cacaoyer à la station de Nkoemvone: bilan et perspectives* PAVIOT, J. Institut Français du Café et du Cacao (IFCC), Yaounde, Cameroon — *Café, Cacao, Thé (France)* v. 21 (4) p. 245-252; Oct 1977.

The object of this study was to use soil analysis to establish the possible economic interest of mineral fertilizers on cocoa (*Theobroma cacao*) in S. Cameroon. In a field trial the chemical changes in the soil, growth, yield and yield components of the cocoa tree were compared for plots with a balanced K-Ca-Mg fertilizer and for control plots. In pots the effect of different doses of fertilizers on the diameter of the stem, the number of foliated shoots, flowering and fruiting, and on the chemical changes of the soil, were studied.

A nursery trial was also done. In this way fertilizer formulations could be determined by which substantial increases in growth and yield could be obtained.

May 1978

(Standard methodology to induce zoosporangia and zoospore production in *Phytophthora palmivora* (Butl.) Bult.) Método standard para produção de zoosporângios e zoósporos de *Phytophthora palmivora* (Butl.) Butl. MEDEIROS, A.G. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (3) p. 107-111; Jul 1977.

A description of the production of 2.7 million zoosporangia and about 25 million zoospores per monozoospore culture, using artificial light, is given.

(Manuring the cacao tree in Brazil. Twelve years of investigations) A fertilização do cacaueiro no Brasil. Doze anos de pesquisas MORAIS, F.I.; SANTANA, C.J.L. DE; SILVA, R.E.C. Setor Fertilidade, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Boletim Técnico — Centro de Pesquisas do Cacau (Brazil)* CEPEC Itabuna, Bahia (Brazil) no. 55, 45 p. 1977

Information on climate, vegetation, geology and soils of the main cacao growing region of Brazil (an area of 91,000 km² in the southeast of Bahia State; about 4 percent is under cacao) is followed by results of research concerning soil mineral deficiencies, availability of P, K, N and micronutrients soil acidity and liming, responses of cacao to fertilizer applications, and foliar diagnosis.

(Efficiency and economics of ULV copper sprayings against Black Pod disease of cacao) Eficiência técnica e econômica de pulverizações com fungicidas de cobre a ultra baixo volume no controle da "Podridão Parda" do cacaueiro MEDEIROS, A.G.; TAFANI, R.R.; BRANDAO, A.L. DE A. Divisão de Fitopatologia, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (2) p. 41-68; Apr 1977.

Formulations of copper hydroxide, cuprous oxide and copper oxychloride with and without stickers added, were compared both in high volume at 160 l of spray liquid/ha, and in ULV (ultra low volume) at 11 l of spray liquid/ha applications. Plots with monthly removal of diseased pods together with non-treated plots (control) were included. Trees received 4 g copper (Cu) in 200 ml water and 2 g Cu in 14 ml of water per round in high volume and ULV respectively. Highest control was obtained using cuprous oxide plus sticker in high volume application, resulting in highest returns as well. Costs of treatments represented on the average about 21 percent of the produce. ULV sprays were 21 percent less effective than high volume applications. Removal of diseased pods was effective in only one case, giving 50 percent control.

(Population dynamics of *Forcipomyia* spp. in Bahia, Brazil. 3. Climatic variables related to the pollination of cacao) Dinâmica populacional de *Forcipomyia* spp. (Diptera, Ceratopogonidae) na Bahia, Brasil. 3. Variáveis climáticas relacionadas com a polinização do cacaueiro SORIA, S. DE J. Divisão de Zoologia Agrícola, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (2) p. 69-84; Apr 1977.

The purpose of this study was to determine which climatic variables exercised the greatest influence on the midge (*Forcipomyia* spp.) population and on the natural pollination of cacao in Bahia, Brazil. The climatic variables studied were the following: temperature aspects, relative humidity, rainfall (mm), sunshine hours, precipitation/sunshine hours (P/B), nebulosity (N/10), evaporation (PICHE), evapotranspiration (Thorntwaite), and water balance. Results indicated significant correlations between temperature and evapotranspiration and insect populations. Results also indicated that heat, sunshine hours, nebulosity and water balance were significantly correlated with natural pollinations. It was concluded that heat, soil water availability and air humidity closely interacted with *Forcipomyia* population and pollination. It was not possible to determine which of the climatic parameters is the single triggering element in the pollination process. Author's summary.

(Effect of fertilizer application and scarification on the growth and production of cacao tree) Efeito da adubação e escarificação do solo no desenvolvimento e produção do cacauero SANTANA, C.J.L. DE; MORAIS, F.I. DE O.; CHEPOTE, R.E. Divisão de Geociências, Centro de Pesquisas do Cacau (CEPEC), Itabuna, Bahia, Brazil — *Revista Theobroma (Brazil)* v. 7 (3) p. 85-91; Jul 1977.

A split plot experimental design with 5 replications was used consisting of 4 treatments, viz. control, 0.5, 1.0 and 1.5 doses of the fertilizer formula 12-30-20 at the basic rate of 286 kg/ha, and 2 sub-treatments, viz. with and without soil cultivation. The fertilizer in all applications increased growth and yields of cacao whereas soil cultivation, using a heavy rigid fine cultivator, resulted in decreased production. Chemical soil analysis showed changes in pH, Mg (magnesium) and especially P content as a result of fertilizer application.

June 1978

Larger cocoa supplies, lower prices expected DULL, R.E.T. — *Foreign Agriculture (USA)* v. 15 (51) p. 9, 16; 19 Dec 1977.

The long term outlook for cocoa is for increasing supplies and further easing of prices. Given the return of better weather conditions in West Africa and increased output from new plantings in the Ivory Coast, Brazil, and Malaysia, world cocoa bean production for 1978/79 could exceed the record 1971/72 harvest of 1.57 million tons.

Diseases of cocoa in Sabah LIU, P.S.W.; LIEW, P.S.C. Agricultural Research Centre, Tuaran, Sabah, Malaysia — *Technical Bulletin — Department of Agriculture (Malaysia)* Department of Agriculture Quoin Hill, Sabah (Malaysia) no. 1, 85 p. 1975.

This publication is an account of cocoa diseases in Sabah. The following groups of diseases are described: thread blight, pod diseases, minor leaf diseases, root diseases, die-back, virus diseases, genetic abnormalities, parasitic plants and epiphytes.

Brazil hopes to become no. 1 cocoa producer, exporter by 1990 YALLOUZ, Y.E. — *Foreign Agriculture (USA)* v. 16 (9) p. 6-8; 27 Feb 1978.

Keystone of the Brazilian cacao production improvement is the CEPLAC cacao programme, which comprises: agricultural research and experimenta-

tion; rural extension and financial assistance; technical training in agriculture and livestock; a special programme for the Amazon, and other special programmes including a national programme for cacao expansion in Brazil.

July 1978

(Final act. 6. International Cocoa Research Conference, 6-12 November 1977) Acta final. 6. Conferencia Internacional sobre Investigación en Cacao del 6 al 12 noviembre de 1977 — Parque Central Caracas (Venezuela) 107 p. 1977.

The conference's theme was: the necessity for the efficient control of cacao diseases and pests. The present report contains: (a) the text of opening and closing speeches; (b) the list of participants and commissions; (c) lists of papers presented and discussed in each of the 11 working sessions, followed by a general concluding comment on the particular session in Spanish, English and French.

(Tests with some fungicides for control of root diseases of cacao (*Theobroma cacao* Linn)) Pengujian beberapa fungisida untuk memberantas penyakit akar tanaman coklat SUYOTO, S.; DJAMIN, A. PNP VI Pabatu, Tebing Tinggi, Deli, Indonesia — *Bulletin Balai Penelitian Perkebunan Medan (Indonesia)* v. 8 (1) p. 4 (En, p. 27-32 (In); Mar 1977.

Field tests with some fungicides to control root diseases of cacao were done at PNP VI estates at Pabatu and Adolina. The results showed that concentration of 20 percent Fomac 2 (pentachloronitrobenzene or PCNB) and 10 percent Calixin (tridemorph) could control the root diseases when painted on diseased roots and stem base from which the mycelia had been scraped. The other fungicides tested, coal tar, Manzate D80 (maneb), Dithane M45 (mancozeb), Bordeaux mixture, Difolatan 4F (captafol) and Derosal (carbendazim) gave inconsistent results.

(Yield increases of bulk cocoa in north Sumatra) Laju kenaikan produksi pada pertanaman bulk cocoa di Sumatera Utara BUTAR-BUTAR, N. PNP VI Pabatu, Tebing Tinggi, Deli, Indonesia — *Bulletin Balai Penelitian Perkebunan Medan (Indonesia)* v. 8 (2) p. 48 (En), 63-71 (In); Jun 1977.

The Upper Amazon hybrid cacao planted in North Sumatra in 1973 is yielding satisfactorily. Yield in the second year after planting was 28 kg/ha of dry cacao beans. It increased to 559 kg/ha in the third year and to 1382/ha in the fourth year, thus giving a total cumulative yield of 1969 kg/ha at 4 years after planting. A yield of 1800 kg/ha is expected in the following year (1977). PNP VI is now conducting a breeding programme with existing material. This is in accordance with the proposal of FAO consultant Dr. H. Toxopeus.

Root distribution of cacao (*Theobroma cacao* L.) as influenced by nitrogen fertilizer FALADE, J.A. Cocoa Research Inst. of Nigeria (CRIN), Ibadan, Nigeria — *Turrialba (IICA)* v. 27 (3) p. 267-271; Jul 1977.

The effect of continued application of N (as urea) at dosages of 0, 45, 90 and 180 kg/ha on spatial distribution of amazon cocoa roots has been investigated. Vertical distribution of roots was greatly affected by the

fertilizer treatments. The quantity of medium (1 to 5 mm diameter) roots was found to decrease, and that of bigger roots to first rise before falling with increasing N dosage. Increasing N dosage did not affect the quantity of small roots (diameter less than 1 mm). Low to medium doses of N either increased or decreased quantity of roots depending on the root fraction and depth considered. Where there was a decrease, it was more pronounced than that caused by high N doses.

(The effect of planting density on the behaviour of hybrid cocoa plants)
Efecto del distanciamiento de siembra sobre el comportamiento de plantas híbridas de cacao REYES, E.; REYES, L.C. DE; ROJAS, E.; VALERA, A. Estacion Experimental, Caucagua, Venezuela – Estación Experimental Caucagua (Venezuela) 17 p. 1977

Hybrid cocoa, ICS-6 x Scavina 6, was planted in a statistical plan at 2 x 2, 2 x 3, 3 x 3 and 4 x 4 m in 4 replications during 1964. The highest yields over the first 9 years of production were obtained in 2 x 2 m spacing. This may be attributed to an early control of grasses, that form a serious competition for water and nutrients, and a lower soil temperature, that may cause a slower decomposition of organic matter. Dense planting will reduce weed control costs early. These costs may be up to 30 percent of the total exploitation costs. Disadvantages of dense planting are increased costs in sanitary pruning, fertilizer application and sucker removal. A 2 x 3 m spacing allows easier management. Witches' brooms incidence in brooms per plot was highest in the wide spacing.

(Effectiveness of fungicides in the control of witches broom, Crinipellis perniciosa (Stahel) Singer in cocoa trees) **Efectividad de fungicidas para el control de escoba de bruja Crinipellis perniciosa (Stahel) Singer en plantas de cacao** REYES, L.C. DE; FREITES, A. Estacion Experimental, Caucagua, Venezuela – Estación Experimental Caucagua (Venezuela) 8 p. 1977

The control of witches' broom caused by *Crinipellis perniciosa* in cocoa was studied on var. UF-677 which was badly affected. Cupravit (copper oxychloride) 10 g/l and Brestan-60 (fentin acetate) 2 g/l were applied in 8 biweekly applications during the rainy season. Cupravit gave 264 percent and Brestan-60 225 percent higher bean production than the control, indicating a good control of pod rot. Cupravit application gave more pods. There is no effect of the fungicides on witches' broom control. The leaf area index increased 75 percent with Cupravit and 39 percent with Brestan as compared with the control. This effect is probably due to a protective action on healthy branches. Fungicide application is highly profitable in view of the benefit-cost ratio. Spray frequency may be reduced when sanitary pruning and fruit waste removal are implemented.

(Behaviour of cocoa varieties affected by witches' broom caused by Crinipellis perniciosa (Stahel) Singer) **Comportamiento de cultivares de cacao al ataque de escoba de bruja Crinipellis perniciosa (Stahel) Singer** REYES, L.C. DE; ROJAS, C.E. Estacion Experimental, Caucagua, Venezuela – Estación Experimental Caucagua (Venezuela) 18 p. 1977

The problems encountered in inoculation with *Crinipellis perniciosa* of germinated cocoa seed and 8 months old seedlings are discussed. Inoculation presents problems as it is not possible to culture the mould in vitro. Data are presented on many mature cocoa progenies in respect of field resistance as

observed in different sites. The Scavina 6 progenies seems the most resistant material available although some field infection has been observed. The less vigorous Criollo types such as Porcelena, Criollos de Mérida and Chuao-2 normally escape field infection. Infection is favoured by pruning at the beginning of the rains, too much fertilizer and poor drainage. Higher planting density than normally recommended and a better distribution of shade trees will reduce disease incidence.

(A review of the function of some micro-organisms in cocoa fermentation)
Tinjauan tentang fungsi beberapa mikroorganisma dalam fermentasi cokelat MANURUNG, Z.M.; SOELISTYOWATI Balai Penelitian Perkebunan Bogor, Jember, Indonesia — *Menara Perkebunan (Indonesia)* v. 44 (5) p. 251-254; Oct 1976.

This paper deals with the microorganisms involved in cacao fermentation. It also provides information on the function of yeasts and bacteria in this process.

Cocoa Research Institute. Annual report 1974-75 — Cocoa Research Inst., Tafo, Ghana — Annual Report — Cocoa Research Institute (Ghana) Cocoa Research Inst. Tafo (Ghana) v. 1974-75, 194 p. 1977.

Reports on research activities during 1974-1975 refer mainly to the following subjects: (1) agronomy — cocoa (shade, spacing, cultivar experiments), kola and coffee; (2) biochemistry and physiology — biochemical studies (properties of cocoa butter, shea butter and tallow) and physiological studies, e.g. reproductive physiology; (3) breeding and selection — introductions, breeding trials, studies on pollination; (4) entomology — capsid, mealy bug, Bathycoelia, miscellaneous insects, insecticides; (5) pathology — cocoa swollen shoot disease, black pod disease; (6) soil science — soil fertility, shade and cocoa nutrition field experiments.

August — September 1978

Distribution and activity of phosphate solubilising microorganisms in the rhizosphere of coconut and cacao under mixed cropping NAIR, S.K.; SUBBA, RAO, N.S. Division of Microbiology, Indian Agricultural Research Inst. (IARI), New Delhi, India — *Journal of Plantation Crops (India)* v. 5 (2) p. 67-70; Dec 1977.

Two efficient phosphate solubilizing microorganisms, *Pseudomonas* sp. and *Aspergillus niger*, were isolated from the rhizosphere of coconut and cacao. They were capable of solubilizing 49 percent and 49.7 percent inorganic phosphate. The incidence of phosphate solubilizing microorganisms and available phosphorus in different rhizosphere soils were directly related. Authors' summary.

Cocoa bean processing — a review ONG KHENG HOI — *Planter (Malaysia)* v. 53 (620) p. 509-530; Nov 1977.

Fermentation, fermentation methods and various drying techniques of cocoa are described.

(Biochemical differences between cacao plants resistant and susceptible to *Phytophthora megalasperma*) Diferencias bioquímicas entre plantas de cacao resistentes y susceptibles a *Phytophthora megalasperma* REYES, E.H.; REYES,

L.C. DE; MARTIN, J.; BRICENO, J. Estacion Experimental, Caucaagua, Venezuela — Ministerio de Agricultura y Cria Caracas (Venezuela) 6 p. 1977

Resistance of cocoa to black pod disease, *Phytophthora megasperma*, seems related to the presence of a group of phenolamines in the pod tissue.

(The effectiveness of systemic fungicides in the control of *Ceratocystis fimbriata* (Ell and Hals) in cacao) Efectividad de fungicidas sistemicos en el control de *Ceratocystis fimbriata* (Ell y Hals) en plantitas de cacao REYES, L.C. DE; SANCHEZ, P.; MIJARES, J.; PALACIOS, C. Estacion Experimental Caucaagua, Venezuela — Estación Experimental Caucaagua (Venezuela) 11 p. 1977

Five systemic fungicides were tested on 18 month old cocoa seedlings inoculated at 10 cm above the ground with *Ceratocystis fimbriata*. The best results were obtained with benlate (benomyl) and cycosin. The fungicides were applied before and after inoculation on the foliage or on the soil. No curative effects were observed but there seems a possibility of preventive use of Cycosin-70 at 200 mg per plant applied on the foliage or 400 mg benlate applied on the ground close to the plant. The use of Actidione (cycloheximide), Triforine and Mertec (thiabendazole) resulted in chlorosis to necrosis of the leaves.

(A comparative pesticide trial to control decline of cacao caused by mites of the family Eriophyidae) Una prueba evaluativa de pesticidas para el control de la engurrunadera del cacao causada por acaros de la familia Eriophyidae. I Encuentra Venezolano de Entomologia, Maracay, 7-9 de Julio de 1976 SANCHEZ, P.A.; REYES, L.C. DE; MARTINSKY, J. Estacion Experimental, Caucaagua, Venezuela — Estación Experimental Caucaagua (Venezuela) 13 p. 1977

A comparative trial with 9 pesticides was executed on 6 year old hybrid cocoa that was severely affected by mites of the family Eriophyidae. Pesticides were sprayed thrice at approximately 25 day intervals. Good control was obtained with Acarin (dicofol) 5 ml/l, Morestan (quinomethionate) 2.4 g/l, Fundal (chlordimeform) 1.4 ml/l, Karathane (dinocap) 1.2 g/l, Orthene (acephate) 1.8 g/l and Finca-atril 1.4 ml/l. Shoot length and leaf number doubled with these pesticides, except Finca-atril, as compared with the control. More studies are needed to determine more exactly the effectiveness of the pesticides.

World cocoa bean production up in 1977/78 DULL, R.E.T. Foreign Agricultural Service, USDA, Washington, D.C., USA — *Foreign Agriculture Circular Cocoa (USA)* USDA-FCB 1-78, 11 p; Mar 1978.

World cocoa bean production for the October-September 1977/78 season is forecast at 1.48 million metric tons, up 10 percent from the poor 1976/77 harvest of 1.35 million tons. It is likely that this second estimate of the 1977/78 world crop will not vary more than 3.5 percent from the actual final outturn. Preliminary data indicate that 1977 producer export earnings from cocoa beans and products will be at an alltime high and in excess of \$ 3 billion, compared with 1976 earnings of \$ 2.1 billion and \$ 1.94 billion in 1975.

Raw cocoa processing LIAU, H.T.L. Agricultural Research Centre, Tuaran, Sabah, Malaysia — *Technical Bulletin — Department of Agriculture (Malaysia)* Department of Agriculture Sabah (Malaysia) no. 2, 37 p. 1976.

This study was carried out in response to many complaints by cocoa buyers that Malaysian cocoa beans possess a very high acidity that imparts a harsh acid taste to the product as well as masking all other flavours. Acidity can be removed dramatically by the addition of a "maturation" period in-between the fermentation and drying processes. A complete study of cocoa processing right from the seeds to the export product is presented. Large box fermentation and hot air drying can be utilized without any detrimental effect to quality.

(Report of activities during 1977) Rapport d'activité 1977 — Institut Français du Café et du Cacao (IFCC), Paris, France — *Rapport d'Activité — Institut Français du Café et du Cacao (France)* IFCC Paris (France) 100 p. 1978.

Research on coffee (*Coffea arabica*, *C. canephora* and their interspecific hybrid Arabusta), cacao, tea and kola (*Cola nitida*) is recorded. Genetic improvement, cultural practices, plant protection measures and improvement of the quality of commercial produce in various countries, including Ivory Coast, Togo and Cameroon, are reviewed.

(The effect of sack covers and openings in cocoa minibox fermentation) Pengaruh penutup dan lubang peti mini pada fermentasi cokelat MANURUNG, Z.M.; HOYARANDA, S; MUHADJIR Balai Penelitian Perkebunan Bogor, Jember, Indonesia — *Menara Perkebunan (Indonesia)* v. 44 (6) p. 319-322; Dec 1976.

An experiment on cocoa minibox fermentation has been carried out on the Kalikempit estate of the State-owned Estate Company XXVI situated in the Banyuwangi region in East Java. For this purpose wooden miniboxes with varying number of clefts or openings were used. After the cocoa beans had been put into the minibox, it was covered with a varying number of sacks. The effect of the number of openings and covers on loss of weight of the cocoa beans after fermentation, recovery and percentage of fermented beans, was studied. From this experiment it can be concluded, that compared with the other treatments and also with sweat box fermentation used on estates, miniboxes having 3 or 5 clefts and 2 covers gave the best results. From authors' summary.

(The effect of irrigation on the earliness of young cocoa trees) Effet de l'irrigation sur la précocité des jeunes cacaoyers JADIN, P.; JACQUEMART, J.P. Section d'Agrologie, Institut Français du Café et du Cacao (IFCC), Bingerville, Ivory Coast — *Café, Cacao, Thé (France)* v. 22 (1) p. 31-36; Jan 1978.

The object of the trial was to demonstrate the effect of different types of irrigation with and without fertilizers on the yield of young cacao plantings. Water does not affect the physiological cycles of the cacao tree, but it promotes the development of young cacao trees and improves the initial yield (or earliness). This beneficial effect is related to the manner in which the water is supplied. Drip irrigation is superior to a sprinkler system, because it makes better use of the small quantity of water at the dripping points under which the roots of the cacao trees have developed.

(Existence of a morphogenous gradient in the upper vegetative buds in the orthotropic axes of the cocoa tree (*Theobroma cacao* L., Sterculiaceae). Occurrence of plagiotropy) Existence d'un gradient morphogène au niveau des bourgeons végétatifs supérieurs des axes orthotropes chez le cacaoyer (*Theobroma cacao* L., Sterculiaceae). Apparition de la plagiotropie VOGEL, M. — *Café, Cacao, Thé (France)* v. 22 (1) p. 13-30; Jan 1978.

In *Theobroma cacao*, a tree with dimorphous branches, the appearance of the crown at the top of the young trunk seems a priori a phenomenon which either occurs or does not occur, in which a typical single-stemmed orthotropic axis is opposite to ramified plagiotropic axes. In fact a gradual progression occurs in certain characteristics, such as phyllotaxis, the shape of the leaves, the possibility of the occurrence and the nature of possible ramification. There are two possible types of passages to plagiotropy: sudden in plants derived from seeds, gradual in certain plants whose development has previously been disturbed. The location, nature and importance of the zone of the passage to plagiotropy (at the top of the young trunk) are themselves subject to "random" fluctuation, common to all biological phenomena.

October 1978

Cocoa production in the South Pacific NEWTON, K. (ED.) South Pacific Commission (SPC), Nouméa, New Caledonia — *SPC Handbook (SPC)* South Pacific Commission Nouméa (New Caledonia) no. 2, 91 p. 1968.

This handbook gives practical and technical information on cacao cultivation in the South Pacific. The agricultural principles are discussed under the following headings: climatic and soil condition requirements, planting material, cacao nursery, planting techniques, shade, planting under bush, leucaena, coconuts, bananas or root crops, mulching, manuring, weed control, pruning, pests, diseases, harvesting and small-scale processing.

A *Colletotrichum* leaf blight of cocoa in Ghana DAKWA, J.T.; DANQUAH, O.A. Cocoa Research Inst., Tafo, Ghana — *Plant Disease Reporter (USA)* v. 62 (4) p. 369-373; Apr 1978.

Colletotrichum gloeosporioides caused severe leaf blight in Ghana on closely planted experimental cocoa, resulting in massive defoliation in the 1975 rainy season. The fungus attacked a wide range of cocoa crosses. From its general prevalence in the affected experimental plots and from the damage it caused, it seems likely that the disease could cause considerable destruction to commercial plantings if conditions prevailed that were favourable for the spread and development of the fungus. Shade reduction can be an effective cultural control method. Authors' summary.

November 1978

(World cacao demand trends and projections for 1976/77 to 1989/90) Tendências e projeções da demanda mundial de cacau de 1976/77 a 1989/90 LAFLEUR, J.R. Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Brasília, D.F., Brazil — *Revista Theobroma (Brazil)* v. 7 (4) p. 113-123; Oct 1977.

Least square regression analyses on world cacao grinding for the period 1946-1976 indicate an average annual growth rate of 3.5 percent. World trend line projections for 1976/77, 1979/80, 1984/85 and 1989/90 were 1778, 1972, 2345 and 2787 thousand metric tons, respectively. The price elasticity of demand is approximately -0.1.

(Physiological behaviour of isolates of *Phytophthora palmivora* (Butl.) Butl. from cacao pods and *P. cactorum* (Lebert & Cohn) Schoeter from soils and roots of cacao trees) Comportamiento fisiológico de aislamientos de *phytophthora palmivora* (Butl.) Butl. provenientes de frutos de cacao, y *P. cactorum* (Lebert y Cohn) Schoeter obtenidos en suelos y raíces de plantas de cacao MONTES, B.R.; RAM, A.; MEDEIROS, A.G. Colegio Superior de Agricultura Tropical, Cardenas, Tabasco, Mexico — *Revista Theobroma (Brazil)* v. 7 (4) p. 133-144; Oct 1977.

Three isolates of *Phytophthora palmivora* and two of *Phytophthora cactorum* were compared in linear growth at different temperatures and pH, rate of colonization in cacao pods of varieties Catongo, Comum, Scavina 6 and UF 613, sporulation and production of chlamydospores. The isolates of *P. cactorum* behaved similarly, those of *P. palmivora* behaved dissimilarly. *P. palmivora* colonized cacao pods faster than *P. cactorum*.

December 1978

(Intensification of cacao cultivation in Cameroon) Intensivierung des Kakaoanbaus in Kamerun ANON. — *Zucker- und Süßwaren Wirtschaft (Germany F.R.)* v. 30 (3) p. 80; Mar 1977.

Several prolonged dry seasons, falling world market prices and insufficient plantation maintenance brought favourable cocoa development to a standstill. The Cameroonian government decided to improve cocoa cultivation by special programmes. Improved cocoa purchase prices to US\$ 0.75/kg did not result in increased supply. The first phase of the cocoa plan, started in 1973, has been completed. The second phase involving pest and disease control and distribution of improved plant material will start in 1977. The Marketing Board will be reorganized. A production of 200 000 t of a better average quality is expected for 1980/81. The most important buyers are The Netherlands, Soviet Union and West Germany.

Natural incidence of canker on Amelonado and hybrid cocoa in Fiji and results from artificial inoculation with *Phytophthora palmivora* FIRMAN, I.D. South Pacific Commission (SPC), Noumea, New Caledonia — *Tropical Agriculture (Trinidad and Tobago)* v. 55 (3) p. 269-272; Jul 1978.

Five-year old Amelonado and some hybrid cocoas were examined for natural canker infection by completely stripping the bark. The resistance of Amelonado in Fiji to this phase of the disease syndrome caused by *Phytophthora palmivora* was confirmed and 90 percent of the trees had no or negligible canker. There were varying proportions of susceptible trees amongst the hybrids. Except in the case of Amelonado, results from artificial inoculation of the trunks could not have been used to predict the incidence of natural infections; some hybrid trees with many natural cankers were resistant to artificial inoculation and others with no natural cankers were susceptible. Author's summary.

Cocoa in Western Nigeria, 1890-1940. A study of an innovation in a developing economy BERRY, S.S. — University Microfilms International Ann Arbor, Michigan (USA) 278 p. 1978.

This study discusses why Yoruba farmers adopted cacao, and how they organized and expanded the crop.

