Establishment and Maintenance of Cocoa on Borneo Abaca Limited's Estates

Part 1. Establishment

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Introduction

Cocoa has been grown by Borneo Abaca Limited since 1953. A viable cocoa estate has been established. There have been many ups and downs. In this paper we aim to set down what we would and would not do again if new plantings had to be established.

Background

Soil

Most of the cocoa on the BAL property has been planted on the slopes of Tiger Hill. The soil is a porous dark brown clay loam of good structure and is predominantly of the Table sub-series. No soil characteristic of the Jerangan sub-series described by Paton (2) has been planted to cocoa, though a small area has been planted on the Quoin sub-series. There have been small plots on other soil types. Four fields totalling 58 acres have been planted on Table Estate and the remaining 1,487 acres is on Tiger Estate.

The soils are less acid than those under cocoa in the Quoin Hill area. While there is considerable local variation, the pH over much of the estate averages 6·2 for 0 to 6″ soil samples, 5·7 for 12 to 18″ and 5·5 for 30 to 36″. In the more acid areas the average pHs are 5·5, 5·2 and 5·1 respectively. However, the foliar symptoms, diffuse light green to yellow mottling of the older leaves and the marginal and interveinal necrosis of oak-leaved pattern in young leaves, described by Wyrley-Birch as occurring in the Quoin Hill area (1), also occur at BAL. In addition there is a periodic general light chlorosis of the interveins of the hardening leaves.

Climate

The rainfall averages about 85″, evenly distributed throughout the year, though there have been marked variations from the monthly averages. Periods of ten days or so of water-stress occur. Sunshine over the past six years averaged 1,600 hours a year. Again, over the years, there appears to be little seasonal variation though marked differences within seasons. Temperatures range between 90° and 69°F. In spite of the rainfall and its distribution, it is unusual to have more than a few days without sun or with humidities over 90 per cent saturation.

Varieties

The cocoa is predominantly Amelonado, introduced into Sabah from Serdang, Malaya. Small plots of a wide variety of material were planted in 1956. Twenty acres of Trinitario were planted between 1956 and 1960. Six acres of Amazon seedlings originating from Serdang seed were planted, three in 1957 and three in 1963, thirteen acres if Amelonado x Amazon crosses in 1964, and two

Young cocoa under Leucaena glauca.

Cocoa planted in 1967 under Gliricidia.

acres of Amazon x Amazon crosses in 1965, both from the Cocoa Research Station, Quoin Hill.

Vegetation before planting

Most of the area was planted from secondary jungle following abandoned Abaca. About 240 acres were planted from logged primary jungle.

Ecological Objective

At the outset we should state that we consider that, for good economic yields, cocoa should be grown in as full sunlight as is consistent with absence of wind, reasonable humidity and the maintenance of a closed cocoa canopy. In other words, cocoa should have as much sunlight as possible, and the plantation should be established and maintained with this in mind.

Yields

The yields in lb. of dry beans per acre during the last three seasons have been:

	Crop Year (September-August)		
	1963–64	**1964–65**	**1965–66**
Cocoa over 8 years old in 1966 ..	910	640	950
9-acre field, shade removed August 1964	1,170	1,630	2,050
11-acre field, shade removed March 1965	680	340	1,760

Establishment

Soil

Basaltic or well drained alluvial soil would be chosen provided the pH of the surface soil was over five and there was an absence of manganese nodules. Soil derived from ash or on the raised coastal platform would be avoided.

Clearing and Shade

We would clear, fell and burn both secondary jungle and logged primary jungle and then establish shade before planting cocoa. Experience with thinned secondary jungle, where *Mallotus* or *Macaranga* were left, showed that early growth of cocoa planted as seedlings under this shade compared unfavourably with that of similar cocoa grown under *Leucaena* or *Gliricidia*—though both these types of shade have their problems. Growth under thinned logged primary jungle did not compare well with that planted under *Leucaena*. If logged primary jungle is left poisoned but standing, it does some damage when it ultimately falls and, if access is to be maintained, the fallen trees have to be sawn through. Workers are also disinclined to work under poisoned timber in a breeze.

All types of established shade would be sown or planted some six to nine months before sowing or planting the cocoa.

The following types of shade have been tried:—

Leucaena glauca (*leucocephala*) var. Hawaii. The seed was hot-water or acid-treated and sown in either the future cocoa rows, or in the interrows at about 10 lb./acre. (This high rate was used to force the plants to height and to prevent bushy growth with early seeding). One row every other cocoa interrow has

Cocoa planted in 1965 under vigorous hedgerows of Albizzia.

been tried. Inoculation with the specific *Rhizobium* made a marked difference only when normal growth was very poor. The rows must be clean-weeded for three months for successful development. We suspect poor growth to be related to more acid soil conditions.

The problem with this shade lies in getting rid of it when you want to, without killing the cocoa. It seeds profusely. When cut above or a little below ground it regenerates. While the planted rows are defoliated by 2, 4, 5–T, they recover. Treating the bark with sodium arsenite paste works but is time-consuming and costly.

Leucaena leucocephala var. Guatemala and El Salvador have been introduced but not yet grown as shade for cocoa.

Gliricidia sp. This can be established from cuttings but care must be taken not to bruise the bark. Rough handling and thrusting the five-foot piece into the ground results in a poor take. It has proved a successful shade planted at $10' \times 10'$ and subsequently lopped and/or thinned. Ring barking and sodium arsenite kills it. It can suffer from the aphid/ant/sooty mould combination resulting in defoliation and the sooty mould spreading to the cocoa, but band-painting the *Gliricidia* with dieldrin against ants may have reduced one outbreak. Some wind damage occasionally occurs, the whole tree being blown over. We would use this again in new plantings and it is well suited for supplying shade where the cocoa canopy has opened.

Papaya, *Carica papaya*, and old abaca, *Musa textilis* var. Tangongon have been tried as nurse crops on a small scale. Both appeared satisfactory but the abaca must be removed within 18 months.

Tree cassava, *Manihot sp.*, was tried and was not liked as being competitive, and it is difficult to control the level of shade due to rapid regrowth.

All these are low-shade trees. For general reduction of wind something taller is desirable.

Erythrina sp. has been found to be subject to a collar rot and to be particularly susceptible to arsenite damage.

Saman, *Enterolobium saman*, grows well but gives too heavy a shade, and is difficult to kill.

The relative merits of *Albizzia* and the small and large leaved *Parkia* (thought to be *Albizzia falcata*, *Parkia speciosa* and *Parkia javanica*) are variable and debatable. *Albizzia* gives a light shade but is subject to trunk snap and has bulky timber, so that when it falls or is thinned it causes damage. Both the *Parkia*, especially the small-leaved one, are less vigorous but more difficult to establish. They seem particularly subject, when planted singly, to caterpillar and bag-worm damage. However, the timber of the grown tree is less bulky and they are likely to be longer lived than the *Albizzia*, and better suited as a long-term high cocoa shade.

One possibility which is under trial is to sow seed between the rows of cocoa and thin subsequently. Alternate rows of *Albizzia* and *Parkia* might be tried, poisoning out the *Albizzia* and thinning the *Parkia*. All are easy to thin with arsenite. One possible difficulty is that high shade may tend to increase the level of rodent damage.

In conclusion, *Leucaena* would only be used on a limited scale, if at all. *Albizzia* and *Parkia* would be used, sown in rows up to the limit of the local seed supply, and *Gliricidia* used for the remainder of the area. A small area of *Papaya* might be tried. If abaca were to be replanted to cocoa, the cocoa would be planted in part of the area, direct into thinned abaca.

Spacing

The spacing chosen is always a matter of compromise between such factors as yield per acre, costs of planting, weeding and harvesting, speed in achieving a closed canopy and the necessity of supplying losses, the likelihood and frequency of spraying against pests such as capsids and diseases such as black pod, and the proportion of the crop borne on the trunk as opposed to the fan branches. Several spacings have been tried, ranging from $12' \times 12'$ to $5' \times 5'$. We would favour $10' \times 7'$ as about right for Amelonado. However, the new Amazon crosses will certainly require a different and wider spacing and, as the habits of growth of the new material in our conditions is not yet fully known, this will make the choice of spacing a problem.

Planting Material

Variety. It is unlikely that Trinitario would feature to any great extent in new plantings because of the specialised nature of the market and the need to secure attractive marketing arrangements. Further, the premium in price is unlikely to be worth the relative lack of vigour and lower yields.

Amelonado has served us well. However, the new Amelonado x Amazon and Amazon x Amazon material, supplied from the Cocoa Research Station, is more vigorous and there is no good indication that this vigour is not related to higher yields. While it is early days yet, AML x PA7 is outstandingly vigorous and precocious. The new material would have a strong claim for inclusion in any new planting, particularly in areas not well suited to Amelonado.

Seed and Seedlings. Seed at stake has been successful where cocoa thrives.

Three seeds were used per point, thinned to one. This is satisfactory for new plantings provided suitable cheap seed is readily available.

Seedlings have also grown well. These are used for supplies, for areas unsuited for seed at stake and if seed was expensive or not easily obtainable. They are grown under shade which is lightened with the approach of planting.

Wire baskets have been used for seedlings. They would not be used again, as planting from such baskets takes too much time and involves too much disturbance of the plant. Black polybags would be used with drainage perforations in the bottom half, size 7" wide by 12" deep when laid flat. This size is thought to give the best compromise in our conditions between the size of bag to be carried, cost, size of plant and time the plant can be left in the nursery. Fertiliser was only used in the nursery when the seedlings looked backward or off colour. As in the past, the seedlings would be planted out at three to five months from the sowing of the seed, and, at the time of planting, holes would be dug the size of the bag. Consolidation is important.

Wherever possible the nursery was sited near the clearing or area to be supplied. Such siting reduced road transport for which a light tractor and trailer were used. The seedlings were carried from the roadside to planting points in two containers slung from a shoulder stick. If there was a drought water was brought by tanker.

Summary

The soil, climate and yields of cocoa from the existing 1,500 acres of cocoa on Borneo Abaca Ltd.'s estates are described.

It is suggested that cocoa should be grown in as much sunlight as possible. Techniques should be geared to this objective.

Methods of establishment which, based on past experience, would be used in any new plantings, are described and discussed.

REFERENCES

1. Allen, A. W. (1966). "Problem Soils in Sabah: Brown loams and nutritional disorders in cocoa". 2nd Malaysia Soil Scientists Conference, Kuala Lumpur. Unpublished paper.
2. Paton, T. R. (1963). "Soils of the Semporna Peninsula, North Borneo". London, H.M.S.O. pp. 28, 36 and 86.

This article is part of a paper presented at a Cocoa Seminar held at Tawau, Sabah, in October 1966 by the Sabah Planters' Association, to which we are grateful for permission to publish. The second part will be included in our next issue. The other papers presented at this seminar were:—

"Cocoa in Sabah",
R. Smith, Director of Agriculture, Jesselton.

"Cocoa Breeding in Sabah",
D. F. Edwards, Plant Breeder, Agricultural Research Centre, Tauran.

"A Note on Interplanting Oil-Palms with Cocoa",
G. A. R. Wood, Agricultural Adviser, Cadbury Brothers Limited, U.K.

"Establishment and Maintenance of Cocoa at Rumidi",
P. W. H. Wilson, Manager, Rumidi Estate, Cadbury Brothers Limited, Sandakan.

"Observations on Cocoa Planting in Sabah",
E. A. Wyrley-Birch, Agronomist, Cocoa Research Station, Quoin Hill, Tawau.