

Observations on Cocoa Planting under Thinned Jungle Shade in Sabah

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Case studies and large-scale development programmes indicate that the advantages of planting cocoa under thinned jungle shade could out-weigh those of planting under Gliricidia shade.

Where the jungle has been extensively logged and regenerating jungle trees afford ideal shade for cocoa, it is advisable not to clear the jungle to plant Gliricidia. In remote areas and when the development programme is extensive and time a factor and where Gliricidia supply is a problem, the argument becomes more convincing. Such constraints as uncertainty of weather conditions, soil type and terrain lend further weight to the findings.

The attractiveness of using jungle shade to establish cocoa is further enhanced when the financial advantage of lower initial cost outlay creating favourable cash flow is considered. Additional advantage include a greater certainty of meeting targets in the planting schedule and a generally long term agronomic benefit of a more vigorous initial growth of the cocoa plant.

Cocoa is generally planted under established permanent shade following clear felling or under thinned jungle (Wood, 1973). It was introduced into Sabah some 30 years ago and was first grown under thinned natural jungle. In 1963, attempts were made to plant cocoa using *Leucaena glauca* as primary shade. The cocoa grew well, and in 1964 a complete fell-burn-clear method was introduced. However, by the end of 1965, *Leucaena* became unpopular because of its prolific seedling problem and *Gliricidia sepium* (= *maculata*), first introduced as shade for tea, found its place in the cocoa industry and later became the primary top shade tree for cocoa in Sabah. Because of this and the favourable results that followed, the use of jungle shade was quickly replaced by the use of *Gliricidia* shade.

As the cocoa price rose in the mid seventies, there was considerable hurry to open up new tracts of jungle for cocoa cultivation. Large-scale development was tried employing mechanical clearing methods, but, these were often found to compact the soil and to greatly impede the growth of *Gliricidia* as well as the successful establishment and growth of cocoa.

Thinned out jungle was then re-employed to provide the initial shade for the young cocoa. In this way, large areas could be rapidly prepared for cocoa planting, eliminating the 9-12 month period required for *Gliricidia* shade to establish itself prior to cocoa planting.

In addition, at that time, *Gliricidia* planting material was not always readily available in large quantities. Nevertheless, inclusive of transportation and establishment costs, planting of *Gliricidia* requires a larger initial input of capital. Moreover, its growth and readiness to provide adequate shade for cocoa is largely dependent on weather conditions. With cocoa seeds also being in high demand, the dual uncertainty made the shade/cocoa planting schedule more difficult to plan and less flexible in practice.

These considerations led many planters and land owners from about 1979 onwards to use jungle shade again for cocoa. Subsequently, many variations of jungle shade thinning have been adopted for differing local conditions.

METHODS

Case studies of two basic methods of preparation of the jungle shade for cocoa planting and subsequent growth are described here. Conventional cocoa planting under *Gliricidia* shade provides the comparison.

Case One

Cocoa was planted in September 1980 at 3 m x 3 m square on soils which belong to the Tanjong Lipat Family of Rumidi Association, a sandy clay soil formed from interbedded sandstone and mudstone parent materials and with slopes of between 6° to 12° and located in the Sandakan district of Sabah.

In one field referred to as Block J1, cocoa was planted under thinned jungle shade after underbrushing, *i.e.* all undergrowth and saplings up to 8 cm diameter were cut down. After the cocoa rows were demarcated, trees that were located within 1 m of the cocoa row were felled and cleared. At the time of planting the cocoa, the overhead shade was estimated to cover about 80% to 90% of the ground surface but this quickly thickened. However, it was generally kept at between 70% and 80% up to mid 1982 and reduced to 20% to 30% by the end of 1983. (Table 1) Shade assessment was only visual and based on the ground shade at about noon time.

In another field, referred to as Block G1, cocoa was under *Gliricidia* shade planted about nine months earlier at a spacing of 3 m x 3 m. *Gliricidia* was regularly pruned to prevent any overhead shading of the cocoa bushes so that about 1.5 m of the *Gliricidia* interrows received direct sunlight. *Gliricidia* bushes were generally pruned to one to two main stems.

Case Two

Cocoa was planted in March 1981 in one field, referred to as Block J2, under jungle shade which had been underbrushed as in Block J1 and subsequently all large jungle trees, *i.e.* trees with diameter more than 20 cm were removed. Also all trees within 1 m cocoa row were felled and cleared before cocoa were planted. Initial overhead shade was estimated at about 50% and this was progressively reduced by poisoning with arboricides to about 20% to 30% by mid 1982. Again, shade assessment was visual as in Case One. *Gliricidia* was then planted at about 6 m x 6 m in the cocoa interrows in the second half of 1982.

In another block, referred to as Block G2, cocoa was planted in January 1981 under conventional *Gliricidia* shade planted about nine months before cocoa planting. The

TABLE 1. DESCRIPTION OF BLOCKS

Item	Block J1	Block J2	Block G1	Block G2
Area	8 to 15 ha.	8 to 15 ha	8 to 15 ha.	8 to 15 ha.
Shade -- Type -- Detail	Thinned Jungle All saplings < 8 cm diameter felled.	Thinned Jungle All saplings < 8 cm diameter + all trees > 20 cm diameter felled. <i>Gliricidia</i> planted mid 1982 at 6 m x 6 m.	Planted <i>Gliricidia</i> 3 m x 3 m	Planted <i>Gliricidia</i> 3 m x 3 m
-- Date	Mid 1980	Early 1981	January 1980	April 1980
Cocoa Planted	September 1980	March 1981	September 1980	January 1981
Shade (%) (Visually Assessed)				
at planting	80 - 90	50	± 80	± 80
up to mid 1982	70 - 80	40	± 50	± 50
after mid 1982	20 - 30	20 - 30	± 20 - 30	± 20 - 30

Gliricidia was regularly pruned to prevent excessive overshadowing of the cocoa interrows. The *Gliricidia* was planted at 3 m x 3 m in between the cocoa rows.

The soils in both the blocks were similar to those in Case One and located also within the same estate.

RESULTS

Cocoa planted under thinned jungle was observed to achieve more vigorous and greater vegetative growth within the first two years after planting out. As a result of their better growth, cocoa bushes were more uniform (except in places where overhead shade was thick) and more precocious. Generally, cocoa planted under thinned jungle and with proper management was at least six months ahead in terms of size and often in precocity compared to cocoa planted under normal established *Gliricidia* shade by the time the cocoa was one and a half to two years of age.

From *Tables 2 and 3* and observations, the following comments can be made.

- The costs incurred in land preparation and field upkeep prior to planting cocoa is distinctly lower for the thinned jungle shade method as compared to the use of established *Gliricidia* shade. The costs were lower in Block J1 where felling of jungle trees was minimal and amounted to only about two thirds of that incurred in the establishment of *Gliricidia* shade. In Block J2, where more thinning of the jungle shade was carried out, the costs increased to around 80% of the *Gliricidia* shade method.
- Weeding costs were appreciably lower under thinned jungle during the first one and a half years. Thereafter when the jungle shade was severely thinned, the costs were reversed with the jungle shade weeding being more expensive. Over the three-year period, however, weeding costs were higher under *Gliricidia*. In jungle shade the avenues under large shade trees in J1 required less weeding than J2 with small shade trees. This is to be expected as weed growth is dependent on sunlight – the more light the more weeds.
- alang eradication and control cost were consistently lower in the jungle shade areas throughout the period under study and amounted to between 20% to 25% of the corresponding costs under the *Gliricidia* shade.
- Control of overhead shade for cocoa involved pruning in the case of *Gliricidia* and poisoning in the case of jungle shade. Shade control by thinning of jungle by poisoning with the arboricide 2,4,5-T cost less than pruning *Gliricidia*. Where the initial jungle stand had a higher density of large trees, the cost situation was reversed.
- In this study, pest and disease costs were consistently lower in the jungle shade areas particularly in the first two years after the cocoa had been planted; costs were 20% to 60% lower than under *Gliricidia*. Disease was relatively unimportant so that pest control accounted for at least 85% of the pest and disease control cost. The major cocoa pests were leaf eaters (such as caterpillars and grasshoppers) and leaf suckers (such as the mosquito bugs).
- Fertiliser costs were marginally higher using *Gliricidia* shade because of the need to supply fertilisers to encourage the establishment and boost the growth of the *Gliricidia* cuttings.

TABLE 2. LABOUR COSTS FOR LAND PREPARATION UP TO COCOA PLANTING

Item	Cost (\$/ha)			
	Block J1	Block J2	Block G1	Block G2
Underbrushing	124	124	99	99
Felling	100	136	124	124
Burning	0	0	25	25
Pruning, reburning	0	0	247	247
Row opening	271	371	0	0
Shade planting, upkeep	0	0	408	408
Lining, holing & planting of cocoa	225	225	188	188
Total	720	225	1091	1091
Mean	788		1091	

- The cost of maintenance in the first two years after cocoa had been planted was lower under both types of jungle shade. Maintenance was appreciably less in the Block J1 as compared to Block J2.
- The yield figures for 1982 are not available. They were only recorded for 1983. It will be unwise to draw any definite conclusion other than to observe that recorded yields in this study indicate that initial yields under *Gliricidia* were higher than under thick jungle shade and that under jungle shade itself higher initial yields were achieved where the remaining jungle shade was less heavy. Observations elsewhere have indicated that when the jungle shade is properly prepared, cocoa growth and yield are at least comparable to cocoa planted under established *Gliricidia* shade.

DISCUSSION

The choice of whether to plant cocoa under thinned jungle shade or under established *Gliricidia* shade depends on a number of factors which vary from situation to situation.

The type of jungle and the density of large trees are primary considerations in the successful use of thinned jungle shade for the planting of cocoa. Where the jungle has a high density of large trees and a corresponding lower stand of smaller lower storey trees, thinning of the jungle to provide suitable shade for cocoa will normally be difficult and required the planting of at least some shade trees. In such jungle areas, a large number of smaller trees will be brought down by the felling of the large trees. After such felling operations, the smaller trees will normally be so damaged that they are unable to provide adequate and reasonably uniform shade for subsequent successful establishment of cocoa. The large amount of felled timber on the ground also means that opening of the cocoa rows will be arduous and costly. Moreover, the large number of logs left on the ground severely restricts mobility and makes the ground maintenance job extremely difficult, until such time as the timber rots away. In dry weather, the dry wood material would also pose a very real fire hazard. On the other hand, if the large trees were to be retained and the smaller trees felled, initial establishment of cocoa will normally be simple and involve low costs. However, the problem is only deferred as the presence of these large trees is non-conducive to satisfactory cocoa performance, as illustrated in Block J1, and will have to be eliminated quickly after the cocoa has been planted out.

TABLE 3. MAINTENANCE LABOUR COSTS OF COCOA

	1981 Cost (\$/ha)			1982 Cost (\$/ha)			1983 Cost (\$/ha)			Total Cost (\$/ha) In first three years										
	J1	J2	GM	J1	J2	GM	J1	J2	GM	J1	J2	GM								
Weeding	257	268	368	411	390	84	136	103	116	110	82	106	22	44	33	423	510	493	571	532
- lalang	0	0	70	69	70	22	27	42	74	58	12	17	20	52	36	34	44	132	195	164
Shade - pruning	0	0	24	0	12	0	0	30	27	29	0	0	0	32	16	0	0	54	59	57
- poisoning	0	92	0	0	0	17	25	0	0	0	10	12	12	7	10	27	129	12	7	10
P & D control	23	19	51	47	49	37	15	47	22	35	22	30	32	27	30	82	64	130	96	113
Cocoa pruning	15	0	0	11	6	44	57	116	57	87	49	133	91	143	117	108	190	207	211	209
Manuring	50	45	65	46	56	57	54	64	69	67	42	49	47	40	44	149	148	176	155	166
<i>Gliricidia</i> Planting	0	36	0	68	34	22	25	0	0	0	12	17	0	3	2	34	78	0	71	36
Total	345	460	578	652	615	283	339	402	365	364	229	364	224	348	286	857	1163	1204	1365	1285
Mean	402	615	311	383	297	286	1010	1285												
Wet cocoa bean (kg/ha)	0	0	n/a	n/a	n/a	123	150	1044	434	123	150	1044	434	123	150	1044	434			

J1 = Jungle shade, trees > 8 cm in diameter.
 J2 = Jungle shade, 8-20 cm in diameter.
 G1 and G2 = *Gliricidia* shade planted 3 m x 3 m.
 GM = Mean of G1 and G2.

Large trees when poisoned will also pose a problem to the cocoa bushes and workers when the trees are felled in large pieces especially during periods of sudden strong winds and rain. Such fallen timber can break the branches or even the main stems of the cocoa bushes and hence set them back by six months to a year. Workers and supervisors also are generally reluctant to work in such areas as large fallen branches can also cause serious or even fatal injuries to them. Where the existing jungle area to be planted out consists of a few large trees and many smaller trees akin to secondary forest, the eventual choice of using either the clean-clearing of thinned jungle method will then depend on other factors including:

- Remoteness of the area – accessibility, roads, ease of availability of *Gliricidia* cuttings in quantities.
- Development schedule – size, rate of development and weather conditions.
- Cash flow position.
- Soil type and terrain.

As observed in this study, *Gliricidia* establishment costs can amount to about 40% of the total establishment costs. Such costs will be higher if the *Gliricidia* has to be transported in over long distances where bruising and the delay between cutting of the *Gliricidia* and planting can cause high casualties. A high casualty rate will require extensive and expensive supplying and cause delays in the subsequent schedule of cocoa planting. The development schedule must depend on the size of the area, the speed of development required and the timing of the operations to coincide with suitable weather conditions. It will also influence the choice and type of shade. Generally, thinned jungle will be favourable if the area to be developed is large, the jungle itself suitable, the speed of development demanded is high and the timing of the land preparation operations with expected weather conditions is inexact.

Under jungle shade, initial land preparation and upkeep are less labour-intensive and less dependent on dry weather conditions for effective burning and wet weather for the planting and establishment of *Gliricidia* shade. In addition, the requirement of less labour means that a smaller number and slower influx of workers is required and hence more widely spaced requirements for housing, transport and other ancillary facilities. Supervisory staff build up will also consequently be more spread out, so such intake can be better organised. In terms of cash flow and capital requirements, the lower initial costs and more protracted development costs would be an advantage coupled with the earlier onset of harvesting from the time of initiation of the development project. Although the total capital outlay would be much the same, repayment could start earlier.

An equally important consideration is the soil type and terrain of the area selected for development. Where soil erosion may become a problem, or where the effective rooting depth is shallow, the thinned jungle method is again preferred.

Experience suggests that jungle shade preference should be for the felling of all large trees leaving a stand of small trees to provide the necessary overhead shade and thinning after establishment to provide about 30% shade during the immature phase of the cocoa. The few remaining jungle trees are then progressively poisoned with arboricides as their canopies thicken with time.