NOTES

A NOTE ON INTERCROPPING OF COFFEE WITH *ARAUCARIA HUNSTEINII* AND *PINUS MERKUSII* TREES IN PENINSULAR MALAYSIA

Abd. Razak Othman

Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia

Agroforestry, a land use system which integrates perennial and annual food and cash crops, and sometimes with livestock, on the same piece of land, has long been practised in Malaysia. The main objective is to maximise land usage and economic return. A common practice in Malaysia is the intercropping of cocoa under coconut. At present, coffee (*Coffea liberica*) is exclusively planted in Peninsular Malaysia as a smallholder crop, usually mixed with coconut. Combe and Budowski (1979) reported that coffee can also be intercropped with forest tree species such as *Albizia* spp., *Inga* spp., and *Eucalyptus deglupta*.

A trial was set up with the main objective to assess the feasibility of intercropping coffee under *Araucaria hunsteinii* and *Pinus merkusii* plantations.

In June 1983, coffee seedlings were interplanted at a spacing of 3 × 3 *m* in plantations of *A. hunsteinii* in Block J and *P. merkusii* in Block B of Sungai Buloh Forest Reserve, Selangor. Later, within each Block three experimental plots were randomly selected and established in January 1986. The area of each experimental plot was 0.1 *ha* consisting of 110 plants (Table 1). *A. hunsteinii* was planted in 1975 and *P. merkusii* in 1967, both at a spacing of 3.7 × 3.7 *m*. The topography at the sites was flat and the average soil pH at 0 to 30 *cm* soil depth was 3.52 in Block B and 4.35 in Block J. Both Blocks had the same soil series.

Table 1. Details of coffee plantings in plantations in Sungai Buloh Forest Reserve

Particulars	Block B	Block J
A 1. Area *(ha)*	0.8	0.5
2. Soil series	Rengam	Rengam
3. Average relative light intensity at midday (%)	20	30
B Coffee		
1. No. of seedlings planted	950	560
2. Date of planting	June 1983	June 1983
3. Spacing *(m)*	3 × 3	3 × 3
4. Survival at age 30 months after planting (%)	93	96
C Overhead species	*Pinus merkusii*	*Araucaria hunsteinii*
1. Date of planting	1967	1975
2. Average top height (m) (30 months after cocoa being planted)	26	9
3. Spacing *(m)*	3.7 × 3.7	3.7 × 3.7

The coffee plants started to fruit at age 2.5 *y* after planting. The fruits were harvested and fresh and dry weights determined. Two sets of coffee yield from the two blocks (B and J) were compared using a t-test (Table 2). Significant difference ($t \leq 0.05$) was found in the fresh weight and dry weight, yields of coffee. The coffee plants under *A. hunsteinii* produced more fruits than those under *P. merkusii*. Fresh and dry weight of coffee planted under *A. hunsteinii* increased in the second year whereas there was a decrease for those planted under *P. merkusii*.

Table 2. Comparison of fresh and dry weight of coffee beans harvested from plants *in Araucaria hunsteinii* (Block J) and *Pinus merkusii* (Block B) plantation plots at stage 2.5 to 4.5 years after planting

Age of coffee trees (*y*)	Average annual fresh fruit weight/plot (*kg*)		Average annual dry weight of beans/plot (*kg*)	
	Block B	Block J	Block B	Block J
2.5 - 3.5	22.84	82.72	5.39	20.56
3.5 - 4.5	18.37	109.58	4.71	28.32
Average annual production	20.60	96.15	5.05	24.44
Calculated t-value	7.501*		7.277*	
Tabulated t-value at $P < 0.05$	2.069 df = 23		2.069 df = 23	

* significant at $T < 0.05$

The *P. merkusii* trees, being eight years older than the *A. hunsteinii* trees, had a heavier canopy and hence produced heavy shading that reduced the quantity of light available for photosynthesis. Being older, the roots of *P. merkusii* were more established and hence affected the growth of the coffee plants through greater root competition for moisture and nutrient uptake (Nutman 1934). Further more, soil under *P. merkusii* in this study was more acidic, and this did not favour the growth of the coffee plants. Amorim (1968) showed that coffee seedlings grow best in the pH range of 4 to 6.

In West Malaysia, the average fresh weight production of *Coffea liberica* in areas where it is the predominant crop is between 4000 to 7500 *kg* ha^{-1} y^{-1} (FAMA unpublished). In mixed crop with coconut it is between 700 to 4500 *kg* ha^{-1} y^{-1} (Lim 1978). In this study, coffee grown in forest tree plantations gave very low yields (206 *kg* ha^{-1} y^{-1} under *P. merkusii* and 962 *kg* ha^{-1} y^{-1} under *A. hunsteinii*).

It is important to take into consideration the type of overhead tree species, soil pH and the spacing used if coffee were to be planted under forest plantation conditions In the coffee and coconut intercropping, the spacing of overhead tree was 7 × 7*m* providing 40 to 60% shade to the coffee plants. This could be the basis to determine the optimum spacing and light condition for the intercropping of coffee in the forest plantations.

In conclusion, the results of the study show that intercropping coffee under *P. merkusii* and *A. hunsteinii* gives very low coffee production compared to that under coconut. It is suggested that forest tree species having light canopy, especially leguminous trees, that can provide suitable shade conditions and have the ability to fix nitrogen so as to improve crop yield should be selected and introduced.

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A NOTE ON GERMINATION OF SESENDOK (*ENDOSPERMUM MALACCENSE*) SEEDS IN THREE DIFFERENT SOWING MEDIA

L. H. Ang & Mohd. Afendi Hussin

Forest Research Institute Malaysia, Kepong, 52109 Kuala Lumpur, Malaysia

Sesendok is a pioneer species. It produces useful timber for match splints, boxes, drawing boards, toys and clogs (Desh & Thomas 1940). Sesendok wildings grow fast in open planting, thus it has potential for future afforestation program in Peninsular Malaysia (Chew 1980, Wan Razali 1988, Darus *et al.* 1990). The lack of viable seed production for sesendok due to severe insect predation was recorded (Yap & Razali 1980). Several authors suggest that other alternative methods to overcome low viability of collected sesendok seeds for planting stock production can be through wildings collection or stem cuttings (Yap & Razali 1980, Darus *et al.* 1990).

Our experience with viability of sesendok seeds collected from one mother tree (Tree No. 6) in Gunung Tampin Forest Reserve, Negeri Sembilan showed otherwise. These seeds were extracted from the yellowish-green mature fruits. Not a single seed was observed to be attacked by seed predators. A total of 600 mature seeds (outer coat removed) were sown in three different sowing media, (1) a 1:1 mixture of sand and forest soils, (2) a 1:3 mixture of sand and forest soils, (3) a 1:3 mixture of sand and forest soils added with Triper superphosphate (1.2 $kg\ m^3$) and ground magnesium limestone (1.6 $kg\ m^3$). Fertiliser was added to enhance the growth of seedlings after germination and lime was added to reduce the acidity of forest soils.

Each sowing medium was considered as a treatment. Each treatment was sown with 50 sesendok seeds. The layout of sowing media was according to randomized block resign. The light gradient from the side (brighter) to the centre of sowing bed was isolated in the analysis by blocking. The set up of the layout was under 50% direct sunlight. Percentage figures were transformed (arc sine transformation) before analysis of variance was done.

Figure 1 shows that sesendok seeds started to germinate 25 to 27 days after sowing in the three sowing media. The germination count of sesendok seeds remained constant