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AAR - NEWS

EDITORIAL

The ban on open burning of old oil palm biomass at replanting has resulted in very high breeding of O. rhinoceros beetle in the palm biomass which in turn has caused untold damage to immature and young mature palms. Mr. Ooi Ling Hoak *et. al.* working on two no-burn methods of clearing oil palm, have managed to reduce the breeding of beetles as indicated by the reduced levels of pest damage on the replanted palms. The main goal of these methods is to quickly reduce the palm chips to tiny pieces by the process of pulverization and spreading them out evenly throughout the field. Managers should be pleased to know that other potential benefits of these techniques include a shorter fallow period, more efficient utilization of nutrients released by the decomposing biomass and facilitation of replanting and subsequent upkeep work. The paper written by Mr. Ooi, L.H. *et. al.* was presented at the ISP, National Seminar on 'Replant or Perish', in Ipoh in June 2004.

Much research on evaluation of potential timber species for forest plantation was carried out by the late Mr. Quah Yin Thye. The article on forestry plantation is a tribute to the late Quah.

INSIDE THIS ISSUE:

Mucuna bracteata has been described as 'a Super legume cover crop' which is extremely vigorous with three to four times the biomass of *Pueraria phaseoloides* (Pp), shade tolerant and deep rooting (2-3m deep). Estates in Sabah have had a headstart in establishing this legume than their Peninsular Malaysian counterparts. TCB's article should hopefully provide some introductory information on the legume for 'first time' managers to establish tracts of *Mucuna bracteata* in their estates.

Finally please read the article on 'women over 30' to better appreciate ladies who fall into that category. Of course it was submitted by a lady who is over 30!

Chan, W.H.

Some Pulverisation Techniques of Clearing Old Palms for Replanting

By LING-HOAK OOI, KODIAPPAN P AND GUNARAJAN M

Introduction

Before the ban on open burning, the most common method of clearing oil palms for replanting was the chip and burn method described by McCulloch (1982). However, burning was usually incomplete and the left over palm biomass became a breeding ground for *Oryctes rhinoceros* (L) beetles. Samsudin *et al.* (1993) reported that up to 500/ha of beetle larvae and pupae were found in the unburnt palm biomass at between 6 and 12 months after partial burning.

With the ban on open burning, the chipped palm biomass were not burnt but windrowed, usually two palm rows to one windrow, and left to decompose in the palm inter-rows or pulverized when the palm chips have partially dried and decomposed (Santa Maria *et al.*, 1996 and Teoh *et al.*, 1999).

The windrowed palm biomass took more than two years to decompose completely and this resulted in very high breeding of *O. rhinoceros* beetles. Ang *et al.* (2002) reported that when palm biomass from 2 palm rows were stacked into a windrow in the inter-row, a total of 1258/ha of larvae, pupae and adult beetles were found in the windrowed palm biomass 12 months after felling of old palms. The number increased to 1870/ha a year later. Breeding of beetles continued into the third year even in the smaller windrows comprising a single row of palm biomass and 192/ha of larvae, pupae and adult beetles were found in such windrows at the thirtieth month after the palms were felled. In an experiment to destroy the rhinoceros breeding site comprising 12 months old windrowed palm chips from 2 rows of palm biomass, the same authors reported that two rounds of pulverization with a tractor-drawn mulcher, with one round of tining in between to dig up the buried palm biomass, was unable to reduce the breeding of beetles in the palm residues in the short term. In fact the population of the beetle and damage to palms continued to increase three months after the windrowed palm biomass were pulverised and remained high 6 months later. Although pulverisation did not reduce the breeding of beetles in the short term, the treatment was able to hasten the decomposition of the palm biomass and hence reduced the period available for the rhinoceros beetles to breed. Ho and Teh (2004) reported that submersion of the entire freshly chipped palm biomass in the close-ended water conservation trenches, thus making them unsuitable for Oryctes breeding, resulted in 24-39% reduction in Oryctes damage to palms.

The other zero burning technique of replanting oil palm was the under-planting method whereby the new stand was planted under partially thinned old palms, which were gradually poisoned as the new stand grew (Hartley, 1977 and Nazeeb & Loong, 1999). This method of replanting resulted in even higher level of beetle breeding. Shamsudin *et al.* (1993) reported beetle larva count of 2100/ha in the poisoned standing palms 12 months after the palms were poisoned and the population increased to 18000/ha 6 months later. It took 24 months for the poisoned standing palms to decompose completely. The beetle caused varying degree of damage to 84% of the under-planted palms.

Currently, the rhinoceros beetle is the most serious pest in immature and young mature palms in Malaysia. Liau *et al*. (1991) and Chung *et al*. (1999) reported that beetle damage could cause crop losses of 40 and 92% in the first year of harvesting respectively. Although the pest could be controlled by a combination of cultural and chemical methods (Ho, 1996 and Ho & Teh, 2004), the most effective way of controlling the pest is through the destruction of the pest breeding sites during land clearing.

Apart from *O. rhinoceros*, palm biomass if not properly treated could also become the source of rats and *Ganoderma boninense* disease problems. Severe infestations of the latter could cause yield loss of about 45% (Gurmit, 1991). In addition, the presence of large amount of big chunks of windrowed palm biomass reported to be in the region of about 85t/ha dry matter (Khalid *et al*., 1996) impeded field access and hindered replanting and the subsequent field upkeep work. The other drawback was that the nutrients released by the windrowed decomposing palm biomass were beyond the root zone of the young replanted palms.

This paper reports two methods of clearing old oil palms for replanting whereby the entire palm was pulverized into small pieces and spread widely over the field and the root mass around the bole dug up during land clearing. The methods have good potential in reducing the breeding of *O. rhinoceros* and rats by depriving them of a suitable breeding site. The clean clearing methods could also reduce the disease inoculums of *G. boninense* in addition to reducing the fallow period, facilitating replanting and the subsequent field upkeep work and improving the utilisation of nutrients released by the decomposing palm biomass by the newly replanted palms. They are environmentally less polluting and could contribute to sustainable palm oil production

Materials and Method

Method 1 - Pulverising the partially decomposed palm chips

The following two techniques of pulverising the partially decomposed palm chips produced by a track-type 120-horsepower excavator fitted with a chipping bucket are reported:

The Telok Sengat Estate Technique

This is an improved version of the clearing method reported by Chow & Ooi (2000) and comprised the following operations:

⇒ Before felling of the old palms, the fields were cleared of timber stumps, discarded building materials, machinery parts, large stones and other objects that could cause damage to the tractor-mulcher.

⇒ A track-type 120-horsepower excavator fitted with a chipping bucket with cutting edge made of high tensile carbon steel fell the palms and chipped the trunks and crowns to thin slices of less than 10cm thick (*Plate 1*). The fronds were cut into 1-metre length pieces so that they would not choke the spindle of the mulcher during pulverisation. The same excavator also dug up the boles and the surrounding root mass and chipped them into small pieces. It is imperative to ensure that the thickness of the chipped palm biomass particularly the harder portion (lower trunk and bole) is not thicker than 10 cm and the entire biomass is spread thinly, preferably no more than 2 layers thick in the previous frond stack inter-rows (the mechanization paths were left alone and maintained for supervision and for future use). Otherwise, the mulcher would have problem pulverizing them. An experienced and reliable contractor carried out this operation under close supervision by the estate.

Plate 1: Excavator chipping palm trunk into slices of <10cm thick

⇒ At about 40 to 60 days after felling, a 105-horsepower tractor with creeper gears and a PTO driven heavy-duty 60-inch mulcher (tractor-mulcher) pulverised the partially decomposed palm biomass (*Plate* 2). A smaller and less efficient 85-horsepower tractor without creeper gears was also used but with a smaller 50-inch mulcher. Two rounds of pulverization were carried out in close succession.

Plate 2: Tractor drawn mulcher pulverizing 40-day old palm chips

⇒ Immediately after the first round of pulverisation, a round of ploughing with a 3-disc (the middle disc was removed to prevent the palm chips from getting stuck in between the closely spaced discs) 24-inch plough was carried out to bring to surface the missed and buried palm chips for a second round of pulverisation. The ploughing also helped to spread the pulverized palm biomass more thinly and evenly, and improved the field condition for the planting of leguminous cover crops (LCC) and palms. The estate check roll workers carried out the pulverization and ploughing.

The main advantages of the Telok Sengat Estate technique were that it was the cheapest method evaluated and the resultant land preparation and replants were excellent. The main constraint was that the tractor-mulcher could only work on flat to undulating terrain or on terraced areas if the land is hilly.

The KLK Technique

The KLK technique is a variation of the Telok Sengat Estate Technique. The main difference was that the mulcher was mounted on an excavator (excavator-mulcher) and driven by a hydraulic motor instead of a tractor PTO (*Plate 3*). It is recommended that felling and chipping, and pulverization contracts are awarded to the same contractor. This would ensure that the chipping contractor would chip the felled palms to specification so that pulverization of the chipped biomass could be carried out efficiently. The chipped biomass was spread into single-palm heaps, the thickness of which should preferably be no more than 3 layers. Spreading the palm chips in small heaps instead of spreading them evenly throughout the field helped to speed up the subsequent pulverization work, as the excavator-mulcher need not have to move as often. At about 2 months after felling, the excavator-mulcher pulverised the partially decomposed palm biomass heap by heap, starting from the top of a heap and working in a downward manner until an entire heap is done before moving on to the next heap.

Plate 3: Excavator driven mulcher pulverizing 2-month old palm chips

About 20% of the areas required a second round of pulverization after a tractor drawn tine has brought up the missed and buried palm chips. An experienced and reliable contractor carried out the entire operation from felling to pulverization under close supervision by the estate. In addition, the estate carried out a round of ploughing and harrowing in the palm and LCC planting rows prior to planting on its own.

The main advantages of the KLK technique were:-

⇒ The contractor was able to use his excavator for both felling and chipping, and pulverisation work. Hence, there was no need to incur an additional capital expenditure to purchase tractors for the pulverisation work.

⇒ As the excavator operator was able to see obstacles in front of him and could remove them with a flick of the mulcher, it was not critical to remove all the timber stumps, discarded building materials, large stones and other objects from the field prior to land clearing.

⇒ The excavator-mulcher was more versatile than the tractor-mulcher as it could work on hill slopes and in low-lying water logged areas.

Method 2 - Pulverising the standing and newly felled palms

Three types of machines i.e. the EnviroMulcher, MountainGoat and Beaver reported by Ooi and Heriansyah (2004) were used to pulverise the standing and newly felled palms in a group of four estates in Johore in 2003:

The EnviroMulcher

The EnviroMulcher is a Malaysian invention and is basically an attachment mounted at the end of a track-type 120-horsepower excavator's boom (*Plate 4*). It consists of a cylindrical steel drum bolted with 111 tungsten carbide tip knives. This was first reported by Ooi *et al.* (2001). In this follow-up evaluation, the EnviroMulcher was made to pulverize the entire palm including the crown and root bole. Previously, the crowns and root boles were not pulverized but chipped and stacked in the inter-rows by a track-type 120-horsepower excavator fitted with a chipping bucket. The stacked biomass became a breeding ground for the rhinoceros beetles.

Plate 4: The EnviroMulcher™ pulverizing a standing palm

To pulverize a palm, the excavator first placed the EnviroMulcher on the highest part of a palm trunk that could be reached by the excavator's boom. It then cut the palm into two and the upper portion was allowed to fall to the ground. The EnviroMulcher pulverized the standing portion of the trunk until the root bole before proceeding to pulverize the fallen portion of the palm including the crown but excluding the fronds, which were left *in situ*. The pulverized palm biomass was spread fairly thinly and evenly over the ground in the process. Another track-type 120-horsepower excavator fitted with a chipping bucket followed to stack the fronds into alternate inter-rows and to dig up the root mass and spread them beside the frond stacks. The excavator also covered the resultant holes with soil.

The MountainGoat

The Morbark 50/36 E-Z MountainGoat built on a Caterpillar 325L undercarriage and powered by a 750 horsepower Caterpillar 3412 engine was imported from USA (*Plate 5*). It required the support of two track-type 120-horsepower excavators fitted a chipping bucket to fell the palms and line them in neat rows for the MountainGoat. The excavators split the palm trunks into two halves if they were bigger than 90 cm in diameter. They also dug up the root mass and covered the resultant holes with soil.

To pulverize a palm, the MountainGoat's grapple fed the felled palm trunk into the chipper drum, which was fitted with 10 pieces of knives arranged in 3 x 2 x 3 x 2 configuration. The pulverised palm biomass was spread fairly thinly and evenly over the entire field through a discharge spout with a 360^0 hydraulic swivel.

Plate 5: The MountainGoat™ pulverizing a newly felled palm

The Beaver

The Beaver is another Malaysian invention built on a D3 Caterpillar undercarriage and powered by a 300 horsepower Caterpillar 3306 engine (*Plate 6*). To fell a palm, the Beaver pushed a 0.9 x 0.3 m cutting blade into the ground immediately below the root bole to severe as much of the root mass as possible on one side of the palm. The palm was then pushed down with the same cutting blade, which was placed in an upward incline on the trunk at about 1.5 m above the ground. The Beaver then pushed the felled palm forward before digging up the root bole and its surrounding root mass with the cutting blade. A 1.18 m long by 0.52 m diameter rotating drum, fitted with 20 pieces of 18 cm long x 8 cm wide self-sharpening flails made of hardened steel with cobarlac tip, mounted at the front of the Beaver pulverized the felled palm *in situ* by driving over it in a forward and backward direction. Two forward and one backward passes were required to pulverize an entire palm. The pulverized biomass was discharged behind the Beaver in rows over the fallen palms.

Plate 6: The Beaver™ pulverizing a newly felled palm

RESULTS AND DISCUSSION

Productivity and cost

The estates kept detailed records of work done by their check roll workers and only lump sum records for work done on contract by the contractors. The productivity and cost of the various land clearing methods are tabulated in *Tables 1* and 2, and *Appendix 1*.

Productivity

The productivity of the various land clearing methods are tabulated in *Table 1*.

i) Work done by the estate's check roll workers

The only major work done by the estate's check roll workers was the pulverization of the partially decomposed palm chips and the ploughing to bring to surface the missed and buried palm chips for a second round of pulverization in the Telok Sengat Estate Technique. Results obtained from clearing a 296-hectare 1979 planting in 2003 are discussed below.

The 85-horsepower tractor fitted with a 50-inch wide mulcher was able to pulverize about 16 palms per hour in the first round of pulverization on average. The productivity increased to 20 palms per hour in the second round of pulverization. The productive time worked per day was 5.95 hours in the first round of pulverization and 5.72 hours in the second round giving a daily output of 91 and 113 palms per tractor-mulcher per day respectively.

The 105-horsepower tractor fitted with creeper gears and a 60-inch wide mulcher was able to pulverize about 21 palms per hour in the first round of pulverization. The productivity increased to 30 palms in the second round. The productive time worked per day was 5.18 hours in the first round of pulverization and 5.69 hours in the second round giving a daily output of 107 and 172 palms per day respectively.

Overall the 105-horsepower tractor-mulcher was about 37 and 44% more productive than the 85-horsepower tractor-mulcher on per day and per hour basis respectively.

The 85-horsepower tractor with a 3-disc 24-inch plough was able to plough 5 ha/day after the first round of pulverisation to bring to surface the missed and buried palm chips for a second round of pulverisation and to spread the pulverized palm biomass more thinly and evenly.

ii) Work done by the contractors

The excavator fitted with a chipping bucket was able to fell, chip and spread about 80 to 100 palms per day. The rate of work was highly dependent on the terrain and thickness of the palm chips specified by the estate.

The excavator-mulcher was able to pulverize 75 palms per day in the first round of pulverization compared to 91 and 107 palms per day achieved by the 85-horsepower and 105-horsepower tractor-mulcher respectively. The corresponding figures for the second round were 100, 113 and 172 palms per day respectively.

The EnviroMulcher and the Beaver were similar in productivity and pulverized about 60 palms per 10-hour day each. However, the former required the assistance of an excavator to stack fronds, dig up root mass and cover up the resultant holes. The MountainGoat was able to pulverize 400 palms per 10-hour day i.e. 6.7 times more productive than the EnviroMulcher and the Beaver but required the support of two excavators. The excavator assisting the EnviroMulcher and the MountainGoat was able clear about 200 palms per day. The productivity figures assumed no downtime of machinery, which happened sometimes.

Table 1 : Productivity of Land Clearing				
Method	Particular	Productivity (palm)		Remark
		Per hour	Per day	
Telok Sengat Estate Technique	Felling, chipping and spreading biomass		80-100	By contract on per palm basis.
	1st round pulverisation	16	91	By estate using a 85-horsepower tractor with a 50-inch wide mulcher. Mean productive hour/day = 5.83
	2nd round pulverisation	20	113	
	Mean	18	102	
	1st round pulverisation	21	107	By estate using a 105-horsepower tractor with a 60-inch wide mulcher. Mean productive hour/day = 5.44
	2nd round pulverisation	30	172	
	Mean	26	140	
	Ploughing	0.7ha	5ha	By estate with a 3-disc 24-inch plough. Mean productive hour/day = 6.95
KLK Technique	Felling, chipping and spreading biomass		100	By contract on per palm basis. About 20% of the areas required a 2nd round of pulverization after tining.
	1st round pulverisation		75	
	2nd round pulverisation		100	
	Tining		5ha	By estate with a tractor-drawn spring tine
EnviroMulcher	Pulverising standing and newly felled palms		60	
MountainGoat			400	
Beaver			60	By contract on per palm basis.
Excavator assisting the EnviroMulcher and the MountainGoat			200	

Cost

The costs of land clearing are summarized in *Table 2*.

i) Work done by the estate's check roll workers

Costs incurred in clearing a 296-hectare 1979 planting in 2003 by the Telok Sengat Estate Technique are discussed below:

The average cost excluding depreciation (the tractor-mulcher had already been depreciated to a nominal value) for the first round of pulverization by the 85-horsepower tractor–mulcher was RM1.19/palm or RM147/ha at palm stand of 124 palms/ha. This comprised RM116/ha for tractor operating expenses inclusive of driver's wages, which came to RM42/ha, and RM32/ha for replacement of mulcher parts. The cost for the second round of pulverization was RM109/ha comprising RM85/ha for tractor operating expenses (RM52/ha for tractor and RM33/ha for driver's wages) and RM24/ha for mulcher parts. The overall total cost inclusive of ploughing and contract felling and chipping was RM8.47/palm or RM1050/ha.

It was cheaper to use the 105-horsepower tractor-mulcher because of its higher productivity. Total cost for two rounds of pulverization by the 105-horsepower tractor-mulcher was RM195/ha comprising RM152/ha for tractor operating expenses (RM95/ha for tractor and RM57/ha for driver's wages) and RM43/ha for mulcher parts. This was about 24% cheaper than the 85-horsepower tractor-mulcher. The overall total cost inclusive of ploughing and contract felling and chipping was RM7.97/palm or RM988/ha.

The cost of one round of ploughing in between the two rounds of pulverization in the Telok Sengat Estate Technique was about RM24/ha, while the cost of "tining" in the KLK Technique was RM12/ha. The former comprised RM18/ha for tractor operating expenses inclusive of driver's wages, and RM6/ha for the plough and workshop expenses.

ii) Work done by the contractors

In the Telok Sengat Estate Technique, palm felling, chipping and spreading the chipped biomass was contracted out at RM6.20/palm. In the KLK Technique, the entire land clearing work was done by contract at RM9.80/palm, which also covered the cost of "tining" (carried out by the estate and charged to the contractor) and a second round of pulverization in 20% of the areas.

The Telok Sengat Estate Technique required more inputs from the estate and the resultant field was well prepared for the planting of LCC and palms, and made the subsequent field upkeep work much easier. In the KLK Technique, the estate has also planned to carry out a round of ploughing and harrowing in the palm and LCC planting rows prior to planting on its own to facilitate the planting of LCC and palms.

For pulverising the standing and newly felled palms, the entire land clearing work including the cost of excavator support was done by contract at about RM13.00/palm in 2003 regardless of the machinery used. The contractors would probably demand a

Table 2 : Cost of Land Clearing				
Method	Particular	Productivity (palm)		Remark
		Per hour	Per day	
Telok Sengat Estate Technique (2003 cost)	Felling, chipping and spreading biomass	6.20		By contract on per palm basis.
	1st round pulverisation	1.19	147	By estate using a 85-horsepower tractor with a 50-inch wide mulcher. Excluding depreciation.
	2nd round pulverisation	0.88	109	
	Total including excavator and ploughing costs	8.47	1050	
	1st round pulverisation	0.95	118	By estate using a 105-horsepower tractor with a 60-inch wide mulcher. Excluding depreciation.
	2nd round pulverisation	0.62	77	
	Total including excavator and ploughing costs	7.97	988	By estate with a 3-disc 24-inch plough. Excluding depreciation.
	Ploughing	0.20	24	
KLK Technique (2004 cost)	Felling, chipping and spreading palm biomass and pulverisation	9.80		All in cost by contract on per palm basis inclusive of a 2nd round of pulverization after tining in 20% of areas.
	"Tining"		12	By estate with a spring tine but cost charged to the land clearing contractor.
EnviroMulcher, MountainGoat and Beaver (2003 cost)	Pulverising standing and newly felled palms	13.00		All in cost inclusive of excavator support by contract on per palm basis.

higher rate now, as the prices of fuel and other inputs have increased substantially since.

Overall, method 2 (pulverising the standing and newly felled palms with either the EnviroMulcher, MountainGoat or the Beaver) was more expensive than method 1 (felling and chipping by an excavator, and pulverising the partially decomposed palm chips by either the tractor-mulcher or excavator-mulcher). It was probably worth paying the extra cost for the former method as the one-off operation saved time (shorter fallow period) and produced very small chips, which facilitated mulching of the newly replanted palms. The fast rate of decomposition of the very small chips also reduced the breeding of pests.

Size of pulverized palm biomass

The size of the pulverized palm biomass produced by the various land clearing methods are tabulated in *Table 3.*

In the Telok Sengat Estate Technique, 53% of the pulverized palm biomass passed through a 15 x 15 cm sieve. The figure improved to 82% after the second round of pulverization. The corresponding figures for the KLK Technique were 63 and 86% respectively.

The pulverized palm biomass produced by the EnviroMulcher, MountainGoat and Beaver were all very small in comparison the Telok Sengat Estate and KLK Techniques. All the three methods produced chip size of less than 0.1g (dry weight). The reduced chip size hastened its decomposition and hence reduced the duration of time suitable for the breeding of rhinoceros beetles. Ooi and Heriansyah (2004) reported that 56% of the palm biomass pulverized by the EnviroMulcher had decomposed at 24 weeks after pulverization.

Table 3 : Size of pulverized palm biomass

Method	*Particular*	*% of pulverized palm biomass passing through various sized sieves (cm)*				
		2.5x2.5	*5 x 5*	*15x15*	*>15x15*	*Total*
Telok Sengat Estate Technique	After 1 round of pulverisation	32	3	18	47	100
	After 2 rounds of pulverisation	52	6	24	18	100
KLK Technique	Sieve size (cm)		>15x15		>15x15	
	After 1 round of pulverisation		63		37	100
	After 2 rounds of pulverisation		86		14	100
EnviroMulcher, MountainGoat and Beaver	Pulverising standing and newly felled palms in a one-off operation	Pulverized palm biomass minute in size in comparison to the Telok Sengat Estate and KLK Techniques. All the three methods produced chips size of less than 0.1g (dry weight).				

Pulverising the entire palm and spreading the pulverized biomass thinly throughout the field and digging up the root mass around the bole prior to replanting conferred the following benefits:

- The resultant field was fairly clear of obstacles and hence facilitated replanting of palms as well as planting of LCC and the subsequent field upkeep work.
- Replanting could proceed as soon as a portion of the field has been cleared, thus shortening the fallow period.
- The pulverized palm biomass could be used to mulch the newly replanted palms. This was particularly easy to carry out when standing and newly felled palms were pulverized without going through the chipping process. Ooi *et al*. (2001) reported that mulching the newly replanted palm circle with 150kg of freshly pulverised palm chips produced by the EnviroMulcher was able to supply the entire major nutrients requirement of the palm in the first year assuming nutrient uptake efficiency of 40%. In a follow-up trial, Ooi (unpublished) found that mulching the newly replanted palm circle (1.2 m radius and 6 cm thick) with 120 kg freshly pulverised palm chips produced by the EnviroMulcher improved palm growth significantly in the nil NK treatments. There was no breeding of beetles at all in the mulched palm circles.
- Although control of Ganoderma disease is still not well understood, clean clearing of palm biomass, particularly digging up of the root mass at replanting is considered essential and recommended. This is because the intact root mass of Ganoderma infected palms is an important source of disease inoculums.
- Most importantly, the methods of clearing reduced the breeding of *O. rhinoceros* and rats by depriving them of a suitable breeding site.
- In addition, these zero burn techniques of replanting are environmentally less polluting and could contribute to sustainable palm oil production.

Breeding of rhinoceros beetle

Results of the rhinoceros beetle population census in fields cleared by the Telok Sengat Estate Technique in 2001 and 2003 are summarized in *Table 4*. Sampling intensity of one point per 30 x 30 palm grid was adopted. At each sampling point, all the residues within a 2 x 2 palm area were dug up and checked for beetle larvae, pupae and adults.

The population of the rhinoceros beetle larva, pupa and adult varied from 201/ha to 309/ha between 12 and 21 months after felling of palms. The very high coefficients of variation indicate that the beetle population was very variable between the sampling points. High beetle populations were invariably found in depressions where there was an accumulation of the pulverized palm biomass. There was no breeding of beetles at all in the sampling points where the pulverized palm biomass was spread thinly. Hence, the level of beetle breeding could be reduced further through more even distribution of the pulverised palm biomass. The beetle population dropped to a very low level of 3/ha by the twenty-fourth month. The results indicate that the method of land clearing was effective in reducing the breeding of beetles. The beetle populations recorded are considered very low in comparison those reported for the under-planting, chip and windrow, and chip-windrow-pulverise methods of land clearing where the population of beetles in the decaying palm biomass numbered in thousands.

Table 4 : Population of Rhinoceros Beetle in fields cleared by the Telok Sengat Estate Technique in 2001 and 2003

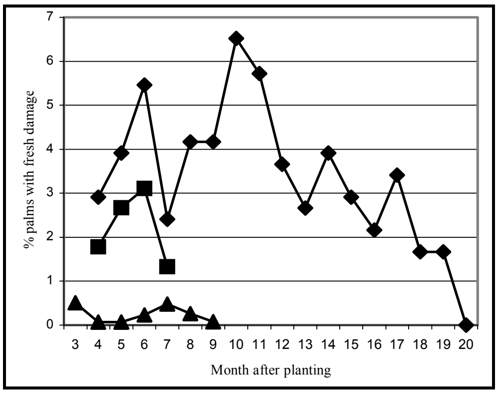
Field/Ha	Month after felling	Beetle population per ha			
		Larva		Pupa + adult	
		Mean	CV%	Mean	CV%
PR2001/129 ha	12	173	196	27	325
	15	292	237	17	325
	18	173	266	24	200
	21	99	236	112	217
	24	3	400	0	0
PR2003/296 ha	12	269	101	20	238

Beetle population census was not carried out for the other methods of land clearing reported in this paper. As all the methods have the same objective of pulverising the entire palm and spreading the pulverized palm biomass as thinly and evenly as possible throughout the field, it could be inferred that all the methods would reduce the breeding of beetles.

Fresh damage on replanted palms by beetles

Results of the monthly census of fresh rhinoceros beetle damage on the spears and the three youngest fronds of the replanted palms in three plantings cleared by the Telok Sengat Estate Technique in two estates are shown in *Plate 7*.

Plate 7 Fresh beetle damage on replanted palms



The incidence of fresh rhinoceros beetle damage on the replanted palms was not high in both estates. The spraying of Cypermethrin at 2 rounds/month regardless of damage level in estate B had contributed to the very low level of monthly fresh pest damage of well below 1% to-date i.e. in the first 9 months after field planting. Higher level of pest damage was reported in Estate A, which only sprayed Cypermethrin at 2 rounds/month when the monthly census of fresh damage exceeded 5%. This occurred in 3 out of 17 rounds of census in field A1 and nil in field A2. In field A1, beetle damage started to decline about a year after planting and by the twentieth month, there was no more fresh damage. The pest damage levels recorded in the two estates are considered very low in comparison those reported for the under-planting, chip and windrow, and chip-windrow-pulverise methods of replanting.

Comparison with the conventional methods

The main difference between the methods of land clearing reported in this paper and the conventional methods such as the chip and windrow, and chip-windrow-pulverise methods was that in the former methods, the palm biomass was pulverized and spread thinly and widely over the field prior to the planting of palms and LCC. In the latter method, palm biomass was windrowed and if pulverization was required, it was done after the palms and LCC had been planted. The windrowed palm biomass became a fertile breeding ground for the rhinoceros beetles and rats, and could hinder fieldwork. At the same time, the nutrients released by the windrowed biomass were beyond the reach of the newly replanted palms. It was difficult to use the big chunks of palm chips to mulch the newly replanted palms, and to pulverise the windrowed palm biomass efficiently. Most of the problems associated with the conventional methods could be overcome or minimized by pulverizing and spreading the palm biomass thinly and widely over the entire field during land clearing prior to the planting of palms and LCC.

CONCLUSIONS

Results of the rhinoceros beetle population census in fields cleared by the Telok Sengat Estate Technique indicate that the method of land clearing was effective in reducing the breeding of rhinoceros beetles. This was reinforced by the low levels of pest damage on the replanted palms in three plantings on two estates. Although beetle population and pest damage census were not carried out for the other methods reported, it could be inferred that they would be as effective, as all the methods have the same objective of pulverising the entire palm and spreading the pulverized palm biomass as thinly and evenly as possible throughout the field thus making them unsuitable for the beetles to breed. The clean clearing of palm biomass, particularly the digging up of the root mass at replanting has the potential reducing the Ganoderma disease problem.

The methods of land clearing could confer other potential benefits such as shorter fallow period, more efficient utilisation of nutrients released by the decomposing palm biomass by the newly replanted palms. The clean clearing methods also facilitated replanting and the subsequent field upkeep work. These zero burn techniques of replanting are environmentally less polluting and could contribute to sustainable palm oil production.

Appendix 1 : Productivity and Cost—The KLK Technique

Operation	Cost item	Particular	Out put Per day (palms)	Cost RM/ palm	Cost RM/ ha
1) Felling, chipping and spareading biomass by excavator-bucket	Diesoline Operator wages Spares/hydraulic oil Sub-total for item 1	170 lit/day RM 100/day	100 100	1.70 1.00 0.25 2.95	231 136 34 401
2) 1st round pulverisation by excavator-mulcher	Diesoline Operator wages Replacement of parts Spares/hydraulic oil Sub-total for item 2	150 lit/day RM 100/day	75 75	2.00 1.33 0.20 0.25 3.78	272 181 27 34 514
Depreciation	Excavator	RM20,000/year for chipping & pulverising 10,000 palms		2.00	272
	Mulcher	4,000/year for pulverising 10000 palms		0.40	54
Total excluding depreciation (operations 1 & 2)				6.73	915
Total including depreciation of excavator-mulcher (operations 1 & 2)				9.13	1242
3) Tining to bring up buried biomass in 20% of areas for 2nd round of pulverisation	Diesoline Operator wages Sub-total for item 3	40 lit/day RM 20/day	680	0.06 0.03 0.09	8 4 12
4) 2nd round pulverisation by excavator-mulcher 20% of areas	Diesoline Operator wages Replacement of parts Spares/hydraulic oil Sub-total for item 4	80 lit/day RM 100/day	100	0.80 1.00 0.20 0.25 2.25	109 136 27 34 306
Depreciation	Excavator Mulcher	At 20% of 1st round of pulverisation		0.40 0.08	54 11
Total for operations 3 & 4				2.82	384

AAR FORESTRY PROJECT

By Chan Weng Hoong

The project on plantation forestry was spawned on the premise that it made economic sense to diversify into crops other than oil palm, given the present scenario of escalating labour costs, decreasing labour availability in Malaysia and diminishing supply of tropical timber worldwide. Suitable timber species could be planted in the pockets of steep to very steep areas where oil palms would unlikely perform well. After the initial few years of maintenance, trees could be left mainly unattended until harvestable size. This situation appears generally attractive from the labour point of view.

The project commenced in 1995/96 with the establishment of a nursery to provide planting materials both for AAR`s trials as well as estates which were interested in trying out small observational plots of forestry trees. Where timber species were not available, sourcing was carried out. Small commercial plots occupying a total of 330 ha spread over nine estates were planted with timber species for observation.
For the research programme, the following aspects were planned, being in general, progressive stages of development of the timber cycle:

- evaluation of timber species, selection and propagation
- evaluation of silvicultural practices
- thinning and wood quality
- logging – thinning and clear felling.

Four trials were laid down to study the above, albeit still mainly at stages 1 and 2 only. The agronomist in charge also made advisory visits to the small blocks of commercial forestry in nine estates (330 ha).

In 2001, the Principals made a decision to curtail commercial plantation forestry in view of the long gestation period of the timber species and also uncertainty of economic returns from planting timber. The pockets of steep terrain were also considered too scattered for economic viability. The very high cost incurred in the first four years of establishment of teak (*Tectona grandis*) over 250 ha in two blocks in an initial commercial project in Sarawak deterred further investment in plantation forestry.

On the basis of the above AAR decided to scale down on the forestry project. The nursery was closed down in early 2002. Advisory visits to the commercial forestry plots however continue. Existing trials also continue to be maintained except for the trial in Kelantan where growth of trees was variable due to pest attack and prolonged drought stretching from February to April for most years. The trial in Kelantan was closed down in early 2003.

This report provides preliminary findings on the timber species evaluated in AAR trial areas.

Materials and Method

Trial details

Four trials were laid down between 1995-1999, the details of which are given in Table 1.

Timber species were mainly planted from seeds raised in 15 x 22.5cm polybags. They were field planted after being in the polybag nursery for 4 months. In the case of *T. grandis*, ramets from `Thai orchid`, Thailand were used in Trial PF 4, ramets from Luasong, Sabah in trial PF 1and PF12 and selected seedlings from Forest Research Institute of Malaysia (FRIM) were planted in trial PF3. The *Khaya senegalensis* and *Khaya ivorensis* (African mahogany) in trial PF12 were planted from cuttings.

The various timber species in each of the trials were planted in separate contiguous blocks which were not replicated.

Tree spacing was 2mx3m for all species except for the *T. grandis* in trial PF12 which was planted at 2mx4m alternating with *Gmelina arborea*. The *G. arborea* was completely thinned out after 2 years leaving a spacing of 2mx8m for the *T. grandis*.

Measurements and records

Girth

Girth measurements were carried out annually from one year after planting onwards. The rows of trees in the core area of each planting and comprising about 10% of total stand constituted the measurement trees. Trees were measured at a height of 1.3m from the ground.

Pests and diseases

Pest and disease attacks on the various timber species in the course of the evaluation were monitored and recorded.

Other observations

Observations on the effect of drought on the various timber species were also recorded.

Results

Mean girth of the timber species in the various trials are given in Tables 2 to 5.

Trial PF 1

The best growth was obtained by *G. arborea* which attained a girth of 82.6cm, followed closely by *Paraserienthes falcataria*. On a comparative basis, *T. grandis* was smallest at the end of the 7th year.

Trial PF 3

Owing to the different periods of planting, growth of timber species may generally be compared only in the 5th year for four species; 7th year for three species and 8th year for two species. In the 5th year, *T. grandis* registered the best growth

Table 1 : Details of Trials

Trial No.	Location	Timber sp.	Date of planting	Ha	Spacing	Soil type/terrain
PF1	Tawau, Sabah	Acacia mangium Gmelina arborea Paraserienthes falcataria Tectona grandis	May'95 May'95 May'95 Nov'96	5.00 2.00 2.00 5.00	2mx3m 2mx3m 2mx3m 2mx3m	Tingkayu family, undulating to hilly, (6°-12°slope)
PF3	Dabong, Kelantan	Azadirachta excelsa Tectona grandis(FRIM) Swietemoa macrophylla Khaya ivorensis	Nov'95 Nov'95 Jun'96 Nov'98	3.60 2.00 0.40 2.00	2mx3m 2mx3m 2mx3m 2mx3m	Batang Merbau series, T. grandis and S. macrophylla mainly in ravines, others on undulating to hilly (6°-20°slope)
PF4	Semenyih, Selangor	Dyera costullata Gmelina arborea Hopea odorata Tectona grandis Swietenia macrophylla	Aug'95 Aug'95 Aug'95 Aug'95 Feb'96	0.12 0.12 0.12 0.12 0.12	2mx3m 2mx3m 2mx3m 2mx3m 2mx3m	Rengam series, undulating (2°-6°slope)
PF12	Semenyih, Selangor	Kyaya ivorensis Khaya senegalensis Tectona grandis (interplanted with Gmelina arborea)	Sept'98 Sept'98 Sept'99	0.60 0.60 0.40	2mx4m (for each specie)	Rengam series, undulating (2°-6°slope), M. arborea subsequently thinned ourt.

Table 2 : Girth of timber species in Trial PF1 (Tawau, Sabah)

Timber species		Girth (cm) Year 1	2	3	4	5	6	7	8
1)	Acacia mangium	24.8	33.2	41.5	44.7	52.3	59.4	65	67.4
2)	Gmelina arborea	25.5	37.1	42.6	47.8	58.3	69.3	75.1	82.6
3)	Paraserienthes falcataria	24.8	33.5	42.0	44.9	55.8	68.8	72.5	76.6
4)	Tectona grandis	14.8	24.5	37.2	46.5	50.0	52.7	57.3	-

Table 3 : Girth of timber species in Trial PF3 (Dabong, Kelantan)

Timber species		Girth (cm) Year 1	2	3	4	5	6	7	8
1)	Azadirachta excelsa	10.0	20.1	29.7	32.7	34.6	36.9	39.5	43.0
2)	Khaya ivorensis	6.9	15.2	24.9	26.1	30.0	-	-	-
3)	Swietenia macrophylla	7.2	17.5	24.7	30.5	35.6	39.4	43.0	-
4)	Tectona grandis	11.7	20.5	24.8	29.9	37.6	42.0	43.9	46.9

Table 4 : Girth of timber species in Trial PF4 (Semenyih, Selangor)

Timber species		Girth (cm) Year 1	2	3	4	5	6	7	8
1)	Dyera costullata	15.6	20.7	27.8	38.0	47.0	58.6	67.1	74.5
2)	Gmelina arborea	22.5	36.4	45.9	55.1	65.0	72.9	81.0	83.9
3)	Hopea odorata	8.5	18.5	27.0	31.2	40.8	46.8	50.4	56.4
4)	Swietenia macrophylla	10.5	20.9	28.0	31.2	34.7	38.8	46.3	51.1
5)	Tectona grandis	13.2	23.1	27.9	33.7	40.5	43.6	46.4	49.6

Table 5 : Girth of timber species in Trial PF12 (Semenyih, Selangor)

Timber species		Girth (cm) Year 1	2	3	4	5	6	7	8
1)	Khaya ivorensis	15.1	28.3	38.1	41.4	46.8			
2)	Khaya senegalensis	14.7	26.9	36.8	42.3	46.2			
3)	Tectona grandis	17.4	24.3	33.1	40.3	-			

among the four timber species. *K. ivorensis* was poorest. *T. grandis* showed the best growth after 7 years.

Trial PF 4

G. arborea showed the best growth after one year and continued to show the best growth every year up to the 8^{th} year of observation. In the 8^{th} year, *G. arborea* with girth at 83.9cm, was 64- 69% better than both *Swietenia macrophylla* and *T. grandis* which were the poorest among the five timber species evaluated.

Dyera costullata registered satisfactory to good growth, being only lower than *G. arborea* but significantly better than the other three species.

Trial PF 12

Both the Khaya species showed similar growth in the 4th year, but were marginally better than *T. grandis*. The Khaya species continued to show similar growth in the 5th year.

Comparison of growth of timber species in different locations

Growth of the timber species planted in different locations is shown in Table 6.

Growth of *S. macrophylla* planted in Selangor was better than in Kelantan in the 7^{th} year of growth.

The *K. ivorensis* in Selangor markedly outgrew its counterpart in Kelantan due probably to shoot borer attack and also the steep terrain which hindered growth of trees in the latter.

The *G. arborea* in Selangor showed similar growth as its counterpart in Tawau, Sabah.

Among the *T. grandis*, trees in Tawau, Sabah registered the best growth, markedly outgrowing its counterparts in Selangor and Kelantan. However trees in PF 12 in Selangor would likely `catch up` as tree spacing was initially wider (2mx4m) which was also further widened to 4m x 8m when the alternate rows of *G. arborea* was thinned out.

Pest, diseases and other inhibitory growth factors

Fusarium caused wilting of *G. arborea* in the trial in Kelantan and had to be replanted with *S. macrophylla*. The *S. macrophylla* in turn was severely attacked by the shoot borer, *Hypsipyla robusta*, in the initial 1-2 years after planting. The attack slowed down when trees attained a height of 5m. A ring bark weevil, *Dysercus longiclaris* also bored into bark of some trees around the 4^{th} year of growth. *K. ivorensis* was also attacked by the shoot borer albeit to a lesser extent. The *A. excelsa* in Kelantan suffered defoliation regularly during drought periods while *T. grandis* suffered defoliation from drought conditions in all locations and also from the leaf skeletoniser, *Paliga damastesalis*. However new foliage emerged with the onset of the rains. A stem borer, *Xyleutus ceramica*, has also caused some minor damage on teak.

Despite the fairly satisfactory growth of *K. ivorensis* especially in Selangor, its bark was severely disfigured by the larva of *Doloessa viridis*, from as early as the third year after planting. The damage commenced from near the base of the trunk and has travelled to as far as the crown. Most of the trees in the trials in Selangor and Kelantan have been severely disfigured by the larva.

Discussion

The forestry project has generally provided some preliminary information on potential timber species suitable for plantation forestry.

G. arborea, *P. falcataria*, *D. costullata*, *H. odorata* and *T. grandis* appear to be the more promising species among those evaluated. These timber species tended to show mainly satisfactory to good growth and were also mainly pest and disease free or suffered only minor affliction, tending to recover quickly. *S. macrophylla*, *K. ivorensis* and *K. senegalensis* however suffered fairly severe shoot borer attack in the early stages of growth. *K. ivorensis* also experienced much damage on the bark. *A. excelsa* tended to defoliate easily due to drought. Of the above timber species, *T. grandis* and *H.*

odorata have timber value of RM 2000 – 2500 per ton sawn timber while both *K. ivorensis* and *K. senegalensis* may fetch RM 1500 per ton saw timber.

Much more work however requires to be carried out particularly on proper breeding and selection to improve hybrid vigour of the timber species picked out for investment into plantation forestry as most of the species planted in the trial plots were obtained from unselected seedlings. This would entail fairly long term planning and research work at AAR.

Table 6 : Comparison of growth of timber species in different locations

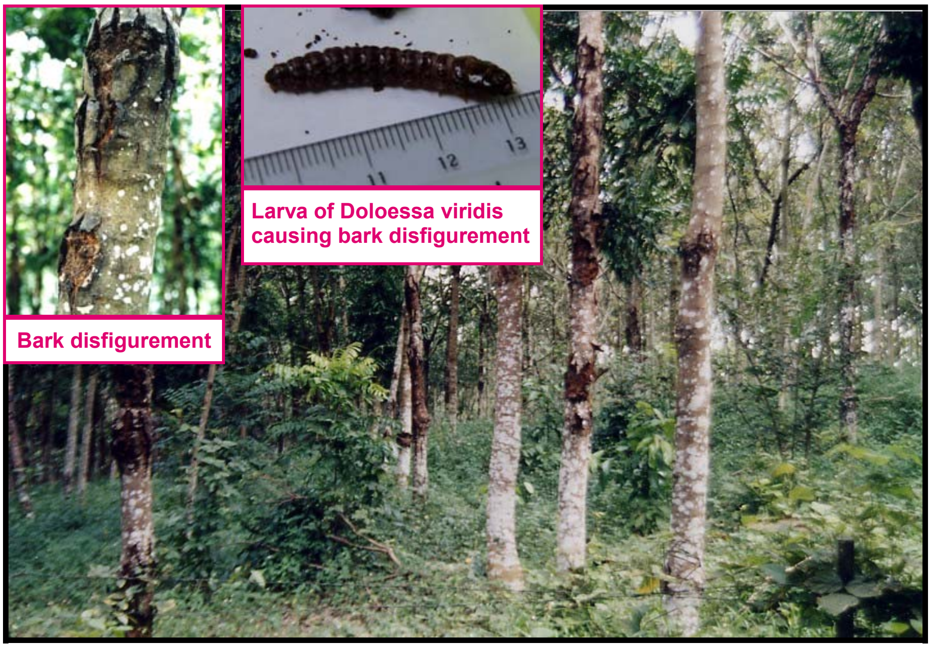
Trial No.	Location	Timber sp.	Spacing	Girth in cm							
				Year							
				1	2	3	4	5	6	7	8
PF3	Kelantan	S.macrophylla	2mx3m	7.2	17.5	24.7	30.5	35.6	39.4	43.0	
PF4	Selangor	S.macrophylla	2mx3m	10.5	20.9	28.0	31.2	34.7	38.8	46.3	51.1
PF3	Kelantan	K.ivorensis	2mx3m	6.9	15.2	24.9	26.1	30.0	-	-	
PF12	Selangor	K.ivorensis	2mx3m	15.1	28.3	38.1	41.4	46.8	-	-	
PF1	Tawau, Sabah	G.arborea	2mx3m	25.5	37.1	42.6	47.8	58.3	69.8	75.1	82.6
PF4	Selangor	G.arborea	2mx3m	22.5	36.4	45.9	55.1	65.0	72.9	81.0	83.9
PF1	Tawau, Sabah	T.grandis	2mx3m	14.8	24.5	37.2	46.5	50.0	52.7	57.3	
PF3	Kelantan	T.grandis	2mx3m	11.7	20.5	24.8	29.9	37.6	42.0	43.9	46.9
PF4	Selangor	T.grandis	2mx3m	13.2	23.1	27.9	33.7	40.5	43.6	46.4	49.6
PF12	Selangor	T.grandis	2mx3m	17.4	24.3	33.1	40.3	-	-	-	

The Principals have however curtailed interest in plantation forestry mainly due to quicker returns from oil palm and also the uncertain economic viability of the scattered nature and limited size of steep hills which had earlier been considered for plantation forestry. In view of the above, it may suffice for AAR to maintain a minor interest in the existing trials in Tawau and Selangor. Mainly monitoring of growth and some ancillary observations would be required in these trials.

Some of the commercial teak plantings in Sabah have however shown relatively good growth, having attained around 62.0 cm girth in 8 years. Hopefully they may breach the minimum marketable size of 90 cm girth in 15 years when return from the investment can be actualised.

Commercial 8 year old *Tectona grandis* with mean girth ~62.0 cm

Promising timber species - *Hopea odorata*



Bark disfigurement

Larva of Doloessa viridis causing bark disfigurement

Bark disfigurement in K.ivorensis - Balau trial PF12

Some notes on *Mucuna bracteata*,
A new shade tolerant legume
By Teo Chor Boo

Introduction

Mucuna bracteata, a perennial legume cover crop was introduced to Malaysia from India in 1991 (Matthews, 1998).Owing to its vigorous growth and large biomass production, it is fast becoming a popular leguminous cover crop for establishment at replanting.

M. bracteata has the following desirable characteristics which merit its establishment:

- Shade and drought tolerance.
- High biomass production
- Improves soil physical and chemical properties by returning large amounts of mulch. Also conserves moisture.
- Good against soil erosion
- Very vigorous growth which suppresses weeds easily.

Seeds

0ne kg of seeds contains 5000-6000 seeds (sufficient to plant up 10 ha). Cost of seed is RM 300 – 350 per kg. The germination rate ranges from 30-90% depending on quality of seeds. Average germination rate is 60%. Germination success declines with storage.

Nursery establishment

Seeds are usually scarified and ready for sowing in 10x 15 cm sized polybags. If unscarified, a nail clipper can be used to clip the testa at the basal section. Sandy clay loam topsoil should be used with rock phosphate mixed into the soil at the rate of 50 kg per ton of topsoil. Initial shade as per oil palm nursery is useful for the first 2 weeks. Adequate watering is crucial and seeds germinate in 5-7 days. Foliar fertilizer application with Grofas yellow (10g per 4.5 l water for 90 seedlings) at 2 weekly intervals speeds up growth. Plants are ready for field planting after 5-6 weeks (2 hardened whorls).

Thick *mucuna bracteata*

Field establishment

Planting of the polybagged seedlings should coincide with wet weather. The planting density depends on the soil type, rate of coverage desired and economics, due to the high cost of seeds.
At a rate of around 400 plants per ha, 80% coverage was obtained in 6 months under Sabah condition. At 270 plants per ha, full coverage of the field took 9 months.

Manuring

Recommended manuring programme is as follows:

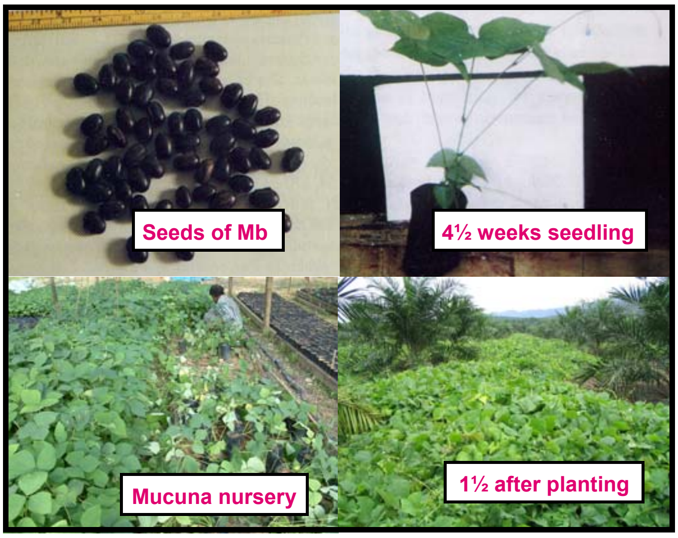
Planting hole : 15g slow release fertilizer followed by 50 g Rock phosphate/ plant

3 months after planting : Rock phosphate at 300 kg per ha

6 months after planting : Rock phosphate at 450 kg per ha. Ground magnesium limestone(GML) at 1500 kg per ha for Peninsular estates.

AAR projects on *Mucuna bracteata*

1) MS 8 : P recycling, growth rates ad biomass production on different rates and sources of phosphate rocks.
2) MS 9 : Establishment of *M.bracteata* under shade.
3) MS 10 : Different methods of raising *M.bracteata* seedlings and field planting.
4) MS 11 : Growth and biomass production of *M. bracteata* under different regimes of phosphate rocks.
5) Adhoc : *M.bracteata* for biological control of weeds.



Nursery establishment

A salute to woman over 30 by Andy Roony

This was written by Andy Rooney from CBS 60 minutes

Andy Rooney says:

- As I grow in age, I value women who are over 30 most of all. Here are just a few reasons why: A woman over 30 will never wake you in the middle of the night to ask, "What are you thinking?" She doesn't care what you think.
- Women over 30 are dignified. They seldom have a screaming match with you at the opera or in the middle of an expensive restaurant.
- Of course, if you deserve it, they won't hesitate to shoot you, if they think they can get away with it.
- Older women are generous with praise, often undeserved. They know what it's like to be unappreciated.
- A woman over 30 has the self-assurance to introduce you to her women friends. A younger woman with a man will often ignore even her best friend because she doesn't trust the guy with other women ……………………
- Women over 30 couldn't care less if you're attracted to her friends because she knows her friends won't betray her.
- Women get psychic as they age. You never have to confess your sins to a woman over 30. They always know.
- Once you get past a wrinkle or two, a woman over 30 is far sexier than her younger counterpart.
- Older women are forthright and honest. They'll tell you right off if you are a jerk if you are acting like one! You don't ever have to wonder where you stand with her.
- Yes, we praise women over 30 for a multitude of reasons. Unfortunately, it's not reciprocal. For every stunning, smart, well-coiffed hot woman of 30+, there is a bald, paunchy relic in yellow pants making a fool of himself with some 22-year-old waitress.
- For all those men who say, "Why buy the cow when you can get the milk for free". Here's an update for you. Nowadays 80% of women are against marriage, why? Because women realize it's not worth buying an entire Pig, just to get a little sausage…………

Julie Yee
(over 30!)