fires in South Sumatra reveals that there may be a large difference in pre-and post-fire conditions in this particular ecosystem. However, in each of the fire-types, modification of the characteristic hydrological and vegetation conditions unique to tropical peat forests played an important role in promoting fire. Specifically, these include annual climate extremes, drainage levels, vegetation species and forest structure. When considering fire prevention strategies in managed peat forests it is necessary to consider the interactions between the spatial and temporal properties of these characteristic conditions. As the above description of the two peat fires illustrates, an important feature of the fires is that disturbance activities in one location affect adjacent forests at points in time often well into the future. Thus, for management purposes it is clear that the peat forest cannot be easily divided in to units of separate land-use activity without careful planning. Unlike most of the adjacent ecosystems in Sumatra, the strong interactions between hydrology, topography and vegetation dictate that entire peat formations must be managed as single units for landuse.

A NOTE ON THE OPTIMAL TIME FOR GROUND COLLECTION OF *GMELINA ARBOREA* ROXB. FRUITS

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Gmelina arborea is a fast growing sub-tropical timber species popularly grown in plantations in Malaysia. Seed stands provide the main source of seeds. The fruits of this species fall once ripened. In harvesting it is more economical to collect naturally fallen fruits from the ground, a method practised by the Forest Research Centre (FRC). When the fruits are mature, the area below the crowns of the trees are cleared of undergrowth to facilitate collecting.

A freshly fallen ripened fruit has a pale green or greenish yellow pericarp; they are preferred for planting. After a few days its colour turns yellow and then brown. Finally the colour turns blackish at which time the pericarp will rot. Brown or blackish fruits have been shown to germinate poorly (Aminuddin & Zakaria 1980).

With additional costs involved in clearing the cover under a tree, and collecting fruits at the preferred stage, we decided to determine seed germinability and occurrence of insect infestation on fruits lying on the ground for various lengths of time before collection. Two different ground conditions were used: (i) ground beneath the crown was cleared of ground cover; and (ii) the ground beneath the crowns of the tree was left untouched. The study was conducted between July 10-16, 1986.

The site used in this study was Plot 5a, a 13-year old seed stand in Gum-Gum Forest Reserve, Sabah, East Malaysia. The plot has moderately undulating terrain with good drainage and contains a total of 34 *G. arborea* trees.

All fruits found within the study area prior to Day 1 were (a) removed from cleared sites and (b) on uncleared sites fruits were not removed but labelled and excluded from assessment. Beginning with Day 1, ten fruits from each of the six trees were randomly selected from among the fruits that fell the previous 24 hours. Each was assessed for date of fall, colour of pericarp and condition of fruits in example signs of insect infestation, bore holes and other defects. After assessment, fruits were returned to their former position and labelled.

Each day, until Day 7, the same procedure as on Day 1 was followed. All fruits previously assessed were re-assessed each day to record changes in colour of pericarp and presence and extent of insect infestation.

After assessment on the seventh day all fruits were collected and grouped by date of fall and tree number. Each fruit was labelled individually. There was a total of 42 groups of ten fruits (6 trees x 7 days x 10 fruits/day).

In the laboratory, each group of fruits was randomly divided with the Seed Section retaining half and the Entomology Section retaining the other half (210 fruits each).

In the Seed Section, the fruits were depulped and the nuts were pretreated by soaking in tap water five times the seed volume for 17 hours,

then drying at 45°C for seven hours and sowed in sterilized media comprising a mixture of two parts soil and one part sand. Assessment for germination continued for four months.

In the Entomology Section, the fruits were examined for insect attack, that is, bore holes, frass and pest insect attack. The pulp of each fruit was split longitudinally (3-4 times) and each fruit was then placed in a transparent plastic container (about 9.5 *cm* diameter x 4.5 *cm* height), the cover of which was perforated with small holes for ventilation. A piece of two-ply tissue paper was added to the bottom of every container for insect pupation purposes.

Following the 63-day period allowed for insect pupation, all nuts were passed back to the seed laboratory for germination tests. Pretreatment of nuts and soil media used were the same as for the first lot of seeds germinated.

The results (Table 1) show germination percentage on cleared sites was slightly lower (108.5%) than on uncleared sites (116.2%) but not significantly different. Likewise there was no significant difference in the percentage germination between any of the seven days of fruit collection on the ground between cleared and uncleared sites.

The percentage of insect infestation on fruits between cleaned and uncleaned sites did not show any significant difference either. Uncleaned sites averaged 84.8% insect infestation, while cleaned sites averaged 81.9% (Table 2).

Table 1. Germination of *Gmelina arborea* nuts after lying on the ground for between one to seven days

No. of days fruits left on ground	% Germination*											
	Trees with uncleaned ground				Trees with cleaned ground				Fruits germinated after 63 days following emergence of all insects			
	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean
1	100	300	100	166.67	60	160	100	106.67	0	125	80	69.2
2	140	120	60	106.67	80	140	100	106.67	80	80	140	100.0
3	100	120	100	106.67	120	120	100	113.33	100	200	100	128.6
4	100	140	160	133.33	80	180	100	120.00	60	100	180	130.8
5	120	80	100	100.00	100	140	120	120.00	60	140	280	160.0
6	100	80	80	86.67	140	100	60	100.00	60	80	120	86.7
7	120	120	100	113.33	100	100	80	93.33	50	100	100	85.7
				116.19				108.50				108.5

* Germination based on number of stones planted rather than the number of embryos that may possibly germinate

Table 2. Percentage insect infestation on fallen *Gmelina arborea* fruits

Day of fall	Tree	Cleaned				Uncleaned			
		1	2	3	Mean	1	2	3	Mean
1		100	100	100	100	100	100	100	100
2		100	100	100	100	100	60	100	86.7
3		80	60	100	80	100	80	100	93.3
4		80	100	80	86.7	80	100	80	86.7
5		40	80	80	66.7	60	100	80	80
6		80	80	100	86.7	60	80	80	73.3
7		60	0	100	53.3	80	60	80	73.3

Fruits which were left on the sites for seven days showed insect infestation of 100% which decreased rather unsteadily until it dropped to 53.3 and 73.3% (Table 2) for fruits left for one day in the cleaned and uncleaned sites, respectively. The relatively high rates of 53.3 and 73.3% suggest that the insect infestation could have started while the fruits were still on the trees.

A total of 12 insect species were found in the fallen *G. arborea* fruits. The three dominant species were *Hapalia ablactalis* (Lepidoptera: Pyralidae), *Lasiodactylus pictus* (Coleoptera: Nitidulidae) and *Drosophila* sp. (Diptera: Drosophilidae). Also present in smaller quantities were *Hymenia perspectalis, Haptoncus liteolus, Carpophilus* sp., *Coenonica* sp., *Dacus dorsalis, Apanteles* sp., *Phanerotoma* sp., *Tetramorium eleatus* and an unidentified earwig.

Almost all of the insects were found feeding on the soft juicy fruit pulp outside the nut. Only a couple (*L. pictus* and *H. luteolus*) were found to have penetrated the central cavity of the nut but germination rates indicated that they did not affect viability of the seeds concerned.

Germination of the second batch of seed received from Entomology Section after 63 days showed a small drop in germination percent as compared to the nuts that were sown immediately (Table 1). The drop in germination is likely due to fermentation since the pericarp of these fruits was not removed, merely split and opened slightly. This has been shown by Aminuddin and Zakaria (1980).

In conclusion, it seems like insect infestation, although very high (53.3 and 73.3% for Day 7) appeared to have no effect on germination since insect attack was almost entirely confined to the pulpy flesh surrounding the nut rather than the nut itself. Fermentation, however, did affect viability. A drop in germination percentage of 22.4% was noted between the nuts sown immediately after field observation and those further observed 63 days later.

The results allow ripened fruit collection on a once weekly basis provided, of course, the fruits are immediately depulped. A well tended site is preferable only since it allows for a faster, less costly collection.

Reference

AMINUDDIN, M. & ZAKARIA, I. 1980. Grading of *Gmelina arborea* (yemane) fruits by colour. *Malaysian Forester* 42: 337 - 339.

ERRATA

1) In page 119 line 29, of JTFS 1 (2), the correct text should be:

Table 2: Furnival's Index of Fit, (FI)

Dependent Variable	Species Groups			
	Dipterocarps		Non–Dipterocarps	
	DIPT	LHW	MHW	HHW
Unweighted Diameter increment (dD)	0.424	0.371	0.376	0.292t
Basal area increment (dBA)	3.563[a]	3.969[b]	4.389	3.696
Logarithmic Ln (dD)	0.098	0.051	0.052	0.032
Ln (dBA)	2.427[b]	1.584	1.544	1.119
Weighted Diameter increment (dD)	0.044	0.025	0.029	0.033
Basal area increment (dBA)	0.404[c]	0.345	0.323	0.299

Models fitted were: $f(X) = b_0 + b_1 D + b_2 D^2$, where f(X) is either dD (*cm/y*), dBA (*cm²/y*), Ln (dD), or Ln (dBA).
The best fit model for each species group is indicated by the lowest FI value, and D is DBHOB.

[a] $FI = [2\sqrt{dBA}]^{-1} * s$ --- unweighted

[b] $FI = [2/\sqrt{dBA}]^{-1} * s$ --- logarithmic

[c] $FI = [2\sqrt{dBA}/D2]^{-1} * s$ --- weighted by $(1/D^2)$

(The LHW, MHW, and HHW follow the same formula).

2) In page 134, line 20, of JTFS 1 (2), the correct text should be:

... Initial vacuum: 711.2 *mm Hg*...
... Final vacuum: 711.2 *mm Hg*...