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A SURVEY OF TERMITE ATTACK IN BAHAU CONIFER PLANTATION, PENINSULAR MALAYSIA

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Termite attack can be a serious, recurring problem in forest plantations (Cowie *et al.* 1989, Tho & Kirton 1990). Conifers were the first forest plantation trees to be planted on a large scale in Peninsular Malaysia. Plantations of conifer species were established intensively from the late 1960s till late 1970s for the production of pulpwood, after which there was a shift in emphasis towards other fast-growing tree species for pole and timber production (Mohd. Afzal & Zakaria 1985). The severity and high incidence of termite attack in Malaysian conifer plantations has been highlighted in a number of studies (e.g. Benedict 1971, Thapa & Shim 1971, Tho 1974). The termite responsible for the damage, *Coptotermes curvignathus* Holmgren, kills and damages trees of virtually any age (Tho 1974). A common symptom of attack is a layer of soil plastering the surface of the tree trunk, from the ground upwards. Beneath this layer of soil, the termites burrow into the trunk of the tree. The leaves of the tree begin to yellow and wither and, eventually, the tree dies. Complete losses in localised areas have been reported in some conifer plantations (Benedict 1971, Tho 1974). Poor drainage is thought to be one factor that can increase the susceptibility of trees to attack (Thapa & Shim 1971, Chew 1975), and some conifer species are believed to be more susceptible than others (Chew 1975).

In view of the serious threat posed by termites in conifer plantations, a survey to evaluate the incidence and pattern of attack in different conifer species was carried out in the Bahau experimental conifer plantation by the late first author. The results of the survey were compiled in an unpublished report (Tho 1976) which has been cited by Tho and Kirton (1990), but is not widely available. In view of its valuable data and findings on the susceptibility of different conifer species to attack, the report has been edited and revised for this publication. The percentages and indices tabulated have been recalculated from the original data in the report. It is envisaged that the information provided here will be useful should there be renewed interest in establishing conifer plantations.

The area surveyed comprised two experimental blocks, Blocks I and II, located in Compartment 12 of Bahau Forest Reserve. The two blocks were identical in layout but were established in sites about a mile apart with different soil series. Conifer trees were planted in the blocks from late 1971 to early 1972 and were, therefore, between four and five years old when surveyed in early April 1976. Further details of establishment, planting and stocking have been given by Chew (1975), who also incorporated the findings of an earlier survey conducted in these blocks about a year after planting (Tho 1973). There were slight differences in the topography of the two sites. Block I was in a low-lying area with a swampy patch running through the middle of the entire block. Block II, on the other hand, was established on a small hillock, the top of which was in the centre of the block, with the ground gently sloping towards the perimeter of the block. Each block occupied approximately 8.1 ha of land cleared of forest, within which eight plots of six different exotic tree

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species were established. The present survey covered six of these plots in each block. The plots excluded were the small fertiliser trial plots of around 300 trees comprising *Pinus merkusii* and *P. caribaea*. These species were present in the bigger plots of 2601 trees.

All trees in the plots were surveyed except those that had been planted in overly swampy areas. Such trees were excluded because they were not expected to perform well, and would be likely to die as a result of the waterlogged soil conditions. The survey was conducted by ten persons working in five pairs in which one person checked the condition of the trees and the other recorded the observations. Each pair surveyed four rows of trees in a single pass through the plots, making it possible for the five pairs to cover 20 rows of trees at a time. Trees were classed into one of five categories defined in Table 1. Living or dead, standing trees with attack symptoms were classed into category B only if termites were present. This was to avoid confusing soil layers occasionally built by other termite species on tree trunks with attack symptoms of *C. curvignathus*. Fallen or broken trunks, or remaining stumps, of trees that had been attacked and killed by termites (category C) were recognised by the symptoms of advanced attack by *C. curvignathus*. The partially consumed wood of such trees or stumps is usually replaced with soil and carton material characteristic of attack by this species. In most cases, termites are also present.

Table 1. Definitions used for the categorisation of trees in the survey

Category	Definition
A	Standing, living trees not attacked by termites
B	Living or dead standing trees attacked by termites (active infestations)
C	Fallen or broken trunks (or remaining stumps) of trees that had died as a result of termite attack
D	Missing trees without traces of stumps, the cause of death of which could not be determined
E	Dead trees (or remaining stumps) in which the cause of death was not due to termites

Two indices of attack, expressed as percentages, were calculated. These indices are defined below:

$$\text{Current attack} = \frac{N_B}{N_A + N_B} \times 100$$

$$\text{Recent attack} = \frac{N_B + N_C}{N_A + N_B + N_C} \times 100$$

where N_A, N_B and N_C are the numbers of trees in categories A, B and C respectively. Current attack reflects active infestations and attack on standing trees, whilst recent attack reflects the short term cumulative effect of termite damage in a plantation, by incorporating both active attack on standing trees and the degree of recent mortality due to attack. Termite attack is usually continuous, the termites feeding on living trees and, eventually, causing their death. In time, the trees fall over due to loss of mechanical strength. The termites often continue to feed on the stump and fallen tree trunk until they disintegrate, a process that may take several months to over a year.

Coptotermes curvignathus was the only termite species that attacked the trees. The results of the survey are summarised in Table 2, which gives the percentages of trees in each category for each conifer species in the two blocks. There were very few trees in category E. As such, categories D and E have been pooled. Table 2 also shows values of the two indices, current and recent attacks.

Table 2. Termite attack rates on different conifer species in each block, showing percentages of trees in each category, and the indices of attack

Conifer species	Block	Total no. of trees	Category (%)				Current attack (%)	Recent attack (%)
			A	B	C	D + E		
Pinus caribaea	I	2169	67.73	1.98	12.82	17.47	2.84	17.93
	II	2601	77.59	1.27	3.19	17.95	1.61	5.44
Pinus merkusii	I	2601	93.58	1.35	1.46	3.61	1.42	2.91
	II	2601	86.77	1.23	2.69	9.30	1.40	4.32
Pinus oocarpa	I	2196	61.84	0.41	4.96	32.79	0.66	7.99
	II	2601	76.55	0.58	1.15	21.72	0.75	2.21
Araucaria hunsteinii	I	433	81.06	5.77	0.00	13.16	6.65	6.65
	II	714	83.33	0.00	0.84	15.83	0.00	1.00
Araucaria cunninghamii	I	750	62.13	5.20	11.20	21.47	7.72	20.88
	II	750	53.33	3.20	3.07	40.40	5.66	10.51
Agathis macrophylla	I	240	70.42	0.42	0.00	29.17	0.59	0.59
	II	240	78.33	0.42	2.08	19.17	0.53	3.09

Some general conclusions can be drawn from the data. There was a high incidence of termite attack in the plantation, and the incidence was higher in Block I than in Block II. This could have been because Block I was established in a low-lying swampy area in which poor soil aeration may have stressed the trees, providing favourable conditions for attack.

Among the different species of *Pinus* in the plantation, *P. caribaea* appeared to be more susceptible to termite attack than the other two species, *P. merkusii* and *P. oocarpa.* However, the attack rate in different conifer species in Block I may have been influenced, to some extent, by the number of trees of each species planted in relatively swampy areas. In the *Araucaria* spp., it is quite evident that *A. cunninghamii* was more susceptible to termite attack than *A. hunsteinii.*

Termite attack in the two blocks was aggregated. When one tree was attacked, the chance of finding other trees similarly attacked in the immediate vicinity was high. Most missing trees (category D) were localised near trees that had been attacked by termites, suggesting that they may have died due to termite attack. Thus, the long-term losses in the plantation due to termites are likely to have been much higher than is indicated by the rate of recent attack. The high percentages of missing trees (category D, Table 2) may reflect the long-term losses due to termites. Termite attack has a slow but continuous effect on plantations. Although the number of trees attacked at any one time may be low, there is a cumulative effect over the years that, in time, can result in high overall losses.

In view of the high incidence of attack and mortality among conifer species in the Bahau experimental conifer plantations, it is recommended that the management of termites be taken into consideration when establishing conifer plantations. Plantations established in areas where populations of *Coptotermes curvignathus* can be expected to be minimal would be expected to suffer the least losses due to termite attack. An example would be land that has long been occupied by grass or scrubby secondary vegetation, which would be devoid of large wood material needed for survival of the termite species (Sharples 1936, Tho 1974). When plantations have to be established in areas with existing populations of the termite, such as on land cleared of forest, prophylactic treatment of the soil in the transplanting hole with an appropriate insecticide should be considered.

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References

BENEDICT, W.V. 1971. *Protecting Plantations of Long-Fibre Tree Species from Loss by Insects and Diseases. Pilot Plantations of Quick-Growing Industrial Tree Species, Malaysia.* FO : SF/MAL 12, Technical Report No. 4. Food and Agriculture Organisation of the United Nations, Kuala Lumpur. 17 pp.

CHEW, T.K. 1975. Preliminary notes on the performances of experimental plantations in Bahau forest reserve. *Malaysian Forester* 38 : 140 - 148.

COWIE, R.H., LOGAN, J.W.M. & WOOD, T.G. 1989. Termite (Isoptera) damage and control in tropical forestry with special reference to Africa and Indo-Malaysia: a review. *Bulletin of Entomological Research* 79 : 173 - 184.

MOHD. AFZAL, A.M. & ZAKARIA, I. 1985. Forest plantation development in Peninsular Malaysia: present state of knowledge and research priorities. Pp. 106 - 119 in Liew, T.C., Udarbe, M.P., Tang, H.T., Tang, R.I.E. & Lee, Y.F. (Eds.) *Proceedings of the Seminar on Forest Plantation Development in Malaysia.* July 9 - 14, 1984, Kota Kinabalu / Kundasang, Sabah.

SHARPLES, A. 1936. *Diseases and Pests of the Rubber Tree.* Macmillan & Co., Limited, London. 480 pp.

THAPA, R.S. & SHIM, P.S. 1971. Termite damage in plantation hoop pine, *Araucaria cunninghamii* D. Don, in Sabah and its control. *Malayan Forester* 34 : 47 - 52.

THO, Y.P. 1973. A report on the termite situation in the Bahau experimental pine plantation in Negeri Sembilan. Unpublished report for the Forest Department of Malaysia.

THO, Y.P. 1974. The termite problem in plantation forestry in peninsular Malaysia. *Malaysian Forester* 37 : 278 - 283.

THO, Y.P. 1976. Preliminary report on a survey of termite attack in the Bahau pine plantation. Unpublished report for the Forest Department of Malaysia.

THO, Y.P. & KIRTON, L.G. 1990. The economic significance of *Coptotermes* termites in Malaysian forestry. Pp. 193 - 199 in *Proceedings of the Third International Conference on Plant Protection in the Tropics.* Volume IV. Genting Highlands, Malaysia, 1990.