FUNGI ASSOCIATED WITH HEART ROT OF *ACACIA MANGIUM* IN PENINSULAR MALAYSIA

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LEE, S.S. & MAZIAH ZAKARIA. 1993. Fungi associated with heart rot of *Acacia mangium* in Peninsular Malaysia. Fungal isolations were made from heart rot affected wood of freshly felled *Acacia mangium* trees of various ages obtained from several locations in Peninsular Malaysia. Seven distinct types of rot were recognised and 25 different Hymenomycete fungi isolated. Only one of the fungal isolates could be positively identified as *Phellinus noxius* from cultural characteristics. Although the other 24 fungi could not be positively identified, they were recognised as different from each other based on cultural characteristics. *Phellinus noxius* was only associated with honeycomb rot found in trees between seven and eight years of age from various locations while a large number of different fungi were associated with white fibrous rot in trees of various ages. The implications of these results are discussed.

Key words: *Acacia mangium* - heart rot - fungi

LEE, S.S. & MAZIAH ZAKARIA. 1993. Kulat yang berasosiasi dengan reput teras *Acacia mangium* di Semenanjung Malaysia. Pengasingan kulat dibuat dari kayu pokok *Acacia mangium* yang baru ditebang yang diserang reput teras. Pokok yang berlainan umur dan yang didapati dari beberapa tempat di Semenanjung Malaysia digunakan. Sebanyak 7 jenis reput yang berbeza dapat dikenalkan dan sejumlah 25 jenis kulat himenomiset diasingkan. Dari kajian ciri-ciri kultur, hanya satu daripada asingan kulat tersebut dapat dikenalkan dengan positif sebagai *Phellinus noxius.* Walaupun identiti 24 kulat yang lain tidak dapat ditentukan secara positif, mereka dapat dikenalkan sebagai jenis-jenis yang berbeza berdasarkan ciri-ciri kultur yang berlainan. *Phellinus noxius* hanya berasosiasi dengan reput berbentuk 'honeycomb' yang terdapat pada pokok berumur antara tujuh dengan lapan tahun yang disampel dari beberapa tempat, manakala sebilangan besar kulat yang berbeza-beza berasosiasi dengan reput putih berserabut dalam pokok yang berbeza umur. Implikasi keputusan tersebut dibincangkan.

Introduction

Heart rot in *Acacia mangium* was first reported in Sabah by Gibson (1981) in 12% of thinnings from a 33-*mth*-old seed stand. Heart rot has subsequently been recognised as a potentially serious problem in *A. mangium* with the capacity to cause substantial losses in wood quality and quantity (Chan cited in Thomas & Kent 1986, Lee *et al.* 1988, Hashim *et al.* 1990).

Gibson (1981) suggested that a Basidiomycete fungus is the causal agent of heart rot in *A. mangium.* In Sook, Sabah, fruiting bodies of unspecified fungal species were observed on *A. mangium* trees and subsequently an unidentified Basidiomycete fungus was isolated from specimens of heart rotted trees (Thomas

& Kent 1986). In Peninsular Malaysia, a sterile brown Hymenomycete was isolated from heart rotted *A. mangium* wood by Lee *et al.* (1988). Hymenomycetes are an economically and ecologically important group of fungi among the Basidiomycetes because of their unique ability to rapidly degrade wood. More recently an unidentified member of the Polyporaceae, which is a family of the Hymenomycetes in the class Basidiomycetes, was isolated from heart rotted *A. mangium* wood by Hashim and co-workers (1990) in Peninsular Malaysia. However, no positive identifications of the fungi have been made from all these isolations.

The main objective of this study was to determine the identity of the fungus or fungi associated with heart rot of *A. mangium*. The confirmation of the identity of any pathogen and an understanding of its etiology is essential for effective prevention and control of the disease.

Materials and methods

Samples of *A. mangium* trees with heart rot were obtained from colleagues conducting a survey of heart rot incidence in *A. mangium* plantations of various ages from various parts of the Peninsula. Sample logs were billets 1*m* in length which had been split longitudinally for determination of the presence of heart rot. Wherever possible, samples were collected and isolations made on the day of felling or the day after the trees had been felled. However, in a few instances where this was not possible, the samples were then stored in the shade or in a cold room prior to making isolations.

Chips measuring approximately 2 × 4 × 5*mm* were aseptically removed from freshly exposed surfaces of heart rotted wood and plated onto 0.5% malt extract agar (MEA) containing 300*ppm* streptomycin sulphate and incubated at 28 ± 2°*C*. Fungi growing out from the chips were transferred onto fresh MEA plates to obtain pure cultures for further tests. The growth rates of the fungi and the reaction of cultures to an alcoholic solution of guaiacum were measured according to Nobles' method (1965). Characteristics of the isolated fungi were then recorded and compared to those listed by Nobles (1965) and Stalpers (1978).

Fungal fruiting bodies wherever observed on heart rotted trees were also collected for identification and isolation onto cultures for comparison with cultures obtained from heart rotted wood.

Results and discussion

Seven main types of rot could be distinguished from rotted *A. mangium* heartwood based on differences in colour, texture and general appearance of the heartwood (Table 1).

White fibrous rot was the most often encountered type of rot while pink pocket rot was found in just a few samples. The appearance of the rotted wood in all the types of rot was typical of that caused by Hymenomycetes of the white rot group of fungi which attack both cellulose and lignin leaving behind a whitish to yellowish, spongy or stringy mass.

Table 1. Types of rot found in *A. mangium* heartwood

Types of rot	Description	Frequency among isolates (%)
Honeycomb rot	Heartwood bleached pale yellow to white, fibrous, with distinct yellowish brown large honeycomb-like lines superimposed on the rotted heart wood	12.5
Spongy rot	Heartwood bleached pale straw to white, spongy, dry, breaking up into small pieces	2.5
Spongy rot with zone lines	Heartwood bleached pale straw to white, spongy and dry, with angular black zone lines, friable	2.5
Wet fibrous rot	Heartwood brownish, very wet (oozing water when pressed), fibrous to spongy	15.0
White fibrous rot	Heartwood bleached pale yellow to white, very fibrous, breaking up into long strands, dry	52.5
Brittle rot	Heartwood pale brown to white, pitted, brittle, breaking easily when picked with a sharp tool	12.5
Pink pocket rot	Occurs in small pockets in the heartwood, wood is pink in colour and spongy	2.5

The majority of the isolates yielded members of the Basidiomycetes although several members of the Fungi Imperfecti, such as *Lasiodiplodia (Botryodiplodia) theobromae, Fusarium, Gliocladium, Trichoderma, Cephalosporium* and *Phomopsis* were also obtained. Some of these fungi such as *Lasiodiplodia* are known to cause discoloration of wood while most of the others are moulds, and are not involved in wood degradation.

A total of 41 Hymenomycete isolates were obtained from heart rotted trees varying between one and eight years of age from various *A. mangium* plantations. These isolates were each assigned a code as they could not be identified immediately for a lack of production of fruiting bodies. However, they could be grouped into several distinct groups based on the kind of rot with which each was associated. These groups could be further regrouped according to common hyphal and cultural characteristics, finally reducing the 41 isolates to 25 different fungi (Table 2). Of these 25 fungi, one was positively identified as *Phellinus noxius* due to its unique cultural and hyphal characteristics. Its identity has since also been confirmed by two other mycologists in the United Kingdom. The identity of the remaining 24 could not be ascertained even with the aid of Nobles' and Stalper's keys primarily because these keys cover only a limited number of species, most of which are temperate. Some of these fungi are being cultured on amended *A. mangium* sawdust in the hope that they will produce fruiting bodies so as to facilitate identification. It was interesting to note that some fungi were

Table 2. Fungal isolates obtained from rotted *A. mangium* heartwood of various ages from different plantations

Type of rot	Fungal isolate	Plantation Location	Age (y)	Fungus (identity)
Honeycomb rot	FRIM/US/15	Ulu Sedili	8	*Phellinus noxius*
	FRIM/US/2	Ulu Sedili	8	*P. noxius*
	FRIM/US/3	Ulu Sedili	8	*P. noxius*
	FRIM/K/1	Kemasul	7	*P. noxius*
	FRIM/BA/25	Batu Arang	8	*P. noxius*
Spongy rot	FRIM/R/34	Rawang	4	#1
Spongy rot with zone lines	FRIM/R/32	Rawang	4	#2
Wet fibrous rot	FRIM/R/45	Rawang	3	#3
	FRIM/R/41	Rawang	3	#4
	FRIM/R/44	Rawang	3	
	FRIM/R/52	Rawang	3	
	FRIM/R/38	Rawang	3	#5
	FRIM/R/42	Rawang	3	
White fibrous rot	FRIM/BA/21	Batu Arang	6	#6
	FRIM/R/50	Rawang	3	#7
	FRIM/BT/17	Bukit Tarik	2	#8
	FRIM/R/33	Rawang	4	
	FRIM/R/40	Rawang	3	
	FRIM/R/51	Rawang	3	#9
	FRIM/R/52	Rawang	3	
	FRIM/R/30			
	FRIM/BA/23	Batu Arang	7	#10
	FRIM/R/39	Rawang	4	#11
	FRIM/R/36	Rawang	3-4	
	FRIM/R/37	Rawang	3-4	#12
	FRIM/BT/20	Bukit Tarik	1-2	
	FRIM/BT/16	Bukit Tarik	1-2	
	FRIM/BT/18	Bukit Tarik	1-2	#13
	FRIM/R/43	Rawang	2-3	#14
	FRIM/BT/19	Bukit Tarik	1-2	#15
	FRIM/R/29	Rawang	4	
	FRIM/R/31	Rawang	3	#16
	FRIM/R/35	Rawang	3	#17
	FRIM/BA/24	Batu Arang	7	#18
	FRIM/US/7	Ulu Sedili	8	#19
Brittle rot	FRIM/R/46	Rawang	3	#20
	FRIM/R/47	Rawang	3	#21
	FRIM/R/48	Rawang	3	#22
	FRIM/R/27	Rawang	4	#23
	FRIM/R/28	Rawang	4	
Pink pocket rot	FRIM/BA/26	Batu Arang	8	#24

quite specifically associated with certain kinds of rot; for example, *Phellinus noxius* was always only associated with honeycomb rot and never with any other types of rot while a host of different fungi appeared to be associated with white fibrous rot. *P. noxius* is known to cause a similar kind of rot in the wood of living rubber trees via wounds and broken branches in the canopy (Ismail Hashim personal communication).

The occurrence of *P. noxius* associated heart rot was not restricted to any one location, but was found in trees from Ulu Sedili, Kemasul and Batu Arang. However, it was only found in trees seven years and older, never in younger trees despite the more intensive sampling of the younger trees.

White fibrous rot was found in samples from all locations and no relationship with age could be discerned for the numerous fungi associated with this kind of rot which was found in trees spanning a range of ages from one to eight years old. This was not surprising since many distinctly different fungi were found to be associated with this kind of rot.

Fungal fruiting bodies were found on only two occasions, once from a branch of a 2-*y*-old tree from Bukit Tarik and on another occasion from the stem of a 1-*y*-old tree also from Bukit Tarik. The fruiting bodies from the branch were tentatively identified as those of a *Trametes* sp. while the ones from the stem were probably from a *Fomes* sp. Both these fungi were found on trees which had white fibrous heart rot.

Brittle rot and wet fibrous rot associated with four different fungi respectively, were recorded only from samples obtained from Rawang. However, the fungi associated with these kinds of rot are also probably found in the other locations, but were not isolated because of the smaller samples obtained from the other plantations.

No one fungus was consistently isolated from the many samples of rotted or decaying heartwood of *A. mangium* trees younger than seven years old although *P. noxius* was consistently isolated from 7- and 8-*y*-old trees from various locations. It appeared that a large number of different Hymenomycetes were able to invade the heartwood of younger trees while *P. noxius* favoured the older trees. It is not our intention here to elaborate on the successional pattern of decay fungi on the heartwood of *A. mangium* but to show the diversity of fungi that are associated with heart rot in *A. mangium* trees of various ages. There is little doubt that *A. mangium* heartwood of all ages is highly susceptible to attack by many wood degrading Hymenomycetes.

The overall diversity of fungi isolated from samples obtained from the different sites indicates a diversity of inoculum in each site. In the various plantations it has been observed that there remains large amounts of woody debris in the form of old stumps and logs, fallen trees and branches which often bear fruiting bodies of various saprophytic wood decay fungi. Dead or dying *A. mangium* branches which remain attached to the tree are usually also colonised by some unidentified hymenomycetous fungi. It is our hypothesis that these fungi which normally grow on the dead wood in the plantation are also able to invade the essentially dead heartwood of the living trees through dead branch stubs and wounds which expose the heartwood of the tree and thereafter cause decay.

It would appear that the best strategy to control this disease would be to breed trees that are less branchy and that heal rapidly upon wounding. Treatment of wounds would not be a viable alternative in view of the many branches to treat, the expense involved and the rapid growth of the tree which would very soon cause cracks to appear in the wound treatment barrier thereby rendering it ineffective. Another alternative would be to ensure complete removal of woody debris from the area to be planted so as to eliminate the occurrence of potential inoculum sources later on.

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References

GIBSON, I.A.S. 1981. *Seed Source Establishment and Tree Improvement – Sabah, Malaysia. Forest Mycology.* Consultants's Report No. 3. FAO/UNDP-MAL/78/009. Rome.

HASHIM MD. NOOR, MAZIAH ZAKARIA & SHEIKH ALI ABOD. 1990. The incidence of heart rot in *Acacia mangium* Willd. plantations: a preliminary observation. Pp. 54 - 59 in Appanah, S., Ng, F.S.P. & Roslan Ismail (Eds.) *Proceedings of the Conference on Forestry and Forest Products Research, CFFPR-90.* October 3-4 1990, Forest Research Institute of Malaysia, Kepong.

LEE, S.S., TENG, S.Y., LIM, M.T. & RAZALI ABD. KADER. 1988. Discoloration and heart rot of *Acacia mangium* Willd. - some preliminary results. *Journal of Tropical Forest Science* 1(2): 170-177.

NOBLES, M.K. 1965. Identification of cultures of wood-inhabiting Hymenomycetes. *Canadian Journal of Botany* 43: 1097-1139.

STALPERS, J.A. 1978. *Identification of wood-inhabiting Aphyllophorales in pure culture.* Studies in Mycology No. 16, Centraalbureau voor Schimmelcultures, Baarn.

THOMAS, K. & KENT, G. 1986. Project proposal submitted to Sepilok Forest Research Centre, Sabah Forest Department.