PRELIMINARY STUDY ON PATHOGENICITY OF THREE ROOT DISEASE FUNGI ON *AZADIRACHTA EXCELSA* (SENTANG)

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Azadirachta excelsa, locally known as sentang, is a well known village tree commonly found in the central to northern regions of Peninsular Malaysia. It is a large evergreen tree where mature trees may reach up to 50 m high with a cylindrical bole of up to 125 cm in diameter. A study by the Forestry Department of Malaysia has identified *A. excelsa* as one of the few indigenous species to meet future log demands (Norani 1997). Its multipurpose properties and fast growth rate make *A. excelsa* very popular as plantation species (Kijkar & Boontawee 1995).

Large-scale planting of *A. excelsa* as a plantation crop is currently being carried out in Peninsular Malaysia. No major disease outbreak has been reported on this species in Southeast Asia (Maziah & Norani 1997). However, before the species can be planted on a large-scale, problems relating to disease and disorders in plantations have to be identified. Survey conducted at several sentang plantations in Peninsular Malaysia have revealed that root disease is one of the most important diseases of sentang (Mohd Farid & Maziah 1999). Several root disease fungi have been isolated and this study was aimed at comparing the pathogenicity of these fungi.

Ninety-six sentang seedlings of approximately 6-month-old obtained from Mata Ayer, Perlis were arranged into a randomised complete block design (RCBD) with four replications and two treatment combinations, namely, fungi and injury. The fungi used were *Phellinus noxius, Rigidoporus vinctus* and *Phellinus* sp. Details of the fungi used in the experiment are given in Table 1.

Table 1 Hosts and origin of the fungi used in the experiment

Fungi	Host	Origin
Phellinus noxius	Sentang	Lendu, Melaka
Rigidoporus vinctus	Sentang	Pelong, Terengganu
Phellinus sp.*	Teak	Perak River Estate, Perak

*Fungus isolated from teak was used because teak was interplanted with sentang at this particular estate.

The potting media consisted of a mixture of forest top soil, sand and peat at a ratio of 3:2:1. The seedlings were potted into polybags sized 30 × 20 cm. Preparation of inoculum blocks for infection of seedlings was based on the method described by Lee & Noraini Sikin (1999). Inoculum blocks measuring 10 × 1 cm were made from the stem of young rubber trees (*Hevea brasiliensis*).

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After four weeks incubation, the well-colonised inoculum block was placed in contact with the taproot of the seedlings by tying it with a string. For treatment 1 the taproot was injured prior to inoculation by making a 1–2 cm wound and for treatment 2 the taproot was uninjured. In both treatments the roots were carefully handled to avoid damage. Initially, the inoculated seedlings were placed into partially filled polybags. More potting media was then used to fill up the polybags. The inoculated seedlings were left in the open under ambient conditions. They were observed for the presence of hyphae rhizomorphs at the collar region and for foliar symptoms. Results were recorded at weekly intervals for 2 1/2 months after inoculation and data were subjected to analysis of variance (ANOVA).

Mortality of the inoculated seedlings started in the fourth week. No mortality occurred in the control treatment (Table 2). Between the fungi, *R. vinctus* caused significantly higher mortality compared to *Phellinus* sp. and *P. noxius*. No significant difference in mortality was observed for *Phellinus* sp. and *P. noxius* inoculated seedling. The result showed that the three experimental fungi did not require injury to induce infection.

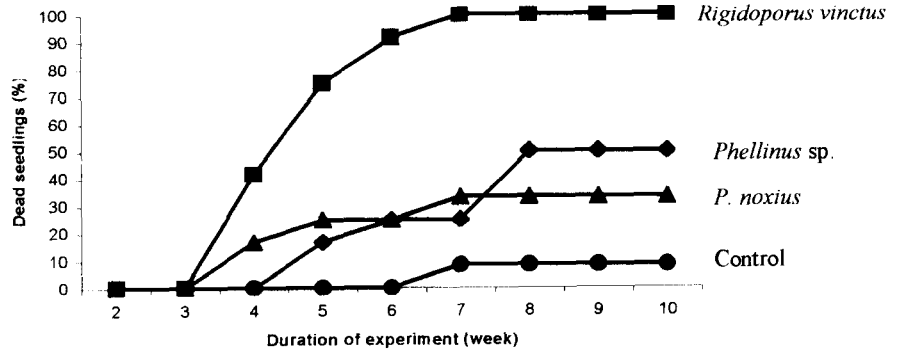
The result also revealed that in both treatments 1 and 2, *R. vinctus* was more pathogenic compared to the other fungi (Figure 1). This fungus caused 100% mortality of 6-month-old seedlings seven weeks after inoculation. The above-ground symptoms started to appear three weeks after inoculation, whereby the lower leaves turned pale green and lost their lustre. Yellowing, defoliation and, finally, wilting of the shoots followed. At this stage, fungal rhizomorphs were observed at the collar region. The presence of rhizormorphs means that the whole root system has already been exposed to root disease (Wheeler 1974).

Below ground, the fungus generally affected the lateral roots first before attacking the taproot. Similar observation was reported by Sharma *et. al.* (1985). In rubber, when the rhizomorphs get in contact with healthy roots, penetration and death of the cambium occur. The fungus then advanced through the lateral roots until it reached the collar region (Anonymous 1974). When infected by the fungus, the woody portion of the roots turn white, lose its texture and become soft and friable. It is usually difficult to observe disease symptoms, but decay of structural roots become obvious when the trees fell or if the root systems are excavated (Manion 1981). *Rigidoporus vinctus*, a synonym to *Poria vincta*, is a pantropical fungus found on angiosperms (Ryvarden & Johansen 1980) and has been recorded to cause root rot of various woody hosts (Ivory 1989).

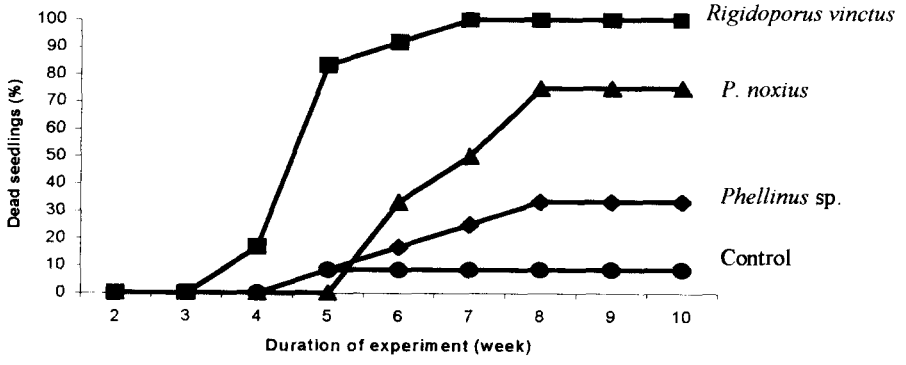
Table 2 Cumulative percentage of mortality of 6-month-old sentang seedlings inoculated with three different root disease fungi

	Cumulative mortality (%) Number of weeks after inoculation						
Fungus	4	5	6	7	8	9	10
Phellinus noxius	8.25ns	16.50ns	25.00ns	41.75ns	45.88ns	45.88ns	45.88ns
Rigidoporus vinctus	29.00***	70.75***	83.38***	95.88***	95.88***	95.88***	95.88***
Phellinus sp.	8.25ns	16.50ns	29.25ns	45.88ns	54.13ns	54.13ns	54.13ns
Control	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***

ns = No significant difference at 0.05 probability level
*** = Significant difference at 0.05 probability level



(a) Injured root



(b) Uninjured root

Figure 1 Mortality of sentang seedlings after inoculation with three root disease fungi and a control in (a) injured root and (b) uninjured root

Mortality of seedlings inoculated with *Phellinus* sp. started to occur at week 4. By the end of the experiment (week 10) the mortalities of the injured and uninjured seedlings were 50 and 33.3% respectively (Figure 1).

The above-ground symptoms caused by *P. noxius* were similar to those caused by *R. vinctus*. In an experiment on *Swietenia macrophylla, Cordia alliodora* and *Gmelina arborea*, Ivory (1990) observed a similar appearance of aerial symptoms, where the whole seedling rapidly became yellow, wilted and died within a few weeks. This usually happens when the collar region has been substantially affected. When leaves become discoloured and shriveled, the tree is beyond saving as the pathogen has firmly established within the root tissues (Lim & Khoo 1985).

However, the below-ground symptoms caused by *P. noxius* were different from those of *R. vinctus*. The initial below-ground symptoms of infection were the formation of light to rusty brown rhizomorphic mycelia form on infected roots which turned dark brown as the fungus grew older. This brown rhizomorph then formed a continuous skin with soil particles adhering to it, giving a distinctive rough, dark appearance. Affected roots became

discoloured and all lateral roots rotted. The roots are penetrated by fungal hyphae and the woody tissue subsequently decay rapidly causing a pocket rot which is characterised by distinct ridges of golden brown hyphae demarcating the pockets (Lee & Noraini Sikin 1999). Similar symptoms are also observed in rubber (Holliday 1980).

Mortality of uninjured and injured seedlings inoculated with *P. noxius* started after five and three weeks respectively. The mortalities of injured and uninjured seedlings were 33.3 and 75% respectively when the experiment was terminated (week 10) The above- and below-ground symptoms of infected seedlings were similar to those inoculated with *Phellinus* sp.

In conclusion, *R. vinctus* was highly pathogenic against 6-month-old sentang seedlings. Injury did not have any significant effect on the infection of sentang seedlings in this experiment. The above-ground symptoms of infected seedlings were similar between the tree fungi but the below-ground symptoms were different. White rhizomorphs covered the roots of seedlings infected by *R. vinctus*, while brown rhizomorphs forming a continuous skin with the soil particles adhering to it, covered roots of seedlings infected by *P. noxius* and *Phellinus* sp.

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